DEPARTMENT OF DEFENSE
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SBIR 20.1 Program Broad Agency Announcement (BAA)

December 10, 2019: DoD BAA issued for pre-release

January 14, 2020: DoD begins accepting proposals

February 12, 2020: Deadline for receipt of proposals no later than **8:00 p.m. ET**

Participating DoD Components:

- Department of the Army
- Department of the Navy
- Department of the Air Force
- Defense Health Agency (DHA)
- Defense Logistics Agency (DLA)
- Defense Microelectronics Activity (DMEA)
- National Geospatial-Intelligence Agency (NGA)
- Office of the Secretary of Defense - ManTech (OSD/ManTech)
- United States Special Operations Command (USSOCOM)

IMPORTANT

Deadline for Receipt: Proposals must be **completely** submitted no later than **8:00 p.m.** ET, February 12, 2020. Proposals submitted after 8:00 p.m. will not be evaluated.

Classified proposals will not be accepted under the DoD SBIR Program.

A Phase I Template is provided at https://www.dodsbirsttr.mil/submissions/learning-support to assist small businesses to generate a Phase I Technical Volume (Volume 2).

The Small Business Administration, through its SBIR/STTR Policy Directive, purposely departs from normal Government solicitation formats and requirements and authorizes agencies to simplify the SBIR/STTR award process and minimize the regulatory burden on small business. Therefore, consistent with the SBA SBIR/STTR Policy Directive, the Department of Defense is soliciting proposals as a Broad Agency Announcement.

SBIR/STTR Updates and Notices: To be notified of SBIR/STTR opportunities and to receive e-mail updates on the DoD SBIR and STTR Programs, you are invited to subscribe to our listserv at https://sbir.defensebusiness.org/

Help Desk: If you have questions about the Defense Department's SBIR or STTR Programs, please call the DoD SBIR/STTR Help Desk at 1-703-214-1333, or email to dodsbirsupport@reisystems.com.

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1.0 INTRODUCTION

The Army, Navy, Air Force, DHA, DLA, DMEA, NGA, OSD – ManTech, and USSOCOM, hereafter referred to as DoD Components, invite small business firms to submit proposals under this BAA for the Small Business Innovation Research (SBIR) Program. Firms with the capability to conduct research and development (R&D) in any of the defense-related topic areas described in Section 12.0 and to commercialize the results of that R&D are encouraged to participate.

While the Phase II proposal process is covered in this announcement, **this BAA is for Phase I proposals only** unless the Component is participating in the **Direct to Phase II Program**. Air Force, Navy, DHA, DLA, OSD – ManTech, and USSOCOM are offering Direct to Phase II topics for the SBIR 20.1 BAA – see the Component-specific instructions for more information.

A separate BAA will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All firms that are awarded Phase I awards originating from this BAA will be eligible to participate in Phase II competitions and potential Phase III awards. DoD Components will notify Phase I awardees of the Phase II proposal submission requirements. Submission of Phase II proposals will be in accordance with instructions provided by individual Components. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the awarding DoD Component either in the Phase I award or by subsequent notification. If a firm submits their Phase II proposal prior to the dates provided by the individual Components, it may be rejected without evaluation.

DoD is not obligated to make any awards under Phase I, Phase II, or Phase III, and all awards are subject to the availability of funds. DoD is not responsible for any monies expended by the proposer before the issuance of any award.

2.0 PROGRAM DESCRIPTION

2.1 Objectives

The objectives of the DoD SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development results.

More than half of the topics in this BAA address the DoD Research, Technology & Laboratory’s (RT&L) top priority technology focus areas, outlined below.

RT&L Technology Focus Area Definitions

Focus Area	Description
5G	Technologies enabling the 5G spectrum to increase speed over current networks, to be more resilient and less susceptible to attacks, and to improve military communication and situational awareness.
Artificial Intelligence (AI)/ Machine Learning (ML)	Systems that perceive, learn, decide, and act on their own. Machine-learning systems with the ability to explain their rationale, characterize their strengths and weaknesses, and convey understanding of how they will behave in the future.
Autonomy	Technology that can deliver value by mitigating operational challenges such as: rapid decision making; high heterogeneity and/or volume of data; intermittent communications; high complexity of coordinated action; danger to mission; and high persistence and endurance.
Biotechnology	Biotechnology is any technological application that harnesses cellular and biomolecular processes. Most current biotech research focuses on agent detection, vaccines, and treatment. Future advances in biotechnology will improve the protection of both the general public and military personnel from biological agents, among numerous other potential applications.
Cybersecurity	Prevention of damage to, protection of, and restoration of computers, electronic communications systems, electronic communications services, wire communication, and electronic communications, including information contained therein, to ensure its availability, integrity, authentication, confidentiality, and nonrepudiation.
Directed Energy (DE)	Technologies related to production of a beam of concentrated electromagnetic energy, atomic, or subatomic particles.
Hypersonics	Innovative concepts or technologies that enable, or directly support, weapons or aircraft that fly at or near hypersonic speeds and/or innovation that allows for enhancing defensive capability against such systems.
Microelectronics	Critical microcircuits used in covered systems, custom-designed, custom-manufactured, or tailored for specific military application, system, or environment.
Networked Command, Control, and Communications (C3)	Fully networked command control and communications including: command and control (C2) interfaces, architectures, and techniques (e.g., common software interfaces and functional architectures and improved C2 processing/decision making techniques); communications terminals (e.g, software-defined radio (SDRs)/apertures with multiple networks on the same band and multi-functional systems); and apertures and networking technologies (e.g., leveraging/managing a diverse set of links across multiple band and software defined networking/ network slicing).
Nuclear	Technologies supporting the nuclear triad-including nuclear command, control, and communications, and supporting infrastructure. Modernization of the nuclear force includes developing options to counter competitors' coercive strategies, predicated on the threatened use of nuclear or strategic non-nuclear attacks.
Quantum Science	Technologies related to matter and energy on the atomic and subatomic level. Areas of interest: clocks and sensors; networks; computing enabling technologies (e.g., low temperature amplifiers, cryogenics, superconducting circuits, photon detectors); communications (i.e., sending/receiving individual photons); and manufacturing improvements.
Space	Technologies supporting space, or applied to a space environment.
General Warfighting Requirements (GWR)	Warfighting requirements not meeting the descriptions above; may be categorized into Reliance 21 areas of interest.

The DoD SBIR Program follows the policies and practices of the Small Business Administration (SBA) SBIR Policy Directive updated on February 24, 2014. The guidelines presented in this BAA incorporate and make use of the flexibility of the SBA SBIR Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to the DoD and the private sector.

The SBIR Policy Directive is available at: http://www.sbir.gov/sites/default/files/sbir_pd_with_1-8-14_amendments_2-24-14.pdf.

2.2 Three Phase Program

The SBIR Program is a three-phase program. Phase I is to determine, to the extent possible, the scientific, technical, and commercial merit and feasibility of ideas submitted under the SBIR Program. Phase I awards are typically between $100,000-$167,500 The period of performance is generally between six to twelve months with twelve months being the maximum period allowable. Proposals should concentrate on research or research and development which will significantly contribute to proving the scientific and technical feasibility, and commercialization potential of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. Proposers are encouraged to consider whether the research or research and development being proposed to DoD Components also has private sector potential, either for the proposed application or as a base for other applications.

Phase II awards will be made to firms on the basis of results of their Phase I effort and/or the scientific merit, technical merit, and commercialization potential of the Phase II proposal. Phase II awards are typically $500,000 to $1,100,000 in size and the period of performance is generally 24 months. Phase II is the principal research or research and development effort and is expected to produce a well-defined deliverable prototype. A Phase II contractor may receive up to one additional, sequential Phase II award for continued work on the project.

Under Phase III, the Proposer is required to obtain funding from either the private sector, a non-SBIR Government source, or both, to develop the prototype into a viable product or non-R&D service for sale in military or private sector markets. SBIR Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by sources other than the SBIR Program. Phase III work is typically oriented towards commercialization of SBIR research or technology.

3.0 DEFINITIONS

The following definitions from the SBA SBIR/STTR Policy Directive and the Federal Acquisition Regulation (FAR) apply for the purposes of this BAA:

3.1 Performance Benchmarks for Progress Toward Commercialization

In accordance with the SBA SBIR-STTR Policy Directive Sec 6(a)(7), DoD established a threshold for the application of a benchmark where it is applied only to Phase I applicants that have received more than twenty (20) awards over the prior five (5) fiscal years as determined by the Small Business Administration. The ratio of Phase II awards received to Phase I awards received during this period must be at least 0.25. Additional information on performance benchmarking for Phase I applicants can be found at https://www.sbir.gov/performance-benchmarks.

3.2 Commercialization

The process of developing products, processes, technologies, or services and the production and delivery (whether by the originating party or others) of the products, processes, technologies, or services for sale to or use by the Federal government or commercial markets.

3.3 Cooperative Research and Development

Research and development conducted jointly by a small business concern and a research institution. For purposes of the STTR Program, 40% of the work is performed by the small business concern, and not less than 30% of the work is performed by the single research institution. For purposes of the SBIR Program, this refers to work conducted by a research institution as a subcontractor to the small business concern. At least two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing firm.

3.4 Essentially Equivalent Work

Work that is substantially the same research, which is proposed for funding in more than one contract proposal or grant application submitted to the same Federal agency or submitted to two or more different Federal agencies for review and funding consideration; or work where a specific research objective and the research design for accomplishing the objective are the same or closely related to another proposal or award, regardless of the funding source.

3.5 Export Control

The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/?id=ddtc_kb_article_page&sys_id=24d528fddbfc930044f9ff621f961987.

NOTE: Export control compliance statements found in the individual Component-specific proposal instructions are not meant to be all inclusive. They do not remove any liability from the submitter to comply with applicable ITAR or EAR export control restrictions or from informing the Government of any potential export restriction as fundamental research and development efforts proceed.

3.6 Federal Laboratory

As defined in 15 U.S.C. §3703, means any laboratory, any federally funded research and development center (FFRDC), or any center established under 15 U.S.C. §§ 3705 & 3707 that is owned, leased, or otherwise used by a Federal agency and funded by the Federal Government, whether operated by the Government or by a contractor.

3.7 Foreign Nationals

Foreign Nationals (also known as Foreign Persons) as defined by 22 CFR 120.16 means any natural person who is not a lawful permanent resident as defined by 8 U.S.C. § 1101(a)(20) or who is not a protected individual as defined by 8 U.S.C. § 1324b(a)(3). It also means any foreign corporation, business association, partnership, trust, society or any other entity or group that is not incorporated or organized to do business in the United States, as well as international organizations, foreign governments and any agency or subdivision of foreign governments (e.g., diplomatic missions).

“Lawfully admitted for permanent residence” means the status of having been lawfully accorded the privilege of residing permanently in the United States as an immigrant in accordance with the immigration laws, such status not having changed.

"Protected individual’’ means an individual who (A) is a citizen or national of the United States, or (B) is an alien who is lawfully admitted for permanent residence, is granted the status of an alien lawfully admitted for temporary residence under 8 U.S.C. § 1160(a) or 8 U.S.C. § 1255a(a)(1), is admitted as a refugee under 8 U.S.C. § 1157, or is granted asylum under Section 8 U.S.C. § 1158; but does not include (i) an alien who fails to apply for naturalization within six months of the date the alien first becomes eligible (by virtue of period of lawful permanent residence) to apply for naturalization or, if later, within six months after November 6, 1986, and (ii) an alien who has applied on a timely basis, but has not been naturalized as a citizen within 2 years after the date of the application, unless the alien can establish that the alien is actively pursuing naturalization, except that time consumed in the Service's processing the application shall not be counted toward the 2-year period.

3.8 Fraud, Waste and Abuse

a. **Fraud** includes any false representation about a material fact or any intentional deception designed to deprive the United States unlawfully of something of value or to secure from the United States a benefit, privilege, allowance, or consideration to which an individual or business is not entitled.
b. **Waste** includes extravagant, careless or needless expenditure of Government funds, or the consumption of Government property, that results from deficient practices, systems, controls, or decisions.
c. **Abuse** includes any intentional or improper use of Government resources, such as misuse of rank, position, or authority or resources.
d. The SBIR Program training related to Fraud, Waste and Abuse is available at: https://www.sbir.gov/tutorials/fraud-waste-abuse/tutorial-1. See Section 4.19 for reporting Fraud, Waste and Abuse.

3.9 Funding Agreement

Any contract, grant, or cooperative agreement entered into between any Federal Agency and any small business concern for the performance of experimental, developmental, or research work, including products or services, funded in whole or in part by the Federal Government. Only the contract method will be used by DoD Components for all SBIR awards.

3.10 HBCU/MI - Historically Black Colleges and Universities and Minority Institutions

Listings for the Historically Black Colleges and Universities (HBCU) and Minority Institutions (MI) are available through the Department of Education Web site, http://www.ed.gov/about/offices/list/ocr/edlite-

minorityinst.html.

3.11 Certified HUBZone Small Business Concern

An SBC that has been certified by SBA under the Historically Underutilized Business Zones (HUBZone) Program (13 C.F.R. § 126) as a HUBZone firm listed in the Dynamic Small Business Search (DSBS).

3.12 Principal Investigator

The principal investigator/project manager is the one individual designated by the applicant to provide the scientific and technical direction to a project supported by the funding agreement.

For both Phase I and Phase II, the primary employment of the principal investigator must be with the small business firm at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the principal investigator's time is spent in the employ of the small business. This precludes full-time employment with another organization. Occasionally, deviations from this requirement may occur, and must be approved in writing by the contracting officer after consultation with the agency SBIR/STTR Program Manager/Coordinator. Further, a small business firm or research institution may replace the principal investigator on an SBIR/STTR Phase I or Phase II award, subject to approval in writing by the contracting officer.

3.13 Proprietary Information

Proprietary information is information that you provide which constitutes a trade secret, proprietary commercial or financial information, confidential personal information or data affecting the national security.

3.14 Research Institution

Any organization located in the United States that is:

a. A university.
b. A nonprofit institution as defined in Section 4(5) of the Stevenson-Wydler Technology Innovation Act of 1980.
c. A contractor-operated federally funded research and development center, as identified by the National Science Foundation in accordance with the government-wide Federal Acquisition Regulation issued in accordance with Section 35(c)(1) of the Office of Federal Procurement Policy Act. A list of eligible FFRDCs is available at: https://www.nsf.gov/statistics/ffrdclist/.

3.15 Research or Research and Development

Any activity that is:

a. A systematic, intensive study directed toward greater knowledge or understanding of the subject studied.
b. A systematic study directed specifically toward applying new knowledge to meet a recognized need; or
c. A systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

3.16 Research Involving Animal Subjects

All activities involving animal subjects shall be conducted in accordance with DoDI 3216.01 “Use of Animals in DoD Programs,” 9 C.F.R. parts 1-4 “Animal Welfare Regulations,” National Academy of

Sciences Publication "Guide for the Care & Use of Laboratory Animals," as amended, and the Department of Agriculture rules implementing the Animal Welfare Act (7 U.S.C. §§ 2131-2159), as well as other applicable federal and state law and regulation and DoD instructions.

"Animal use" protocols apply to all activities that meet any of the following criteria:

a. Any research, development, test, evaluation or training, (including experimentation) involving an animal or animals.
b. An animal is defined as any living or dead, vertebrate organism (non-human) that is being used or is intended for use in research, development, test, evaluation or training.
c. A vertebrate is a member of the subphylum Vertebrata (within the phylum Chordata), including birds and cold-blooded animals.

See DoDI 3216.01 for definitions of these terms and more information about the applicability of DoDI 3216.01 to work involving animals.

3.17 Research Involving Human Subjects

All research involving human subjects shall be conducted in accordance with 32 C.F.R. § 219 "The Common Rule," 10 U.S.C. § 980 "Limitation on Use of Humans as Experimental Subjects," and DoDD 3216.02 "Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research," as well as other applicable federal and state law and regulations, and DoD component guidance. Proposers must be cognizant of and abide by the additional restrictions and limitations imposed on the DoD regarding research involving human subjects, specifically as they regard vulnerable populations (DoDD 3216.02), recruitment of military research subjects (DoDD 3216.02), and informed consent and surrogate consent (10 U.S.C. § 980) and chemical and biological agent research (DoDD 3216.02). Food and Drug Administration regulation and policies may also apply.

"Human use" protocols apply to all research that meets any of the following criteria:

a. Any research involving an intervention or an interaction with a living person that would not be occurring or would be occurring in some other fashion but for this research.
b. Any research involving identifiable private information. This may include data/information/specimens collected originally from living individuals (broadcast video, web-use logs, tissue, blood, medical or personnel records, health data repositories, etc.) in which the identity of the subject is known, or the identity may be readily ascertained by the investigator or associated with the data/information/specimens.

See DoDD 3216.02 for definitions of these terms and more information about the applicability of DoDI 3216.02 to research involving human subjects.

3.18 Research Involving Recombinant DNA Molecules

Any recipient performing research involving recombinant DNA molecules and/or organisms and viruses containing recombinant DNA molecules shall comply with the National Institutes of Health Guidelines for Research Involving Recombinant DNA Molecules, dated January 2011, as amended. The guidelines can be found at: https://osp.od.nih.gov/wp-content/uploads/2013/06/NIH_Guidelines.pdf. Recombinant DNA is defined as (i) molecules that are constructed outside living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in living cells or (ii) molecules that result from the replication of those described in (i) above.

3.19 Service-Disabled Veteran-Owned Small Business (SDVOSB)

A small business concern owned and controlled by a Service-Disabled Veteran or Service-Disabled Veterans, as defined in Small Business Act 15 USC § 632(q)(2) and SBA's implementing SDVOSB regulations (13 CFR 125).

3.20 Small Business Concern (SBC)

A concern that meets the requirements set forth in 13 C.F.R. § 121.702 (available here).

An SBC must satisfy the following conditions on the date of award:

a. Is organized for profit, with a place of business located in the United States, which operates primarily within the United States or which makes a significant contribution to the United States economy through payment of taxes or use of American products, materials or labor;

b. Is in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that if the concern is a joint venture, each entity to the venture must meet the requirements set forth in paragraph (c) below;

c. Is more than 50% directly owned and controlled by one or more individuals (who are citizens or permanent resident aliens of the United States), other small business concerns (each of which is more than 50% directly owned and controlled by individuals who are citizens or permanent resident aliens of the United States), or any combination of these; and

d. Has, including its affiliates, not more than 500 employees. (For explanation of affiliate, see www.sba.gov/size.)

3.21 Subcontract

A subcontract is any agreement, other than one involving an employer-employee relationship, entered into by an awardee of a funding agreement calling for supplies or services for the performance of the original funding agreement. This includes consultants.

3.22 United States

"United States" means the fifty states, the territories and possessions of the Federal Government, the Commonwealth of Puerto Rico, the Republic of the Marshall Islands, the Federated States of Micronesia, the Republic of Palau, and the District of Columbia.

3.23 Women-Owned Small Business Concern

An SBC that is at least 51% owned by one or more women, or in the case of any publicly owned business, at least 51% of the stock is owned by women, and women control the management and daily business operations.

4.0 PROPOSAL FUNDAMENTALS

Unless otherwise specified, Section 4 applies to both Phase I and Phase II.

4.1 Introduction

The proposal must provide sufficient information to demonstrate to the evaluator(s) that the proposed work represents an innovative approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria. The proposed research or research and development must be responsive to the chosen topic, although it need not use the exact approach specified in the topic. Anyone contemplating a proposal for work on any specific topic should determine that:

a. The technical approach has a reasonable chance of meeting the topic objective,
b. This approach is innovative, not routine, with potential for commercialization and
c. The proposing firm has the capability to implement the technical approach, i.e., has or can obtain people and equipment suitable to the task.

4.2 Proposer Eligibility and Performance Requirements

a. Each proposer must qualify as a small business concern as defined by 13 C.F.R §§ 701-705 at time of award and certify to this in the Cover Sheet section of the proposal. The eligibility requirements for the SBIR/STTR programs are unique and do not correspond to those of other small business programs (see Section 3.15 of this BAA). Proposers must meet eligibility requirements for Small Business Ownership and Control (see 13 CFR § 121.702 and Section 4.4 of this BAA).

b. A minimum of <u>two-thirds</u> of the research and/or analytical work in Phase I must be conducted by the proposing firm. For Phase II, a minimum of one-half (50%) of the research and/or analytical work must be performed by the proposing firm. The percentage of work is measured by both direct and indirect costs.

c. For both Phase I and II, the <u>primary employment</u> of the principal investigator must be with the small business firm at the time of the award and during the conduct of the proposed effort. Primary employment means that more than <u>one-half</u> of the principal investigator's time is spent with the small business. Primary employment with a small business concern precludes full-time employment at another organization.

d. For both Phase I and Phase II, all research or research and development work must be performed by the small business concern and its subcontractors in the United States.

e. **Benchmarks.** Proposers with prior SBIR/STTR awards must meet two benchmark requirements for Progress Towards Commercialization as determined by the Small Business Administration (SBA) on June 1 each year.

(1) For all proposers with greater than 20 Phase I awards over the past five fiscal years excluding the most recent year (currently FY 2013-2017), the ratio of Phase II awards to Phase I awards must be at least 0.25.

(2) For all proposers with greater than 15 Phase II awards over the last ten fiscal years excluding the last two years (currently FY 2007-2016), the proposer must have received, to date, an average of at least $100,000 of sales and/or investments per Phase II award received <u>or</u> have received a number of patents resulting from the SBIR work equal to or greater than 15% of the number of Phase II awards received during the period.

Consequence of failure to meet the benchmarks:

- SBA will identify and notify Agencies on June 1st of each year the list of companies which fail to meet minimum performance requirements. These companies will not be eligible to submit a proposal for a Phase I award for a period of one year from that date.
- Because this requirement only affects a company's eligibility for new Phase I awards, a company that fails to meet minimum performance requirements may continue working on its current ongoing SBIR/STTR awards and may apply for and receive new Phase II and Phase III awards.
- To provide companies with advance warning, SBA notifies companies on April 1st if they are failing the benchmarks. If a company believes that the information used was not complete or accurate, it may provide feedback through the SBA Company Registry at www.sbir.gov.
- In addition, SBA has posted a Guide to SBIR/STTR Program Eligibility to help small businesses understand program eligibility requirements, determine if they will be eligible at the time of award, and accurately complete necessary certifications.
- The benchmark information on the companies will not be available to the public.

4.3 Joint Ventures

Joint ventures and limited partnerships are permitted, provided that the entity created qualifies as a small business in accordance with the Small Business Act, 13 U.S.C. § 121.701.

4.4 Majority Ownership in Part

Majority ownership in part by multiple venture capital, hedge fund, and private equity firms: Small businesses that are owned in majority part by multiple venture capital operating companies (VCOCs), hedge funds, or private equity funds are ineligible to submit applications or receive awards for opportunities in this BAA. Please check Component instructions for further information.

4.5 Conflicts of Interest

Contract awards to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees which may be a violation of federal law

4.6 Classified Proposals

Classified proposals will not be accepted under the DoD SBIR Program. If topics will require classified work during Phase II, the proposing firm must have a facility clearance in order to perform the Phase II work. For more information on facility and personnel clearance procedures and requirements, please visit the Defense Security Service Web site at: http://www.dss.mil/index.html.

4.7 Research Involving Human Subjects

All research involving human subjects, to include use of human biological specimens and human data, shall comply with the applicable federal and state laws and agency policy/guidelines for human subject protection (see Section 3.12).

Institutions to be awarded funding for research involving human subjects must provide documentation of a current Federal Assurance of Compliance with Federal regulations for human subject protection, for example a Department of Health and Human Services, Office for Human Research Protections Federal-wide Assurance (http://www.hhs.gov/ohrp). Additional Federal Assurance documentation may also be requested by the awarding DoD Component. All institutions engaged in human subject research, to include subcontractors, must also have a valid Assurance. In addition, personnel involved in human subjects research must provide documentation of completing appropriate training for the protection of human subjects. Institutions proposing to conduct human subject research that meets one of the exemption criteria in 32 CFR 219.101 are not required to have a Federal Assurance of Compliance. Proposers should clearly segregate research activities involving human subjects from other research and development activities in their proposal.

If selected, institutions must also provide documentation of Institutional Review Board (IRB) approval or a determination from an appropriate official in the institution that the work meets one of the exemption criteria with 32 CFR 219. As part of the IRB review process, evidence of appropriate training for all investigators should accompany the protocol. The protocol, separate from the proposal, must include a detailed description of the research plan, study population, risks and benefits of study participation, recruitment and consent process, data collection and data analysis.

The amount of time required for the IRB to review and approve the protocol will vary depending on such things as the IRB's procedures, the complexity of the research, the level of risk to study participants and the responsiveness of the Investigator. The average IRB approval process can last between one and three months. Once the IRB has approved the research, the awarding DoD Component will review the protocol and the IRB's determination to ensure that the research will be conducted in compliance with DoD and DoD Component policies. The DoD review process can last between three to six months. Ample time should be allotted to complete both the IRB and DoD approval processes prior to recruiting subjects. **No funding can be used towards human subject research until ALL approvals are granted.**

4.8 Research Involving Animal Subjects

All research, development, testing, experimentation, education or training involving the use of animals shall comply with the applicable federal and agency rules on animal acquisition, transport, care, handling, and use (see Section 3.11).

For submissions containing animal use, proposals should briefly describe plans for their Institutional Animal Care and Use Committee (IACUC) review and approval.

All Recipients must receive their IACUC's approval as well as secondary or headquarters-level approval by a DoD veterinarian who is trained or experienced in laboratory animal medicine and science. **No animal research may be conducted using DoD funding until all the appropriate DoD office(s) grant approval.**

4.9 Research Involving Recombinant DNA Molecules

All research involving recombinant DNA molecules shall comply with the applicable federal and state law, regulation and any additional agency guidance. Research shall be approved by an Institutional Biosafety Committee.

4.10 Debriefing

Please refer to the Component-specific instructions for your topics of interest. It is important to note that some Component-unique debriefing processes exist; in those cases, the Component debriefing instructions supersede instructions provided here. The process may include these methods: An unsuccessful proposer that submits a request for a debriefing within 30 days of being notified that their proposal was not selected for award will be provided a debriefing which may be done orally, in writing, or by any other method acceptable to the contracting officer. The request should be emailed to the DoD organization that provided such notification to the proposer. Be advised that a proposer that fails to submit a timely request is not entitled to a debriefing, although untimely debriefing requests may be accommodated at the Government's discretion.

4.11 BAA Protests

Interested parties may have the right to protest this BAA by filing directly with the agency by serving the Contracting Officer (listed below) with the protest, or by filing with the Government Accountability Office (GAO). If the protest is filed with the GAO, a copy of the protest shall be received in the office designated below within one day of filing with the GAO. The protesting firm shall obtain written and dated acknowledgment of receipt of the protest from:

SBIR/STTR Contracting Office
WHS/Acquisition Directorate
1155 Defense Pentagon
Washington, DC 20301-1155

Ms. Chrissandra Smith
DoD SBIR/STTR BAA Contracting Officer
E-mail: chrissandra.smith.civ@mail.mil

4.12 Selection and Award Protests

Protest of Phase I and Phase II selections and awards need to be directed to the contracting officer from the awarding DoD Component or by filing with the Government Accountability Office (GAO). If the protest is filed with the GAO, a copy of the protest shall be received in the office of the DoD Component within one day of filing with the GAO. To ensure a timely protest, protesters should secure the name of the Component Contracting Officer before submitting a protest with GAO. Protests of the small business status of a selected firm may also be made to the Small Business Administration.

4.13 Phase I Award Information

a. **Number of Phase I Awards**. The number of Phase I awards will be consistent with the Component's RDT&E budget, the number of anticipated awards for interim Phase I modifications, and the number of anticipated Phase II contracts. No Phase I contracts will be awarded until evaluation of all qualified proposals for a specific topic is completed.

b. **Type of Funding Agreement**. Each Phase I proposal selected for award will be funded under negotiated contracts or purchase orders and will include a reasonable fee or profit consistent with normal profit margins provided to profit-making firms for R/R&D work. Firm-Fixed-Price, Firm-Fixed-Price Level of Effort, Labor Hour, Time & Material, or Cost-Plus-Fixed-Fee type contracts can be negotiated and are at the discretion of the Component Contracting Officer.

c. **Dollar Value**. The Phase I contract value varies among the DoD Components; it is therefore important for proposing firms to understand Section 5.2, "Summary of Component Programs," for the Component to which they are applying for any specific instructions regarding award size.

d. **Timing**. The SBA SBIR Policy Directive, Section 7(c)(1)(ii), states that agencies should issue the Phase I award no more than 180 days after the closing date of the BAA. However, across DoD, the median time between the date that the SBIR BAA closes and the award of a Phase I contract is approximately four months. Normally proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date for this BAA.

4.14 Phase II Award Information

a. **Number of Phase II Awards**. The number of Phase II awards will depend upon the results of the Phase I efforts and the availability of funds. Historically, approximately 40% of the Phase I awards will result in Phase II projects. This is merely an advisory estimate and the Government may make no awards, fewer awards, or more awards.

b. **Type of Funding Agreement**. Each Phase II proposal selected for award will be funded under a negotiated contract and will include a reasonable fee or profit consistent with normal profit margins provided to profit-making firms for R/R&D work. Firm-Fixed-Price Level of Effort, Firm-Fixed-Price, Labor Hour, Time & Material, Cost-Plus-Fixed-Fee or Other Transaction Authority type contracts can be negotiated and are at the discretion of the Component Contracting Officer.

c. **Average Dollar Value**. The typical size of award varies across the DoD Components. Information on award size will be provided in DoD Component-specific instructions for submission of Phase II proposals.

d. **Timing**. Across DoD, the median time between DoD's receipt of a Phase II proposal and the award of a Phase II contract is six months.

4.15 Questions about this BAA and BAA Topics

a. **General SBIR Questions/Information**.

(1) **Help Desk.** The DoD SBIR/STTR Help Desk is prepared to address general questions about this BAA, the proposal preparation and electronic submission process and other program-related areas. The Help Desk may be contacted from 9:00 a.m. to 5:00 p.m. ET Monday through Friday at:

- Phone: 1-703-214-1333
- E-mail: dodsbirsupport@reisystems.com

(2) **Web sites**. The DoD SBIR/STTR Web site at https://sbir.defensebusiness.org/ has information on the DoD SBIR/STTR Program, including:

- Topics Search engine
- Technical Q&A through the SBIR Interactive Topic Information System (SITIS)
- Links to electronic Proposal Submission for Phase I and Phase II Proposals. Firms submitting through this site for the first time will be asked to register on https://www.dodsbirsttr.mil/submissions.

(3) **SBIR/STTR Updates and Notices:** To be notified of SBIR/STTR opportunities and to receive e-mail updates on the DoD SBIR and STTR Programs, you are invited to subscribe to our listserv via https://sbir.defensebusiness.org/.

b. **General Questions about a DoD Component**. General questions pertaining to a particular DoD Component should be submitted in accordance with the instructions given at the beginning of that Component's topics, in Section 12.0 of this BAA.

c. **Direct Contact with Topic Authors.** From **December 10, 2019 to January 13, 2020,** this BAA is issued for Pre-Release with the names of the topic authors and their phone numbers and e-mail addresses. During the pre- release period, proposing firms have an opportunity to contact topic authors by telephone or e-mail to ask technical questions about specific BAA topics. Questions should be limited to specific information related to improving the understanding of a particular topic's requirements. Proposing firms may not ask for advice or guidance on solution approach and you may not submit additional material to the topic author. If information provided during an exchange with the topic author is deemed necessary for proposal preparation, that information will be made available to all parties through SITIS (SBIR/STTR Interactive Topic Information System). After this period questions must be asked through SITIS as described below.

d. **SITIS Q&A System.** Once DoD begins accepting proposals on **January 14, 2020** no further direct contact between proposers and topic authors is allowed unless the Topic Author is responding to a question submitted during the Pre-release period. However, proposers may submit written questions through SITIS at https://sbir.defensebusiness.org/topics. In SITIS, the questioner and respondent remain anonymous and all questions and answers are posted electronically for general viewing.

   Questions are limited to technical information related to improving the understanding of a topic's requirements. Any other questions, such as those asking for advice or guidance on solution approach, will not receive a response. Proposing firms may locate the topic to which they want to submit a technical question by using the Topic Search feature on this Web site. Then, using the form at the bottom of the topic description page, enter and submit the question. Answers are generally posted within seven working days of question submission. (Answers will also be e-mailed directly to the inquirer when the inquirer provides an e-mail address.)

   The SITIS Q&A online service for this BAA opens on **January 14, 2020** and closes to new questions on **January 22, 2020, at 8:00 p.m**. Typically questions and answers will be posted between **January 08 and February 12, 2020**. Once the BAA closes to proposal submission, no communication of any kind with the topic author or SITIS regarding your submitted proposal is allowed.

   Proposing firms are advised to monitor SITIS during the BAA period for questions and answers. Proposing firms should also frequently check the SBIR/STTR Portal for updates and amendments to the topics.

4.16 Registrations and Certifications

Proposing firms must be registered in the DoD Submission system at: https://www.dodsbirsttr.mil/submissions/ in order to prepare and submit proposals.

Before the DoD Components can award a contract, proposing firms must be registered in the System for Award Management (SAM). If you were previously registered in CCR, your information has been transferred to SAM. However, it is in the firm's interest to visit SAM and ensure that all of the firm's data is up to date from SAM and other databases to avoid delay in award. SAM replaced the Central Contractor Registration (CCR), Online Representations and Certifications Application (ORCA), and the Excluded Parties List System (EPLS). SAM allows firms interested in conducting business with the federal government to provide basic information on business capabilities and financial information. To register, visit www.sam.gov.

Follow instructions found on the SAM Web site on how to obtain a Commercial and Government Entry (CAGE) code and Data Universal Numbering System (DUNS) number. Once a CAGE code and DUNS number are obtained, update the firm's profile on the DoD Submission Web site at https://www.dodsbirsttr.mil/submissions/.

In addition to the standard federal and DoD procurement certifications, the SBA SBIR Policy Directive requires the collection of certain information from firms at time of award and during the award life cycle. Each firm must provide this additional information at the time of the Phase I and Phase II award, prior to final payment on the Phase I award, prior to receiving 50% of the total award amount for a Phase II award, and prior to final payment on the Phase II award.

4.17 Promotional Materials

Promotional and non-project related discussion is discouraged, and additional information provided via Universal Resource Locator (URL) links or on computer disks, CDs, DVDs, video tapes or any other medium will not be accepted or considered in the proposal evaluation.

4.18 Prior, Current, or Pending Support of Similar Proposals or Awards

IMPORTANT -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work (see Section 3.3) for consideration under numerous federal program BAAs or solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning prior, current, or pending support of similar proposals or awards, it must be disclosed to the soliciting agency or agencies as early as possible. See Section 5.4.c(11).

4.19 Fraud and False Statements

Knowingly and willfully making any false, fictitious, or fraudulent statements or representations may be a felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to $10,000, up to five years in prison, or both.

The Department of Defense, Office of Inspector General Hotline ("Defense Hotline") is an important avenue for reporting fraud, waste, abuse, and mismanagement within the Department of Defense. The Office of Inspector General operates this hotline to receive and investigate complaints or information from contractor employees, DoD civilians, military service members and public citizens. Individuals who wish to report fraud, waste or abuse may contact the Defense Hotline at (800) 424-9098 between 8:00 a.m. and 5:00 p.m. Eastern Time or visit http://www.dodig.mil/Components/Administrative-Investigations/DoD-Hotline/Hotline-Complaint/ to submit a complaint. Mailed correspondence should be addressed to the Defense Hotline, The Pentagon, Washington, DC 20301-1900, or e-mail addressed to hotline@dodig.mil.

4.20 Adequate Accounting System

In order to reduce risk to the small business and avoid potential contracting delays, it is suggested that companies interested in pursuing Phase II SBIR contracts and other contracts of similar size with the Department of Defense (DoD), have an adequate accounting system per General Accepted Accounting Principles (GAAP), Generally Accepted Government Auditing Standards (GAGAS), Federal Acquisition Regulation (FAR) and Cost Accounting Standards (CAS) in place. The accounting system will be audited by the Defense Contract Audit Agency (DCAA). DCAA's requirements and standards are available on their Website at: http://www.dcaa.mil and click on "Guidance" and then click on "Audit Process Overview – Information for Contractors," and also at: http://www.dcaa.mil and click on "Checklists and Tools" and then click on "Pre-award Accounting System Adequacy Checklist."

4.21 State and Other Assistance Available

Many states have established programs to provide services to those small business firms and individuals wishing to participate in the Federal SBIR Program. These services vary from state to state, but may include:

- Information and technical assistance;
- Matching funds to SBIR recipients;
- Assistance in obtaining Phase III funding.

Contact your State SBIR/STTR Support office at https://www.sbir.gov/state_services?state=105813# for further information. Small Businesses may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States.

4.22 Discretionary Technical and Business Assistance (TABA)

DoD is not mandating the use of TABA pending further SBA guidance and establishment of a limit on the amount of technical and business assistance services that may be received or purchased by a small business concern that has received multiple Phase II SBIR or STTR awards for a fiscal year. However, proposers should carefully review individual component instructions to determine if TABA is being offered and follow specific proposal requirements for requesting TABA funding

5.0 PHASE I PROPOSAL

5.1 Introduction

This BAA and the DoD SBIR/STTR Submission Web site are designed to reduce the time and cost required to prepare a formal proposal. Since the guidance on allowable content may vary by Component, it is the proposing firm's responsibility to consult the Component-specific instructions for detailed guidance.

A complete proposal consists of:

Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report – not in use for 20.1 BAA
Volume 5: Supporting Documents
Volume 6: Fraud, Waste and Abuse Training

The Submission Web site provides a structure for providing these five sections, but the proposing firm must begin entering its proposal by providing information for the Proposal Cover Sheet. Once the firm begins a Proposal Cover Sheet they will be assigned a proposal number. Please make note of this proposal number and print it for future reference.

Volume 5, Supporting Documents, was implemented beginning with the SBIR 18.2 BAA cycle.

- Volume 5 is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3).
- Volume 5 is available when submitting Phase I and Phase II proposals.
- Please refer to the Component-specific instructions for your topics of interest to see how each program office will be handling the Volume 5 information.

Volume 6

Fraud, Waste and Abuse Training, was implemented beginning with the SBIR 18.3 BAA cycle.

- Please refer to the Component-specific instructions for your topics of interest to see how each program office will be handling the Volume 6 Fraud, Waste and Abuse Training information.

In addition, a Phase I Proposal Template is available on the Submission Web site to provide helpful guidelines for completing each section of your complete Phase I technical proposal. This template was implemented with the SBIR 18.2 BAA cycle.

To submit a proposal, the proposer must click the green "Submit Proposal" button. If the proposal status is "In Progress" it will not be considered "Submitted." For a more detailed explanation, visit: https://www.dodsbirsttr.mil/submissions/. The proposer may add the remaining volumes or modify the Proposal Cover Sheet until BAA close. It is the proposing firm's responsibility to verify that the Technical Volume does not exceed the page limit after upload to the DoD SBIR/STTR Submission site by clicking on the "Verify Technical Volume" icon.

Please refer to Component-specific instructions how a technical volume is handled if the stated page count is exceeded. Some Components will reject the entire technical proposal if the proposal exceeds the stated page count.

Signatures are not required on the electronic forms at the time of submission. If the proposal is selected for award, the DoD Component program will contact the proposer for signatures at the time of award.

5.2 Summary of Component Programs

DoD Component	Cost	Duration	Phase I Option	Technical and Business Assistance
Army	Base NTE $111,500 + Phase I Option NTE $56,000	6 Month Base + 4 Month Phase I Option	Required	$5,000
Navy	Base NTE $140,000 + Phase I Option NTE $100,000	6 Month Base + 6 Month Phase I Option	Required	$6,500
Navy ADAPT Topics	Base NTE $200,000	4 Month Base	Not Applicable	Not Available
Navy Direct to Phase II	Base NTE $1,000,000 + Phase II Option NTE $500,000	24 Month Base + 12 Month Option	Phase II Option - Required	$25,000
Air Force Ph I	Base NTE $150,000	9 Month Base + 3 Month Reporting Period	Not Applicable	Not Available
Air Force Direct to Ph II	Base NTE $1,612,500	12 Month Base + 3 Month Reporting Period	Not Applicable	Not Available
DHA	Base NTE $250,000	6 Month Base	Not Applicable	Not Available
DHA Direct to Ph II	Base NTE $1,100,000	24 Months	Not Applicable	Not Available
DLA	Base: $100,000	9 Month Base	Not Applicable	$5,000
DLA Direct to Phase II	Base: $1,000,000	24 Months	Not Applicable	$10,000
OSD Mantech Direct to Ph II	Base NTE: $1 ,650,000	18 Month Base 1 Month Reporting Period	Not Applicable	Not Available
USSOCOM	Base $150,000	6 Month Base	Not Applicable	$6,500
USSOCOM Direct to Phase II	Base $1,500,000-$1,600,000	Typically 18 Month	Not Applicable	$50,000

5.3 Marking Proprietary Proposal Information

Proposers that include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall:

(1) Mark the first page of each Volume of the proposal submission with the following legend:

"This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed-in whole or in part-for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this proposer as a result of-or in connection with-the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in pages [insert numbers or other identification of sheets]"; and

(2) Mark each sheet of data it wishes to restrict with the following legend:

"Use or disclosure of data contained on this page is subject to the restriction on the first page of this volume."

The DoD assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

Restrictive notices notwithstanding, proposals and final reports submitted through the DoD Submission Web site may be handled, for administrative purposes only, by support contractors. All support contractors are bound by appropriate non-disclosure agreements.

5.4 Phase I Proposal Instructions

a. Proposal Cover Sheet (Volume 1)

On the DoD Submission Web site at https://www.dodsbirsttr.mil/submissions/, prepare the Proposal Cover Sheet. The Cover Sheet must include a brief technical abstract of no more than 200 words that describes the proposed R&D project with a discussion of anticipated benefits and potential commercial applications. **Do not include proprietary or classified information in the Proposal Cover Sheet**. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits may be publicly released on the Internet. Once the Cover Sheet is saved, the system will assign a proposal number. You may modify the cover sheet as often as necessary until the BAA closes.

b. Format of Technical Volume (Volume 2)

(1) Type of file: The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus is detected, it may cause rejection of the proposal. **Do not lock or encrypt the uploaded file**. **Do not include or embed active graphics such as videos, moving pictures, or other similar media in the document.**

(2) Length: Please refer to Component-specific instructions for how a technical volume is handled if the stated page count is exceeded. Some Components will reject the entire technical proposal if the proposal exceeds the stated page count.

(3) Layout: Number all pages of your proposal consecutively. Those who wish to respond must submit a direct, concise, and informative research or research and development proposal (no type smaller than 10-point on standard 8-1/2" x 11" paper with one-inch margins). The header on each page of the Technical Volume should contain your company name, topic number, and proposal number assigned by the DoD SBIR/STTR Submission Web site when the Cover Sheet was created. The header may be included in the one-inch margin.

c. Content of the Technical Volume (Volume 2)

The Technical Volume should cover the following items in the order given below:

(1) **Identification and Significance of the Problem or Opportunity.** Define the specific technical problem or opportunity addressed and its importance.

(2) **Phase I Technical Objectives.** Enumerate the specific objectives of the Phase I work, including the questions the research and development effort will try to answer to determine the feasibility of the proposed approach.

(3) Phase I Statement of Work (including Subcontractors' Efforts)

a) Provide an explicit, detailed description of the Phase I approach. If a Phase I option is required or allowed by the Component, describe appropriate research activities which would commence at the end of Phase I base period should the Component elect to exercise the option. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

b) This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained (see Sections 4.7 - 4.9).

(4) **Related Work**. Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following: (1) short description, (2) client for which work was performed (including individual to be contacted and phone number), and (3) date of completion.

(5) Relationship with Future Research or Research and Development

a) State the anticipated results of the proposed approach if the project is successful.

b) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.

c) Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

(6) **Commercialization Strategy.** Describe in approximately one page your company's strategy for commercializing this technology in DoD, other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your company expects to achieve.

(7) **Key Personnel**. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). <u>All resumes will count toward the page limitations for Volume 2</u>.

(8) **Foreign Citizens**. Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these

individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Proposers frequently assume that individuals with dual citizenship or a work permit will be permitted to work on an SBIR project and do not report them. This is not necessarily the case and a proposal will be rejected if the requested information is not provided. Therefore, firms should report any and all individuals expected to be involved on this project that are considered a foreign national as defined in Section 3.5 of the BAA. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

(9) **Facilities/Equipment**. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(10) **Subcontractors/Consultants**. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described according to the Cost Breakdown Guidance. A minimum of two-thirds of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposers must certify their use of such facilities on the Cover Sheet of the proposal.

(11) **Prior, Current, or Pending Support of Similar Proposals or Awards**. If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information:

a) Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.
b) Date of proposal submission or date of award.
c) Title of proposal.
d) Name and title of principal investigator for each proposal submitted or award received.
e) Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
f) If award was received, state contract number.
g) Specify the applicable topics for each SBIR proposal submitted or award received.

Note: If this does not apply, state in the proposal "No prior, current, or pending support for proposed work."

d. Content of the Cost Volume (Volume 3)

Complete the Cost Volume in the format shown in the Cost Breakdown Guidance by using the on-line cost volume form on the DoD Submission Web site. Some items in the Cost Breakdown Guidance may not apply to the proposed project. If that is the case, there is no need to provide information on each and every item. What matters is that enough information be provided to allow us to understand how you plan to use the requested funds if a contract is awarded.

(1) List all key personnel by name as well as by number of hours dedicated to the project as direct labor.

(2) While special tooling and test equipment and material cost may be included under Phases I, the inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Component Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.

(3) Cost for travel funds must be justified and related to the needs of the project.

(4) Cost sharing is permitted for proposals under this BAA; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a Phase I proposal.

(5) A Phase I Option (if applicable) should be fully costed separately from the Phase I (base) approach.

(6) All subcontractor costs and consultant costs must be detailed at the same level as prime contractor costs in regard to labor, travel, equipment, etc. Provide detailed substantiation of subcontractor costs in your cost proposal. Enter this information in the Explanatory Material section of the on-line cost proposal form. The Supporting Documents Volume (Volume 5) may be used if additional space is needed.

When a proposal is selected for award, you must be prepared to submit further documentation to the Component Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors). For more information about cost proposals and accounting standards, see http://www.dcaa.mil. Click on "Guidance" and then click on "Audit Process Overview Information for Contractors."

e. **Company Commercialization Report (Volume 4)** The Company Commercialization Report Volume will NOT be available during the STTR 20.1 BAA cycle. Therefore, no Commercialization Achievement Index will be generated. Volume 4 will be available for future DoD BAA cycles.

f. Supporting Documents (Volume 5)

The Supporting Documents Volume was implemented beginning with the SBIR 18.2 BAA. Volume 5 is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) which is limited to 20 pages, and the Cost Volume (Volume 5). The Supporting Documents Volume is available for use for submitting Phase I and Phase II proposals for both the DoD SBIR and STTR Programs.

Documents that are acceptable and may be included in Volume 5 are:

1. Letters of Support
2. Additional Cost Information
3. Funding Agreement Certification
4. Technical Data Rights (Assertions)
5. Lifecycle Certification
6. Allocation of Rights

7. Other

Please refer to the Component-specific instructions for your topics of interest to learn how each program office will be handling the Volume 5 information.

g. Fraud, Waste and Abuse Training (Volume 6)

The Fraud, Waste and Abuse Training Certification was implemented beginning with the SBIR 18.3 BAA cycle. Please refer to the Component-specific instructions for your topics of interest to see how each program office will be handling the Fraud, Waste and Abuse Training (Volume 6) information.

5.5 Phase I Proposal Checklist

The Proposer's proposal shall be in accordance with Section 5.0. A complete proposal consists of:

- Volume 1: Proposal Cover Sheet
- Volume 2: Technical Volume
- Volume 3: Cost Volume
- Volume 4: Company Commercialization Report – not in use for 20.1 BAA
- Volume 5: Supporting Documents
- Volume 6: Fraud, Waste and Abuse Training

DoD Component	Volume 5 – Supporting Documents	Volume 6 – Fraud, Waste & Abuse	Technical Volume Page Limits
Army	Not Accepted	Not Accepted	20 pages
Navy	Accepted but Not Evaluated	Not Accepted	20 pages
Navy ADAPT Topics	Accepted but Not Evaluated	Not Accepted	5 pages
Navy Direct to Phase II	Accepted but Not Evaluated	Not Accepted	50 pages
Air Force Ph I	Required-15 Slide Pitch Deck	Required	5 pages
Air Force Direct to Ph II	Required-15 Slide Pitch Deck	Required	15 pages
DHA	Not Accepted	Not Accepted	20 pages
DHA Direct to Ph II	Not Accepted	Not Accepted	60 pages
DLA	Required	Accepted	20 pages
DLA Direct to Phase II	Accepted	Accepted	60 pages
OSD ManTech Direct to Ph II	Not Accepted	Not Accepted	10 pages
USSOCOM	15 page PowerPoint	Accepted but Not Evaluated	5 pages
USSOCOM Direct to Phase II	15 page PowerPoint	Accepted but Not Evaluated	10 pages

Those responding to this BAA should note the proposal preparation tips listed below:

a. Read and follow all instructions contained in this BAA, including the Component-specific instructions listed in Section 12.0 of the DoD Component to which the firm is applying.

b. Register the firm on the secure, password-protected DoD Submission Web site at https://www.dodsbirsttr.mil/submissions/ and, as instructed on the Web site, prepare the firm's submission.

c. Register the firm with SBA's Company Registry at www.sbir.gov and provide the SBA SBC Identification Number on each proposal Cover Sheet submitted in response to this BAA.

d. Check that the cost adheres to the Component criteria specified and the cost on the Cover Sheets matches the cost in the Cost Volume.

e. Check that the Project Abstract and other content provided on the Cover Sheets contain NO proprietary information.

f. Mark proprietary information within the Technical Volume as instructed in Section 5.3.

g. The content in the Technical Volume, including the option (if applicable), includes the items in Section 5.4.c.

h. That the header on each page of the technical volume should contain the company name, topic number, and proposal number. (The header may be included in the one-inch margins.)

i. Limit your Technical Volume to page limits outlined in Component Instructions. Refer to Component-specific instructions for how a technical volume in excess of page limits is handled. Some Components will reject the entire technical proposal if it exceeds the page limit.

j. A Phase I Template to assist in preparing your Technical Volume is available on the SBIR/STTR Submission Web site at https://www.dodsbirsttr.mil/submissions/learning-support/firm-templates.

6.0 PHASE I EVALUATION CRITERIA

Proposals will be evaluated based on the criteria outlined below, unless otherwise specified in the Component-specific instructions. Selections will be based on best value to the Government considering the following factors which are listed in descending order of importance:

a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c. The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

Cost reasonableness and realism shall also be considered to the extent appropriate.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be contained or referenced in the proposal and will count toward the page limit.

7.0 PHASE II PROPOSAL

7.1 Introduction

Unless the Component is participating in the **Direct to Phase II**, Phase II proposals may only be submitted by Phase I awardees. Submission of Phase II proposals are not permitted at this time and, if submitted, may be rejected without evaluation. Phase II proposal preparation and submission instructions will be provided by the DoD Components to Phase I awardees. See Component-specific instructions for more information on **Direct to Phase II Program** preparation and submission instructions.

7.2 Proposal Provisions

IMPORTANT -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work for consideration under numerous federal program BAAs and solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning this, it must be disclosed to the soliciting agency or agencies as early as possible. If a proposal submitted for a Phase II effort is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Cover Sheet and provide the information required in Section 5.4.c(11).

Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular firm per topic using SBIR/STTR program funds, Head of Agency Determinations are now required before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact your original sponsoring agency before submitting a Phase II proposal to an agency other than the one who sponsored the original topic.

Section 4(b)(1)(i) of the SBIR and the STTR Policy Directives provide that, at the agency's discretion, projects awarded a Phase I under a solicitation for SBIR may transition in Phase II to STTR and vice versa. A firm wishing to transfer from one program to another must contact their designated technical monitor to discuss the reasons for the request and the agency's ability to support the request. The transition may be proposed prior to award or during the performance of the Phase II effort. Agency disapproval of a request to change programs shall not be grounds for granting relief from any contractual performance requirement. All approved transitions between programs must be noted in the Phase II award or award modification signed by the contracting officer that indicates the removal or addition of the research institution and the revised percentage of work requirements.

7.3 How to Submit

Each Phase II proposal must be submitted through the DoD SBIR/STTR Submission Web site by the deadline specified in the Component-specific instructions. Each proposal submission must contain a Proposal Cover Sheet, Technical Volume, and Cost Volume.

7.4 Commercialization Strategy

At a minimum, your commercialization strategy must address the following five questions:

(1) What is the first product that this technology will go into?
(2) Who will be the customers, and what is the estimated market size?

(3) How much money will be needed to bring the technology to market, and how will that money be raised?
(4) Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
(5) Who are the proposing firm's competitors, and what is the price and/or quality advantage over those competitors?

The commercialization strategy must also include a schedule showing the anticipated quantitative commercialization results from the Phase II project at one year after the start of Phase II, at the completion of Phase II, and after the completion of Phase II (i.e., amount of additional investment, sales revenue, etc.). For further Phase II requirements, please refer to the Component-specific instructions.

8.0 PHASE II EVALUATION CRITERIA

Phase II proposals will be evaluated based on the criteria outlined below, unless otherwise specified in the Component-specific instructions. Selections will be based on best value to the Government considering the following factors which are listed in descending order of importance:

a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c. The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

Cost reasonableness and realism shall also be considered to the extent appropriate.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be contained or referenced in the proposal and will count toward the page limit.

9.0 PHASE II ENHANCEMENT POLICY

To further encourage the transition of SBIR research into DoD acquisition programs as well as the private sector, certain DoD Components have developed their own Phase II Enhancement policy. Under this policy, the Component will provide a Phase II awardee with additional Phase II SBIR funding if the company can match the additional SBIR funds with non-SBIR funds from DoD acquisition programs or the private sector.

Phase II projects that qualify under Phase II Enhancement may:

a. Extend an existing Phase II contract for up to one year and
b. Match with SBIR funds, up to $537,500 of non-SBIR funds from either DoD non-SBIR Programs or from an outside investor.

Phase II Enhancement requirements and matching rates vary by Component. See each Component's instructions in Section 12.0 of this BAA. Phase II Enhancement applications must be prepared and submitted through the DoD SBIR/STTR Submission Web site at https://www.dodsbirsttr.mil/submissions/. DoD retains the discretion not to approve or fund any Phase II Enhancement application and to review contractor eligibility at the time of selection.

10.0 COMMERCIALIZATION READINESS PROGRAM (CRP)

The SBIR/STTR Reauthorization Act of 2011 established the Commercialization Pilot Program (CPP) as a long-term program titled the Commercialization Readiness Program (CRP).

Each Military Department (Army, Navy, and Air Force) has established a Commercialization Readiness Program. Additionally, each Department has developed criteria and processes to identify projects with the potential for rapid transition to Phase III and that are expected to meet high priority needs of their Department. A project's inclusion in the CRP is by invitation and at the discretion of the Departments. CRP participants may receive a variety of assistance services and/or opportunities to facilitate the transition of their projects. Participation in the CRP may also include modifications to existing Phase II contracts with additional non-SBIR funding, as well as additional SBIR funding beyond the normal SBIR funding guidelines, to enhance ongoing projects with expanded research, development, test, or evaluation to accelerate transition and commercialization. Additional reporting on CRP participants and results achieved is required.

11.0 CONTRACTUAL REQUIREMENTS

11.1 Other Contract Requirements

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of Government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulation that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. While a Phase II contract may include some or all of the provisions below, additional provisions will be required. Copies of complete general provisions will be made available prior to award.

a. **Standards of Work.** Work performed under the contract must conform to high professional standards.
b. **Inspection.** Work performed under the contract is subject to Government inspection and evaluation at all reasonable times.
c. **Examination of Records.** The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.
d. **Default.** The Government may terminate the contract if the contractor fails to perform the work contracted.
e. **Termination for Convenience.** The contract may be terminated at any time by the Government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.
f. **Disputes.** Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.
g. **Contract Work Hours.** The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).
h. **Equal Opportunity.** The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
i. **Affirmative Action for Veterans.** The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran.
j. **Affirmative Action for Handicapped.** The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.
k. **Officials Not to Benefit.** No member of or delegate to Congress shall benefit from the contract.
l. **Covenant Against Contingent Fees.** No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bona fide employees or commercial agencies maintained by the contractor for the purpose of securing business.
m. **Gratuities**. The contract may be terminated by the Government if any gratuities have been offered to any representative of the Government to secure the contract.
n. **Patent Infringement.** The contractor shall report each notice or claim of patent infringement based on the performance of the contract.
o. **Military Security Requirements.** The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.
p. **American Made Equipment and Products.** When purchasing equipment or a product under the SBIR funding agreement, purchase only American-made items whenever possible.
q. **Unique Identification (UID).** If your proposal identifies hardware that will be delivered to the government be aware of the possible requirement for unique item identification in accordance with DFARS 252.211-7003.
r. **Publication Approval.** Government review and approval will be required prior to any dissemination or publication, except within and between the Contractor and any subcontractors, of

classified and non-fundamental information developed under this contract or contained in the reports to be furnished pursuant to this contract.

s. **Animal Welfare.** Contracts involving research, development, test, evaluation, or training on vertebrate animals will incorporate DFARS clause 252.235-7002.
t. **Protection of Human Subjects.** Effective 29 July 2009, contracts that include or may include research involving human subjects in accordance with 32 CFR Part 219, DoD Directive 3216.02 and 10 U.S.C. 980, including research that meets exemption criteria under 32 CFR 219.101(b), will incorporate DFARS clause 252.235-7004.
u. **E-Verify.** Contracts exceeding the simplified acquisition threshold may include the FAR clause 52.222-54 "Employment Eligibility Verification" unless exempted by the conditions listed at FAR 22.1803.
v. **ITAR.** In accordance with DFARS 225.7901-4, Export Control Contract Clauses, the clause found at DFARS 252.225-7048, Export-Controlled Items (June 2013), must be included in all BAAs/solicitations and contracts. Therefore, all awards resulting from this BAA will include DFARS 252.225-7048. Full text of the clause may be found at http://farsite.hill.af.mil/reghtml/Regs/far2afmcfars/fardfars/Dfars/Dfars252_220.htm?zoom_highlight=dfars+252%2E225-7048#P4543_324418.
w. **Cybersecurity.** Any Small Business Concern receiving an SBIR award is required to provide adequate security on all covered contractor information systems. Specific security requirements are listed in DFARS 252.204.7012, and compliance is mandatory.

11.2 Commercialization Updates in Phase II

If, after completion of Phase I, the contractor is awarded a Phase II contract, the contractor shall be required to periodically update the following commercialization results of the Phase II project through the Web site at https://www.dodsbirsttr.mil/submissions/:

a. Sales revenue from new products and non-R&D services resulting from the Phase II technology;
b. Additional investment from sources other than the federal SBIR/STTR Program in activities that further the development and/or commercialization of the Phase II technology;
c. Whether the Phase II technology has been used in a fielded DoD system or acquisition program and, if so, which system or program;
d. The number of patents resulting from the contractor's participation in the SBIR/STTR Program;
e. Growth in number of firm employees; and
f. Whether the firm has completed an initial public offering of stock (IPO) resulting, in part, from the Phase II project.

These updates on the project will be required one year after the start of Phase II, at the completion of Phase II, and subsequently when the contractor submits a new SBIR or STTR proposal to DoD. Firms that do not submit a new proposal to DoD will be asked to provide updates on an annual basis after the completion of Phase II.

11.3 Copyrights

With prior written permission of the Contracting Officer, the awardee may copyright (consistent with appropriate national security considerations, if any) material developed with DoD support. DoD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgment and disclaimer statement.

11.4 Patents

Small business firms normally may retain the principal worldwide patent rights to any invention developed with Government support. The Government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the Government will not make public any information disclosing a Government-supported invention for a period of five years to allow the awardee to pursue a patent. See also Invention Reporting in Section 11.6.

11.5 Technical Data Rights

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this BAA generally remain with the contractor, except that the Government obtains a royalty-free license to use such technical data only for Government purposes during the period commencing with contract award and ending five years after completion of the project under which the data were generated. This data should be marked with the restrictive legend specified in DFARS 252.227-7018. Upon expiration of the five-year restrictive license, the Government has unlimited rights in the SBIR data. During the license period, the Government may not release or disclose SBIR data to any person other than its support services contractors except: (1) For evaluation purposes; (2) As expressly permitted by the contractor; or (3) A use, release, or disclosure that is necessary for emergency repair or overhaul of items operated by the Government. See DFARS clause 252.227-7018, "Rights in Noncommercial Technical Data and Computer Software – Small Business Innovation Research (SBIR) Program."

If a proposer plans to submit assertions in accordance with DFARS 252.227-7017, those assertions must be identified and assertion of use, release, or disclosure restriction MUST be included with your proposal submission. The contract cannot be awarded until assertions have been approved.

11.6 Invention Reporting

SBIR awardees must report inventions to the Component within two months of the inventor’s report to the awardee. The reporting of inventions may be accomplished by submitting paper documentation, including fax, or through the Edison Invention Reporting System at www.iedison.gov for those agencies participating in iEdison.

11.7 Final Technical Reports - Phase I through Phase III

a. **Content:** A final report is required for each project phase. The reports must contain in detail the project objectives, work performed, results obtained, and estimates of technical feasibility. A completed SF 298, "Report Documentation Page," will be used as the first page of the report. submission resources at http://www.dtic.mil/dtic/submit/guidance_on_submitting_docs_to_dtic.html. In addition, monthly status and progress reports may be required by the DoD Component.

b. SF 298 Form “Report Documentation Page” Preparation:

(1) If desirable, language used by the company in its Phase II proposal to report Phase I progress may also be used in the final report.

(2) For each unclassified report, the company submitting the report should fill in Block 12 (Distribution/Availability Statement) of the SF 298, "Report Documentation Page," with the following statement: “Distribution authorized to U.S. Government only; Proprietary Information, (Date of Determination). Other requests for this document shall be referred to the Component SBIR Program Office.” *Note: Data developed under a SBIR contract is subject to SBIR Data Rights which allow for protection under DFARS 252.227-7018 (see Section 11.5, Technical Data Rights). The sponsoring DoD activity, after reviewing the company's*

entry in Block 12, has final responsibility for assigning a distribution statement.

For additional information on distribution statements see the following Defense Technical Information Center (DTIC) Web site: http://www.dtic.mil/dtic/pdf/distribution_statements_and_reasons.pdf

(3) Block 14 (Abstract) of the SF 298, "Report Documentation Page" must include as the first sentence, "Report developed under SBIR contract for topic [insert BAA topic number. [Follow with the topic title, if possible.]" The abstract must identify the purpose of the work and briefly describe the work conducted, the findings or results and the potential applications of the effort. Since the abstract will be published by the DoD, **it must not contain any proprietary or classified data and type "UU" in Block 17**.

(4) Block 15 (Subject Terms) of the SF 298 must include the term "SBIR Report".

c. **Submission:** In accordance with DoD Directive 3200.12 and DFARS clause 252.235-7011, a copy of the final report shall be submitted (electronically or on disc) to:

Defense Technical Information Center
ATTN: DTIC-OA (SBIR)
8725 John J Kingman Road, Suite 0944
Ft. Belvoir, VA 22060-6218

Delivery will normally be within 30 days after completion of the Phase I technical effort.

Other requirements regarding submission of reports and/or other deliverables will be defined in the Contract Data Requirements List (CDRL) of each contract.

Special instructions for the submission of CLASSIFIED reports will be defined in the delivery schedule of the contract.

DO NOT E-MAIL Classified or controlled unclassified reports, or reports containing SBIR Data Rights protected under DFARS 252.227-7018.

ARMY
20.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The U.S. Army Combat Capabilities Development Command (CCDC) is responsible for execution of the Army SBIR Program. Information on the Army SBIR Program can be found at the following Website: https://www.armysbir.army.mil/.

Broad Agency Announcement (BAA), topic, and general questions regarding the SBIR Program should be addressed according to the DOD Program BAA. For technical questions about the topic during the pre-release period, contact the Topic Authors listed for each topic in the BAA. To obtain answers to technical questions during the formal BAA period, visit https://sbir.defensebusiness.org/. Specific questions pertaining to the Army SBIR Program should be submitted to:

Monroe Harden
Acting Program Manager, Army SBIR
usarmy.apg.ccdc.mbx.sbir-program-managers-helpdesk@mail.mil
U.S. Army Combat Capabilities Development Command
6662 Gunner Circle
Aberdeen Proving Ground, MD 21005-1322
TEL: 866-570-7247

The Army participates in three DOD SBIR BAAs each year. Proposals not conforming to the terms of this BAA will not be considered. Only Government personnel will evaluate proposals.

PHASE I PROPOSAL SUBMISSION

SBIR Phase I proposals have four Volumes: Proposal Cover Sheet, Technical Volume, Cost Volume and Company Commercialization Report. **Please note that the Army will not be accepting a Volume Five (Supporting Documents), nor a Volume Six (Fraud, Waste and Abuse) as noted at the DOD SBIR website.** The Technical Volume .pdf document has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Small businesses submitting a Phase I Proposal must use the DOD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheet, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DOD SBIR Help Desk at 1-703-214-1333 or DoDSBIRSupport@reisystems.com.

The small business will also need to register at the Army SBIR Small Business website: https://sbir.army.mil/SmallBusiness/ in order to receive information regarding proposal status/debriefings, summary reports, impact/transition stories, and Phase III plans. PLEASE NOTE: If this is your first time submitting an Army SBIR proposal, you will not be able to register your firm at the Army SBIR Small Business website until after all of the proposals have been downloaded and we have transferred your company information to the Army Small Business website. This can take up to one week after the end of the proposal submission period.

Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume such as descriptions of capability or intent in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically generated Cover Sheets and Cost Volume are excluded from the 20-page limit. **Army Phase I proposals submitted containing a Technical Volume .pdf document containing over 20 pages will be deemed NON-COMPLIANT and will not be evaluated. It is the responsibility of the Small Business to ensure that once the proposal is submitted and uploaded into the system that the technical volume .pdf document complies with the 20 page limit.**

Phase I proposals must describe the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

Phase I proposals will be reviewed for overall merit based upon the criteria in Section 6.0 of the DOD Program BAA.

20.1 Phase I Key Dates

BAA closes, proposals due	12 Feb 2020, 8:00 pm ET
Phase I Evaluations	14 Feb 2020 – 30 Apr 2020
Phase I Selections Announced	12 May 2020
Phase I Award Goal	10 Aug 2020*

**Subject to the Congressional Budget process*

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL

The Army implements the use of a Phase I Option that may be exercised to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to have the Phase I Option exercised. The Phase I Option, which **must** be included as part of the Phase I proposal, should cover activities over a period of up to four months and describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 20-page limit for the Phase I proposal. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume such as descriptions of capability or intent, in other sections of the proposal as these will count toward the 20 page limit.

PHASE I COST VOLUME

A firm fixed price or cost plus fixed fee Phase I Cost Volume with maximum dollar amount of **$167,500** must be submitted in detail online. Proposers that participate in this BAA must complete a Phase I Cost Volume not to exceed a maximum dollar amount of **$111,500** for the six months base period and a Phase I Option Cost Volume not to exceed a maximum dollar amount of **$56,000** for the four months option period. The Phase I and Phase I Option costs must be shown separately but may be presented side-by-side in a single Cost Volume. The Cost Volume DOES NOT count toward the 20-page Phase I proposal limitation when submitted via the submission site's on-line form. When submitting the Cost Volume, complete the Cost Volume form on the DOD Submission site, versus submitting it within the body of the uploaded proposal.

PHASE II PROPOSAL SUBMISSION

Only Small Businesses that have been awarded a Phase I contract for a specific topic can submit a Phase II proposal for that topic. Small businesses submitting a Phase II Proposal must use the DOD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/)This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheet, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DOD Help Desk at 703-214-1333.

Army SBIR has four cycles in each FY for Phase II submission. A single Phase II proposal can be submitted by a Phase I awardee within one, and only one, of four submission cycles and must be submitted between 4 to 17 months after the Phase I contract award date. Any proposals that are not submitted within these four submission cycles and before 4 months or after 17 months from the contract award date will not be evaluated. The submission window opens at 0001hrs (12:01 AM) eastern time on the first day and closes at 2359 hrs (11:59 PM) eastern time on the last day. Any subsequent Phase II proposal (i.e., a second Phase II subsequent to the initial Phase II effort) shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by Army SBIR PM in advance.

The next available four Phase II submission cycles following the announcement of selections for the 20.1 BAA are:

2021(a) 15 Oct – 13 Nov 2020
2021(b) 1 Mar – 30 Mar 2021
2021(c) 15 Jun - 14 Jul 2021
2021(d) 2 Aug – 31 Aug 2021

For other submission cycles see the schedule below, and always check with the Army SBIR Program Managers Office helpdesk for the exact dates.

SUBMISSION CYCLES	TIMEFRAME
Cycle One	30 calendar days starting on or about 15 October*
Cycle Two	30 calendar days starting on or about 1 March*
Cycle Three	30 calendar days starting on or about 15 June*
Cycle Four	30 calendar days starting on or about 1 August*

*Submission cycles will open on the date listed unless it falls on a weekend or a Federal Holiday. In those cases, it will open on the next available business day.

Army SBIR Phase II Proposals have three Volumes: Proposal Cover Sheet, Technical Volume, and Cost Volume. The Technical Volume .pdf document has a 38-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes), data assertions and any attachments. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 38 page limit. As with Phase I proposals, it is the proposing firm's responsibility to verify that the Technical Volume .pdf document does not exceed the page limit after upload to the DOD SBIR/STTR Submission site by clicking on the "Verify Technical Volume" icon.

Only the electronically generated Cover Sheet and Cost Volume are excluded from the 38-page Technical Volume.

Army Phase II Proposals submitted containing a Technical Volume .pdf document over 38 pages will be deemed NON-COMPLIANT and will not be evaluated.

Army Phase II Cost Volumes must contain a budget for the entire 24 month Phase II period not to exceed the maximum dollar amount of **$1,100,000.** During contract negotiation, the contracting officer may require a Cost Volume for year one and year two. The proposal cost volumes must be submitted using the Cost Volume format (accessible electronically on the DOD submission site), and may be presented side-by-side on a single Cost Volume Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the first year prior to extending funding for the second year.

Small businesses submitting a proposal are required to develop and submit a technology transition and commercialization plan describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal.

DOD is not obligated to make any awards under Phase I, II, or III. For specifics regarding the evaluation and award of Phase I or II contracts, please read the DOD Program BAA very carefully. Phase II proposals will be reviewed for overall merit based upon the criteria in Section 8.0 of the BAA.

BIO HAZARD MATERIAL AND RESEARCH INVOLVING ANIMAL OR HUMAN SUBJECTS

Any proposal involving the use of Bio Hazard Materials must identify in the Technical Volume whether the contractor has been certified by the Government to perform Bio Level - I, II or III work.

Companies should plan carefully for research involving animal or human subjects, or requiring access to government resources of any kind. Animal or human research must be based on formal protocols that are reviewed and approved both locally and through the Army's committee process. Resources such as equipment, reagents, samples, data, facilities, troops or recruits, and so forth, must all be arranged carefully. The few months available for a Phase I effort may preclude plans including these elements, unless coordinated before a contract is awarded.

FOREIGN NATIONALS

If the offeror proposes to use a foreign national(s) [any person who is NOT a citizen or national of the United States, a lawful permanent resident, or a protected individual as defined by 8 U.S.C. 1324b (a) (3) – refer to Section 3.5 of this BAA for definitions of "lawful permanent resident" and "protected individual"] as key personnel, they must be clearly identified. **For foreign nationals, you must provide country of origin, the type of visa or work permit under which they are performing and an**

<u>explanation of their anticipated level of involvement on this project. Please ensure no Privacy Act information is included in this submittal.</u>

OZONE CHEMICALS

Class 1 Ozone Depleting Chemicals/Ozone Depleting Substances are prohibited and will not be allowed for use in this procurement without prior Government approval.

CONTRACTOR MANPOWER REPORTING APPLICATION (CMRA)

The Contractor Manpower Reporting Application (CMRA) is a Department of Defense Business Initiative Council (BIC) sponsored program to obtain better visibility of the contractor service workforce. This reporting requirement applies to all Army SBIR contracts.

Offerors are instructed to include an estimate for the cost of complying with CMRA as part of the Cost Volume for Phase I (**$111,500 maximum**), Phase I Option (**$56,000 maximum**), and Phase II (**$1,100,000 maximum**), under "CMRA Compliance" in Other Direct Costs. This is an estimated total cost (if any) that would be incurred to comply with the CMRA requirement. Only proposals that receive an award will be required to deliver CMRA reporting, i.e. if the proposal is selected and an award is made, the contract will include a deliverable for CMRA.

To date, there has been a wide range of estimated costs for CMRA. While most final negotiated costs have been minimal, there appears to be some higher cost estimates that can often be attributed to misunderstanding the requirement. The SBIR Program desires for the Government to pay a fair and reasonable price. This technical analysis is intended to help determine this fair and reasonable price for CMRA as it applies to SBIR contracts.

- The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains the secure CMRA System. The CMRA Web site is located here: https://www.ecmra.mil/.

- The CMRA requirement consists of the following items, which are located within the contract document, the contractor's existing cost accounting system (i.e. estimated direct labor hours, estimated direct labor dollars), or obtained from the contracting officer representative:

  (1) Contract number, including task and delivery order number;
  (2) Contractor name, address, phone number, e-mail address, identity of contractor employee entering data;
  (3) Estimated direct labor hours (including sub-contractors);
  (4) Estimated direct labor dollars paid this reporting period (including sub-contractors);
  (5) Predominant Federal Service Code (FSC) reflecting services provided by contractor (and separate predominant FSC for each sub-contractor if different);
  (6) Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (The Army Requiring Activity is responsible for providing the contractor with its UIC for the purposes of reporting this information);
  (7) Locations where contractor and sub-contractors perform the work (specified by zip code in the United States and nearest city, country, when in an overseas location, using standardized nomenclature provided on Web site);

- The reporting period will be the period of performance not to exceed 12 months ending September 30 of each government fiscal year and must be reported by 31 October of each calendar year.

- According to the required CMRA contract language, the contractor may use a direct XML data transfer to the Contractor Manpower Reporting System database server or fill in the fields on the Government Web site. The CMRA Web site also has a no-cost CMRA XML Converter Tool.

Given the small size of our SBIR contracts and companies, it is our opinion that the modification of contractor payroll systems for automatic XML data transfer is not in the best interest of the Government. CMRA is an annual reporting requirement that can be achieved through multiple means to include manual entry, MS Excel spreadsheet development, or use of the free Government XML converter tool. The annual reporting should take less than a few hours annually by an administrative level employee.

Depending on labor rates, we would expect the total annual cost for SBIR companies to not exceed $500.00 annually, or to be included in overhead rates.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA) (FORMERLY KNOWN AS DISCRETIONARY TECHNICAL ASSISTANCE)

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), the Army will provide technical assistance services to small businesses engaged in SBIR projects through a network of scientists and engineers engaged in a wide range of technologies. The objective of this effort is to increase Army SBIR technology transition and commercialization success thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth.

The Army has stationed nine Technical Assistance Advocates (TAAs) across the Army to provide technical assistance to small businesses that have Phase I and Phase II projects with the participating organizations within their regions.

For more information go to: https://www.armysbir.army.mil, then click the “SBIR” tab, and then click on Transition Assistance/Technical Assistance.

This technical and business assistance to SBIR awardees to assist in:

- Making better technical decisions on SBIR projects
- Solving technical problems that arise during SBIR projects;
- Minimizing technical risks associated with SBIR projects; and
- Developing and commercializing new commercial products and processes resulting from such projects including intellectual property protections.

Army may provide up to $5,000 of SBIR funds for the technical assistance described above for each Phase I award, and $10,000 per Phase II project to these vendors for direct support to SBIR awardees.

Alternatively, an SBIR firm may directly acquire the technical assistance services described above and not through the vendor selected by the Components. Firms must request this authority from the agency and clearly identify the need for assistance (purpose and objective of required assistance), provide details on the provider of the assistance (name and point of contact for performers) and why the proposed TABA providers are uniquely skilled to conduct the work (specific experience in providing the assistance proposed), and the cost of the required assistance (costs and hours proposed or other details on arrangement). This information must be included in the Explanatory Material section of the firm's cost proposal specifically identified as "Discretionary Technical and Business Assistance."

If the awardee demonstrates this requirement sufficiently, the agency shall permit the awardee to acquire such technical assistance itself, in an amount up to $5,000 for each Phase I award and $10,000 for each Phase II project, as an allowable cost of the SBIR award. The per year amount will be in addition to the award and is not subject to any profit or fee by the requesting (SBIR) firm and is inclusive of all indirect rates.

The TABA provider may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner or research institution).

Failure to include the required information in the Phase I and/or Phase II proposal will result in the request for discretionary technical and business assistance being disapproved. Requests for TABA funding outside of the Phase I or Phase II proposal submission will not be considered. If the firm is approved for TABA from a source other than that provided by the agency, the firm may not be eligible for the technical assistance services normally provided by those organizations. Small business concerns that receive technical or business assistance as described in this section are required to submit a description of the assistance provided, and the benefits and results achieved. Contact the Army SBIR Program Office for any other considerations.

NOTE: The Small Business Administration (SBA) is currently developing regulations governing TABA. All regulatory guidance produced by SBA will apply to any SBIR contracts where TABA is utilized.

It should also be noted that if approved for discretionary technical and business assistance from an outside source, the firm will not be eligible for the Army's Technical Assistance Advocate support. All details of the TABA agency and what services they will provide must be listed in the technical proposal under "consultants". The request for TABA must include details on what qualifies the TABA firm to provide the services that you are requesting, the firm name, a point of contact for the firm, and a web site for the firm. List all services that the firm will provide and why they are uniquely qualified to provide these services. The award of TABA funds is not automatic and must be approved by the Army SBIR Program Manager. The maximum TABA dollar amount that can be requested in a Phase I Army SBIR proposal is $5,000. The maximum TABA dollar amount that can be requested in a Phase II Army SBIR proposal is $5,000 per year (for a total of $10,000 for two years).

COMMERCIALIZATION READINESS PROGRAM (CRP)

The objective of the CRP effort is to increase Army SBIR technology transition and commercialization success and accelerate the fielding of capabilities to Soldiers. The CRP: 1) assesses and identifies SBIR projects and companies with high transition potential that meet high priority requirements; 2) matches SBIR companies to customers and facilitates collaboration; 3) facilitates detailed technology transition plans and agreements; 4) makes recommendations for additional funding for select SBIR projects that meet the criteria identified above; and 5) tracks metrics and measures results for the SBIR projects within the CRP.

Based on its assessment of the SBIR project's potential for transition as described above, the Army utilizes a CRP investment fund of SBIR dollars targeted to enhance ongoing Phase II activities with expanded research, development, test and evaluation to accelerate transition and commercialization. The CRP investment fund must be expended according to all applicable SBIR policy on existing Phase II availability of matching funds, proposed transition strategies, and individual contracting arrangements.

NON-PROPRIETARY SUMMARY REPORTS

All award winners must submit a non-proprietary summary report at the end of their Phase I project and any subsequent Phase II project. The summary report is unclassified, non-sensitive and non-proprietary and should include:

- A summation of Phase I results
- A description of the technology being developed
- The anticipated DOD and/or non-DOD customer
- The plan to transition the SBIR developed technology to the customer
- The anticipated applications/benefits for government and/or private sector use
- An image depicting the developed technology

The non-proprietary summary report should not exceed 700 words, and is intended for public viewing on the Army SBIR/STTR Small Business area. This summary report is in addition to the required final technical report and should require minimal work because most of this information is required in the final technical report. The summary report shall be submitted in accordance with the format and instructions posted within the Army SBIR Small Business Portal at:
https://sbir.army.mil/SmallBusiness/ and is due within 30 days of the contract end date.

ARMY SBIR PROGRAM COORDINATORS (PCs) for Army SBIR PHASE 20.1

Participating Organizations	Program Coordinator	Phone
Army Futures Command (AFC)	Casey Perley	716-754-6311
Armaments Center (AC)	Sheila Speroni	973-724-6935
Aviation and Missile Center (AvMC-A)	Dawn Gratz	256-842-3272
Aviation and Missile Center (AvMC-M)	Dawn Gratz	256-842-3272
Army Research Laboratory (ARL)	Francis Rush Nicole Fox	919-549-4347 919-549-4395
Army Test & Evaluation Command (ATEC)	Kendra Raab	443-861-9344
Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR)	Lauren Marzocca	410-395-4665
Chemical Biological Center (CBC)	Martha Weeks	410-436-5391

Engineer Research & Development (ERDC)	Melonise Wills	703-428-6281
Ground Vehicle Systems Center	George Pappageorge	586-282-4915
PEO Aviation	Randy Robinson	256-313-4975
PEO Command, Control and Communications Tactical (PEO C3T)	Meisi Amaral	443-395-6725
PEO Intelligence, Electronic Warfare & Sensors (PEO IEW&S)	Michael Voit	443-861-7851
PEO Missiles & Space	David Tritt	256-313-3431
PEO Soldier	Mary Harwood	703-704-0211
PEO STRI	Robert Forbis	407-384-3884
Space and Missile Defense Command (SMDC)	Jason Calvert	256-955-5630
Soldier Center (SC)	Cathy Polito	508-206-3497

ARMY SUBMISSION OF FINAL TECHNICAL REPORTS

A final technical report is required for each project. Per DFARS clause 252.235-7011 (http://www.acq.osd.mil/dpap/dars/dfars/html/current/252235.htm#252.235-7011), each contractor shall (a) Submit two copies of the approved scientific or technical report delivered under the contract to the Defense Technical Information Center, Attn: DTIC-O, 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218; (b) Include a completed Standard Form 298, Report Documentation Page, with each copy of the report; and (c) For submission of reports in other than paper copy, contact the Defense Technical Information Center or follow the instructions at http://www.dtic.mil.

DEPARTMENT OF THE ARMY PROPOSAL CHECKLIST

This is a Checklist of Army Requirements for your proposal. Please review the checklist to ensure that your proposal meets the Army SBIR requirements. You must also meet the general DOD requirements specified in the BAA. **Failure to meet these requirements will result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

1. The proposal addresses a Phase I effort (up to **$111,500** with up to a six-month duration) AND an optional effort (up to **$56,000** for an up to four-month period to provide interim Phase II funding).

2. The proposal is limited to only **ONE** Army BAA topic.

3. The technical content of the proposal, including the Option, includes the items identified in Section 5.4 of the BAA.

4. SBIR Phase I Proposals have three (3) sections: Proposal Cover Sheet, Technical Volume and Cost Volume. The Technical Volume .pdf document has a 20-page limit including, but not limited to: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents [e.g., statements of work and resumes] and all attachments).

However, offerors are instructed to NOT leave blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal submission as THESE WILL COUNT AGAINST THE 20-PAGE LIMIT. Any information that details work involved that should be in the technical volume but is inserted into other sections of the proposal will count against the page count. ONLY the electronically generated Cover Sheet and Cost Volume are excluded from the Technical Volume .pdf 20-page limit. Army Phase I proposals submitted with a Technical Volume .pdf document of over 20-pages will be deemed NON-COMPLIANT and will not be evaluated.

5. The Cost Volume has been completed and submitted for both **the Phase I and Phase I Option** and the costs are shown separately. The Army requires that small businesses complete the Cost Volume form on the DOD Submission site, versus submitting within the body of the uploaded proposal. The total cost should match the amount on the cover pages.

6. Requirement for Army Accounting for Contract Services, otherwise known as CMRA reporting is included in the Cost Volume (offerors are instructed to include an estimate for the cost of complying with CMRA).

7. If applicable, the Bio Hazard Material level has been identified in the Technical Volume.

8. If applicable, plan for research involving animal or human subjects, or requiring access to government resources of any kind.

9. The Phase I Proposal describes the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

10. If applicable, Foreign Nationals are to be identified in the proposal.

ARMY

ARMY SBIR 20.1 Topic Index

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A20-041	Low Probability of Intercept Sense Thru Wall Radar
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A20-044	Novel Single Plane Optics for Lightweight, Compact Imaging Systems
A20-045	Additive Nanostructured Arrays (ANA) for Broadband Anti-Reflectivity (AR)
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A20-050	Dual-Band Lens SWAP Reduction and Increased Optical Throughput with Calcium Lanthanum Sulphide (CLS)
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A20-061	AI Based Autonomous Agents that Possess Human-like Cognitive Skills in a Real-Time Strategy Game Environment
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A20-067	Advanced Materials for Power Electronics
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A20-071	Radio Network Sniffer and Baseband Signal Analysis Tool
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A20-080	Continuous-Time Digital Signal Processing (DSP) Using Reconfigurable Devices
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A20-087	Compact, Hemispherical Coverage Early Warning Detection and Track Sensor for Multi-Mission Applications
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ARMY SBIR 20.1 Topic Descriptions

A20-001 TITLE: ARMORS (Augmented Reality Maintainer-Operator Relay System): Real-time maintenance management software

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop a software application to allow Soldiers to easily identify, document, and manage vehicle maintenance issues that includes an augmented-reality based guidance system for operators and mechanics.

DESCRIPTION: The Army's current approach to preventative vehicle maintenance is outdated and analog. Currently a soldier must locate the technical manual for the vehicle and follow the listed instructions. Any deficiencies, known as faults, are then written by hand on a paper form. Faults that cannot be immediately rectified must also have a fault code – found in the technical manual – listed next to the deficiency. Upon completion of the preventative maintenance the paper form is then passed to a mechanic to verify the faults, and passed again to a clerk who enters the faults into a software system that tracks the maintenance status of the fleet as well as locates or orders the required parts.

There are numerous pain points in this process. Technical manuals are sometimes missing and often damaged. The analog maintenance process also only captures faults as recorded and does not allow leaders to see when preventative maintenance was not performed at all, when steps were skipped, or faults were misidentified. The current process also does not make the vehicle maintenance history available to the operators and mechanics working on the vehicle line, leading to further misidentification of problems. The passing of the form to numerous people can lead to its loss and delayed entry into maintenance and supply chain management system. Human error in transferring fault codes from the manual, to a form also introduces error. Leaders have no way of managing this process without inserting themselves into the paperwork routing process, creating bottlenecks and increasing the time delay between fault identification and part sourcing. Lastly, this entire process is inefficient because it must occur sequentially and requires one busy Soldier to physically find another busy Soldier simply to pass a piece of paper. Automating this process will increase maintenance readiness of the Army's fleet of vehicles by assisting soldiers in performing preventative maintenance through visual aids and by allowing leaders to track the fault identification and verification process in real-time.

Capabilities of this solution could include (but are not limited to):

-A computer vision enabled augmented reality application, implemented on a handheld or headset computing platforms, that allows operators and mechanics to receive visual aids for maintenance activities and provide recommended solutions
-Real-time geolocation of vehicles with faults within the motorpool, ability to prioritize verification based on vehicle type, geography, bumper number, fault-type or other criteria
-Picture-taking capability to allow for remote verification of faults
-Integration with training manual so that fault codes, and part identification (and alternate identification) numbers appear when fault is identified
-Ability to see past maintenance history of a vehicle when conducting services to confirm past faults have been corrected, and visualize part status for outstanding faults

PHASE I: Develop a solution that either assists with either/both maintenance supply chain operations or provides visualize aids during maintenance for a single vehicle type. Solutions are not required to be part of integrated whole. Proposals will be evaluated on a holistic basis based on the value they provide to the Army, allowing for solutions with a different constellation of features to be scored based on usefulness to maintainers and operators.

PHASE II: Develop an integrated solution, implemented on handheld or headset computing platforms, that integrates both augmented reality assistance with maintenance activities and supply chain activities into a single platform for a single vehicle type. As with phase I proposals will be evaluated on a holistic basis to assess the value they provide to the maintainers/operators of vehicles based on the included features.

PHASE III DUAL USE APPLICATIONS: Develop application for numerous vehicle types that interfaces with existing maintenance status and supply chain systems to facilitate improved preventative maintenance and equipment procurement. Potential commercial applications of the technology exist within the transportation sector (automotive, airline, rail) and electronics repair industries.

REFERENCES:
1. N. Neethu and A. Bk, "Role of Computer Vision in Automatic Inspection Systems," International Journal of Computer Applications, August 2015, pp. 28-31.

2. E. Mendivil, R. Solis, and H. Rios, "Innovative Augmented Reality System for Automotive Assembling Processes and Maintenance," 2013 15th International Conference on Transparent Optical Networks.

3. M. Anastassova, J. Burkhardt, C. Megard, P. Ehanno, "Results from a user-centred critical incidents study for guiding future implementation of augmented reality in automotive maintenance," International Journal of Industrial Ergonomics, Volume 35, Issue, 1, January 2005, pp. 67 – 77.

4. M. Januszka and W. Panfil, "Augmented Reality Techniques for Vehicle Maintenance," Proceedings of the Institute of Vehicles, Volume 2, 2015, pp. 37 – 48.

5. E. Bottani & G. Vignali, "Augmented reality technology in the manufacturing industry: A review of the last decade," IISE Transactions, 2019, Volume 51:3, pp. 284-310.

KEYWORDS: Vehicle maintenance; Augmented reality; computer vision; supply chain; heads-up display

A20-003 TITLE: True Harvard Architecture RISC-V DSP

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: RISC-V is an open source instruction set architecture (ISA). The offeror shall develop a RISC-V Digital Signal Processor (DSP) architecture using a true Harvard cache and bus architecture (completely separate instruction and data bus architecture).

DESCRIPTION: We are interested in RISC-V DSP architecture to create an open source DSP standard with preplanned expansion opportunities similar to the RISC-V design philosophy [1-5]. We are also interested in the benefits provided by a true Harvard architecture over a unified von Neumann architecture. A true Harvard machine can perform simultaneous program instruction and data memory operations. The cybersecurity benefits for completely separating (isolating) program instructions from data has been ignored by the computer industry.

The offeror shall develop a RISC-V DSP architecture using a true Harvard cache and bus architecture [6] (completely separate instruction and data bus architecture). We are not interested in a modified Harvard architecture [7] nor a von Neumann architecture [8]. The offeror shall develop a RISC-V DSP architecture which provides for fixed point and floating point complex multiply and add and other DSP related instructions with planned extensions for 64 bit and higher.

The offeror is required to meet the performance objectives (1)-(4) by comparing the performance of an equivalent RISC-V floating point microprocessor to the proposed RISC-V DSP. The only architecture differences between the RISC-V core and RISC-V DSP are the instruction extensions and architecture extensions to support DSP operations.
(1) For a 256 by 256 complex double precision floating point matrix, and an 8 by 8 complex double precision floating point convolution kernel, demonstrate a 20 % higher performance.
(2) For a 16k (1024*16) input sequence, and a 500 (or 501) tap double precision floating point, FIR Hilbert transform, demonstrate a 20 % higher performance.
(3) For a 16k (1024*16) point double precision, floating point complex number FFT, demonstrate a 50% higher

performance.
(4) For a 64k (1024*64) point double precision, floating point complex number FFT, demonstrate 10% less energy used for the calculation.
Higher performance definition: 20 % higher performance means 20% less wall clock time to execute.

PHASE I: For the Phase I proposal, offeror shall describe the feasibility of developing a true Harvard RISC-V DSP architecture using a hardware/software co-design approach. The phase I proposal must address requirements (1)-(5). Proposals that do not meet the requirements will be deemed non-compliant and will not be reviewed.

(1) Propose a co-design approach for RISC-V DSP architecture and DSP software extensions.
(2) Propose DSP extensions for RISC-V architecture and a path forward to standardize the proposed extensions.
(3) A design concept to achieve the performance metrics in the description section.
(4) Describe potential Army, DoD, and commercial applications; and
(5) Provide a business model to market (a) the proposed open source RISC-V DSP and (2) if the offeror chooses to develop a closed source version a second marketing plan.

For the phase I effort, the offeror shall demonstrate the feasibility of developing a RISC-V DSP architecture using a true Harvard machine architecture.
(1) Develop models, simulations, prototypes, etc. to determine technical feasibility of developing a true Harvard architecture RISC-V DSP.
(2) Deliver a System Architecture Report describing RISC-V DSP architecture.
(3) Publish a proposed, open standard for RISC-V DSP ISA and Harvard cache and bus Architecture.
(4) Write a report describing the benefits [9] and costs of a true Harvard architecture over a von Neumann architecture covering (1) higher bandwidth, (2) better isolation between instructions and data, (3) more parallelism, et al. The intention of this report is to (1) illustrate to the microprocessor community the parallel performance advantages of a Harvard architecture and (2) to show to the cybersecurity community that the isolation provided by a Harvard architecture is significantly better than a von Neumann architecture.

PHASE II: Phase II: Offeror shall develop a RISC-V DSP based on offeror's proposal and phase I effort. The offeror shall demonstrate RISC-V DSP for an Army application (like Joint Multi-Role Technology Demonstrator [10]). The Offer shall propose potential applications for a system demonstration and implement an application with government concurrence.

Offeror shall create an open source RISC-V DSP version in a standard hardware description language (VHDL, Verilog, SystemC, etc.) and provide an open source license. The offeror shall publish an open source architecture document covering RISC-V DSP (VHDL, Verilog, SystemC, etc.) code and system development board. Offeror is free to develop another version which may be fully proprietary.
Offeror shall deliver 2 prototype systems to the government point of contact for test and evaluation with all software tools and licenses (if required), and hardware description language code(s) and software to build and use the system. Offeror shall provide 2 days of on-site training for the system.

PHASE III DUAL USE APPLICATIONS: Offeror will develop and market RISC-V DSP based on phase II development work and marketing plan from phase I. Offeror may target low power applications or high end DSP market. Offeror will integrate RISC-V DSP into an Army Aviation or Missile subsystem currently under development or via technology refresh.

REFERENCES:
1. D. Patterson and A. Waterman: The RISC-V Reader: An Open Architecture Atlas, Strawberry Cannon LLC, 2017. ISBN 978-0-9992491-1-6.

2. C. Hua Chang: "RISC-V DSP (P) Extension Proposal," RISC-V Barcelona Workshop, 9 May 2019.

3. D. Schiavone, et al.: "DSP ISA Extensions for an Open-Source RISC-V Implementation," ETH Zurich Integrated Systems Laboratory. (no date).

4. P. Schiavone, et al.: “A near-threshold RISC-V core with DSP extensions for scalable IoT Endpoint Devices,” pre-print. https://arxiv.org/pdf/1608.08376.pdf

5. AndesCore™ AX25: http://www.andestech.com/product-details01.php?cls=3&id=111#

6. https://en.wikipedia.org/wiki/Harvard_architecture

7. https://en.wikipedia.org/wiki/Modified_Harvard_architecture

8. https://en.wikipedia.org/wiki/Von_Neumann_architecture

9. P. Jungwirth, et al.: "Cyber defense through hardware security", Proc. SPIE 10652, Disruptive Technologies in Information Sciences, 106520P (9 May 2018); doi: 10.1117/12.2302805; https://doi.org/10.1117/12.2302805

10. http://www.defenseinnovationmarketplace.mil/resources/JMR_AMRDEC01.pdf

KEYWORDS: RISC-V, digital signal processing, Harvard machine, Hardware/Software Co-design

A20-004 TITLE: Using Artificial Intelligence to Optimize Logistics and Sustainment Trade-offs

TECHNOLOGY AREA(S): Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop methods to use artificial intelligence (AI), machine learning, and real-time computational intelligence to optimize Army logistics and sustainment simulations and predictions for both legacy and future Army aviation systems. Identify aviation platform life cycle metrics, such as Materiel Availability (Am), Operational Availability (Ao), sparing, cost, maintenance man-hours, and other KSA's, to be optimized by AI. Provide to a logistics engineer knobs to turn to see effects on metrics such as system reliability, system availability, system downtime, administrative delay time, maintenance man-hours, manpower, and OPTEMPO.

DESCRIPTION: The CCDC AvMC Logistics Engineering Lab (LogLab) developed a sustainment simulation capability for Army aviation using a government-owned software tool called System of Systems Analysis Tool (SoSAT). Multiple PM's use this capability to conduct analysis and provide input for major acquisition documents. The LogLab is looking to upgrade the simulation capabilities of the software tool using artificial intelligence and machine learning to optimize logistics outcomes for CCDC AvMC customers like Future Vertical Lift (FVL). Artificial intelligence would determine strategies of sparing, costs, supply chain locations, maintenance staffing, maintenance levels, scheduled maintenance times, to best measure and optimize sustainment options and logistics support for Army aviation and weapon systems. SoSAT is a government-owned software package and will be provided. Notional and/or representative Army aviation reliability and supply data will be used. The size of the dataset will also be representative of actual datasets used and expected to be used by future Army aircraft -- a typical 30-year Army aviation model is approximately 25GB, and multiple models could be combined, yielding datasets in the range of 100-200GB. Any AI solution will need to run on US government network computers and will be export controlled.

PHASE I: Perform a design study to determine how to use artificial intelligence, machine learning, and real-time computational intelligence to optimize sustainment and logistics support. Deliver a final design of AI's capabilities, a simulation model of Army aviation assets, and a demonstration of an AI-infused logistics model capable of making intelligent trade-off decisions to meet specified PM threshold and objective sustainment metrics -- specifically, downtime and readiness levels as calculated by Army aviation, using inputs such as failure rates, ALDT, repair times, and maintenance man hours. A successful design will be able to optimize support, minimizing aviation system downtime and maximizing aviation system availability, using logistics inputs (component failure rates, repair part shipping times, repair times, maintenance man hours and maintainer staffing). Designed AI must be capable of handling, learning from, living in, and analyzing datasets upwards of 200GB in size. Designed AI must also show a 75% reduction in results data processing time over current methods, a 10% reduction in data input, import, and formatting time over current methods, and a 30% reduction in output dataset size. Test method to determine success for above metrics will be accomplished through analysis.

PHASE II: Deliver and implement a working prototype of an AI-infused logistics model (as designed in Phase I) capable of deep learning and making intelligent trade-off decisions to meet specified PM threshold and objective sustainment metrics. The model will also provide the capability to measure the impacts of technology insertions, obsolescence, reset, and other significant events in the entire Army aviation platform's life cycle, and to optimize such downtime and upgrade scheduling over that typical life cycle (30-50 years). Prototype AI must be capable of handling datasets upwards of 200GB in size. Prototype AI must be able to learn from baseline sustainment datasets, learn from excursion datasets on the fly, and apply learned behaviors. Prototype AI must show a 100% reduction in results data processing time over current methods, a 20% decrease in data input, import, and formatting time over current methods, and a 50% reduction in output dataset size. Test method to determine success for above metrics will be accomplished through demonstration. Mission profiles and operations in the model will be based on notional Army aviation and weapon concept of operations (CONOPS).

PHASE III DUAL USE APPLICATIONS: Deliver a polished and complete working AI-infused logistics sustainment model making intelligent trade-off decisions to meet specified PM threshold and objective sustainment metrics to all Army PM's and for all Army aviation platforms. The final product should model and optimize logistics and sustainment at multiple levels of fidelity from battalions to component parts, from individual missions to entire 50-year life cycles, use advanced web and cloud services to compute and be hardware-independent, may include an asynchronous mobile application to view and sort results, handle upwards of 1TB of data, and be hosted or otherwise available to all CAC-enabled personnel. Test method to determine success for above metrics will be accomplished through operations.

REFERENCES:
1. Rosienkiewicz, Maria. (2013). “Artificial Intelligence Methods in Spare Parts Demand Forecasting. Logistics and Transport.” 2013.

2. Real Carbonneau, Kevin Laframboise, Rustam Vahidov. “Application of Machine Learning Techniques for Supply Chain Demand Forecasting.” European Journal of Operational Research, Vol. 184, Issue 3, 1 Feb 2008, pp. 1140-1154.

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KEYWORDS: artificial intelligence, logistics, simulation, modeling and simulation, sustainment, availability, reliability, maintainability, supportability, software development, machine learning, neural networks, real-time computational intelligence, data science, software architecture, deep learning, support vector machines, Levenburg-

Marquardt, particle swarm optimization

A20-006 TITLE: Articulated Landing Gear for Class IV UAS

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: Develop an actively controlled, legged, articulated landing gear which significantly improves rugged landing capabilities of large UAS air vehicle. The articulated landing gear will also support landing under degraded visual environments (DVEs), shipboard landing, and extreme terrain operations.

DESCRIPTION: Landing safely on uneven ground in unprepared areas and landing safely on a pitching and rolling ship represent two of the greatest challenges faced by rotorcraft conducting military operations today. It is often impossible for UAS operators to know the slope dynamics of the micro-terrain below them when landing in these environments at night, or in DVE. Compounding this problem is on-site, non-aviation ground personnel that may be unaware of landing limitations; or remote operators with limited awareness of landing site topography. Conducting these types of landings is a difficult task even for UAS operators and can lead to air vehicle accidents during military operations. The use of an actively aircraft controlled articulated robotic landing system can mitigate a large portion of the aforementioned risks. These actively controlled legs allow the air vehicle to conform to uneven and sloped terrains and significantly reduce the cognitive loads placed on the autopilot system. Progress has been made towards the development of such systems, with theoretical and computational models being developed to simulate the rigid body dynamics and controls involved in the design of an articulated landing gear [1-3]. The concept of articulated robotic landing gear has also been successfully demonstrated and flight tested on a small scale (~200 lbs.) unmanned helicopter [4].

An additional benefit of actively controlled landing system is its ability to enhance hard landing survivability. The system can act as a shock absorber with a relatively large stroke, and through active and passive control, can spread impact loads over longer duration times hence reducing active and passive control, can spread impact loads over longer duration times hence reducing loads seen by the landing gear and the airframe. Studies conducted using rigid body simulation tools have shown that such a system can reduce peak loads by 70 to 90% for particular landing conditions when compared with conventional landing gear [1].

This program will investigate the capability of actively controlled robotic landing gear as a benefit of replacing traditional landing gears with such a system. The focus of the project is on evaluating the capabilities of such a system through design, fabrication, and testing. The end result should be a validated design and simulation package for the deployment of these system to various UAS platforms. Towards the goal of commercialization, the system should be sized for a four-legged Class IV UAS in the 3,000-5,000 lbs. gross weight range and subsequently analyzed using a comprehensive simulation tool set. The program should explore optimization of the design for landing in extreme conditions while maintaining the capabilities of the system as an articulated landing gear and minimizing weight. The program should also define criteria for material selection when sizing the system for various aircraft. The use of advanced materials such as carbon fiber reinforced polymer (CFRP) composites should also be explored.

PHASE I: The awardee will study a robotic landing system sized for a helicopter or vertically landing Class IV UAS in the 3,000-5,000 lbs. gross weight range and investigate its capabilities to land in extreme environments. Detailed trade studies should be performed including studies on drive system power draws, system weight and volume in various modes, and drag. The study should include stress analysis to prove crashworthiness while optimizing the design for weight minimization. Determine potential automation software, structural, and other failure modes, effects, and mitigations. Also should determine increase in suitable landing zones available for design concepts for various slopes (e.g. % earth with < 7 deg slopes vs. % earth with < 25 deg slope and variations in landing surface quality) and resultant operational impacts that may mitigate weight penalties. An experimental test plan for characterizing and validating the modeling tools used in the design process should also be proposed as part of this effort. The study should address weight savings/penalties over comparable conventional landing gear. Lastly, assess suitability for limited ground mobility.

PHASE II: The awardee will fabricate a working prototype and experimentally validate its capabilities. Awardee is expected to perform mechanical characterization experiments to calibrate all modeling requirements, predict the systems capabilities, and experimentally validate model predictions. Using the experimentally validated simulation tools, scaling factors and contributing issues will be clearly articulated in the final report with an assessment for scaling up to the 7,000 lbs. and 21,000 lbs. range.

PHASE III DUAL USE APPLICATIONS: Integrate prototype into flight test demonstrators as a modular solution which may be added to existing platforms to increase mission capabilities. The system may also be repackaged for commercial UAS operators. Successful demonstration at this scale may provide future opportunities at larger scales as well as for manned rotorcraft/VTOL systems. Commercial opportunities may exist for surveying in areas of rough terrain, autonomous package delivery, and paramilitary and police “perch and stare” surveillance

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KEYWORDS: Robotic, Landing Gear, Crashworthiness, Impact Mitigation, Unmanned Aerial Systems

A20-007 TITLE: Compact Thermal Solutions through Advanced Manufacturing Techniques

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Additive Manufacturing is a quickly growing field of technology that has been adopted across the military and even deployed on the ISS by NASA. The technology allows for the creation of complex components that cannot be achieved using traditional subtractive methods such as machining. The CCDC Aviation and Missile Center is interested in using Additive Manufacturing to create thermal management solutions to handle device heat fluxes of more than 1,500 watts per square centimeter, supporting high performance missile and radar electronic transceivers at a system-on-a-chip level enabling significant miniaturization beyond current state-of-the-art.

Oscillating heat pipes rapidly remove localized heat by incorporating phase change material in capillary channels that oscillate between material states enabling large heat flux. Copper heat sinks structurally landscaped around printed circuit board components provide a path for the heat to be transferred. By utilizing advanced manufacturing techniques such as additive metal printing, complex geometries can be achieved that cannot be created through traditional subtractive manufacturing (machining). This topic is focused on 3” to 5” diameter thermal management solutions to support hypersonic missile, densely packaged Radio Frequency (RF) and electronic integration. Barriers to this development include, but are not limited to, the capability to print (additively manufacture) metal heat pipes with integrated wicking, bi-metal print capability, modeling and measuring heat generation and measuring effectiveness of the resulting thermal system prototype.

DESCRIPTION: It is the intent of this topic for the offeror to demonstrate the capability to create landscaped thermal management copper structures employing oscillating heat pipe technology. Proposals must employ metal additive manufacturing to generate the prototypes.

PHASE I: In Phase 1, the offeror shall research, develop and fabricate prototypes of wicking oscillating heat pipes that can handle device heat fluxes of more than 1,500 watts per square centimeter. A phase change material must be designed in the heat pipe. The heat pipe should be approximately 5-7 inches in length (knowing that effective thermal conductivity varies with heat pipe length), with a diameter less than 1/4”. The thermal structure should sustain heat transfer in variable gravity orientations. The final prototype of Phase 1 shall be printed using copper or similar thermally conductive material. The design shall be fully modeled and heat removal effectiveness simulated. Prototypes are required during Phase I and must be supplied to CCDC Aviation and Missile Center.

PHASE II: In Phase II, the offeror shall use methods developed in Phase 1 to research, develop, fabricate, and evaluate integrated thermal heatsinks ranging from 3” to 5” in diameter and less than 1/2” thickness (including all landscaped structures) using oscillating heat pipes within board-landscaped, additive copper or similar thermally conductive structures enabling cooling of system-on-a-chip processor technology with high throughput to handle device heat fluxes of more than 1,500 watts per square centimeter. This technology is aimed at supporting thermal management for direct sampling that would eliminate much of an analog receive chain for significant miniaturization. The desired products of Phase II include: 1) a developmental board design, 2) thermal analysis and design of an integrated solution using additive structures, pockets of phase change material and oscillating heat pipes structured in a heatsink that would surround components of a Radio Frequency (RF) System-on-a-Chip (SoC) printed wiring board design, 3) prototypes of the landscaped thermal mitigation solution, 4) model/simulation results compared with measured effectiveness of the thermal system prototype. Heat generation levels should include that created through RF power amplification, general processing, and digital transceiver system components that would be highly integrated onto the heat sink-based thermal management solution resulting in a significant miniaturization of these type systems. Prototypes are required during Phase II and must be supplied to CCDC Aviation and Missile Center.

In addition, the offeror shall expand the research and development to rugged prototypes of printed thermal management structures that can withstand environmental concerns including humidity, dust, shock, and vibration such as that of a missile launch and relevant lifetime. All results are to be fully documented, and before and after prototypes of evaluations are to be supplied to CCDC Aviation and Missile Center.

PHASE III DUAL USE APPLICATIONS: For Phase 3 of this effort, the offeror shall expand upon the thermal management solutions of Phase II to develop a fully integrated RF System-on-a-Chip processing structure at high throughput. The purpose of this demonstration is to show the level of efficiency using actual RF transceiver system components at a frequency of interest in the millimeter wave band. The prototype will consist of RF power amplification, and components to conduct direct sampling at the RF frequency to eliminate much of the analog receive chain to achieve miniaturization. The prototype shall be highly integrated onto the thermal management heat sink-based solution. Prototypes are required during Phase III and must be supplied to CCDC Aviation and Missile Center.

Phase 3 dual use applications: Particular military applications include generic radar sensor system applications for use on missile technologies that can be applied to hypersonic missile fight environments. Commercial applications include all high throughput processing system applications. Transitions of opportunity include both immediate and local capability generation of additively manufactured designs of thermal management solutions for highly integrated processing and RF system-on-a-chip sensors. The most likely path to transition for the thermal management technology is a commercial development or for a CCDC missile program such as Long Range Maneuverable Fires to adapt the technology during their development and test cycle. These programs run through

2029.

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KEYWORDS: Heat Pipes, Thermal Management, Advanced Manufacturing, Metal Printing

A20-008 TITLE: Additively Manufactured Functionally Graded Radomes for Hypersonic Vehicles

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop an advanced additive manufacturing technology for constructing functionally graded radomes for use in missiles and other hypersonic vehicles.

DESCRIPTION: Radome is a cover or enclosure that protects radar antennas from environmental influences, and made from an electromagnetically transparent material. The radome can have a huge influence on sensitivity, radiated antenna pattern and immunity to vibrations. Minimization of microwave reflection at the surface of the cover should be a key aspect in designing a radome, and therefore, materials with low dielectric constant (< 5) and low loss tangent (< 5~10%) are needed without compromising thermal and mechanical characteristics required for the target environment. For hypersonic vehicles at Mach 5~10 (1~2 miles/sec), the temperature of the aircraft can reach anywhere from 1500C to 2000C. Thus, the radome materials must also satisfy certain unique thermal and mechanical requirements relevant to the harsh operating environment. Among them, high melting temperature >3200F (or >1760C), high flexural strength >50-100 MPa and high Young’s modulus > 50-100 GPa are critical parameters. In addition, high thermal conductivity, low water absorption, low density, high particle, rain and thermal impact resistance, and high mechanical strength, hardness, and flexibility are also important characteristics depending on the application.

Different radome wall structures have been used, including half-wave wall, thin wall, A-sandwich, B-sandwich, C-sandwich, multilayer, and graded radome wall structures. Half-wave wall or thin wall radomes are individual layer radome materials suitable for narrow band applications. Layered and graded radome wall structures are used for broadband radome applications. Conventional sandwich or layered radome wall structures are typically fabricated by epoxy bonding which has a limited range of operation temperature and, therefore, they suffer from delamination at high operation temperatures due to mismatched thermal expansion coefficients. Functionally graded radome wall structures enable the combined properties for hypersonic radomes, and are under intensive research. Additive manufacturing processes are based on layer-by-layer manufacturing, which constitute an excellent fit for fabricating the functionally graded radomes for hypersonic vehicles. At the same time, the additive manufacturing has numerous advantages such as rapid prototyping with a fast turn-around time, low-cost entry, low waste generation and high energy efficiency. Additive manufacturing also allows fabless designing 3-D complex structures like composition and functionally graded radomes by using commercially available software and fabricating the structures at remote shared facilities for additive manufacturing, and hence lowering the costs.

Besides the selection of materials and fabrication processes, the electromagnetic design of functionally graded radomes is also highly critical for the optimum radome performance for hypersonic vehicles. Radome materials and structure must be carefully designed for minimum transmission loss in the desired frequency bandwidth and minimum boresight error, in addition to the other electromagnetic, thermal, mechanical, and environmental requirements. These interrelated challenges must be addressed with a combination of materials selection, functional graded radome wall structure, electromagnetic design, and innovative manufacturing technologies.

PHASE I: Identify candidate radome materials and facilities capable of high temperature electrical, thermal, and mechanical testing of the radome materials for temperatures ranging from 500C to 1500C. Develop high temperature material characterization capabilities at small sample sizes and perform high temperature (from 500C to 1500C) material characterizations: thermal testing (thermal expansion coefficient, thermal conductivity, melting temperature, and thermal capacity), electrical testing (dielectric constant and loss tangent for different frequency bands from 50 MHz ~ 50 GHz, and resistivity), and mechanical testing (flexural strength, Young's modulus, and Poisson's ratio). Develop an electromagnetic design of functionally graded radome materials (FGRMs) with melting temperature >1760C, a low dielectric constant (< 5), low loss tangent (< 5~10%), high flexural strength (> 50-100 MPa), and high Young's modulus > 50-100 GPa for hypersonic vehicles operating at temperatures >1500C. Identify a feasible and scalable additive manufacturing process for the identified radome materials. Provide experimental data along with projected performance in the target environment.

PHASE II: Develop a scalable additive manufacturing process for the FRGMs and demonstrate the production of a scale-down version of a 3-D radome with functionally graded wall structures. Perform electrical, thermal, mechanical, and reliability testing of the radome across the temperature range from 500C to 1500C (required) / >1760C (desired). Optimize functionally graded radome material design and process and conduct detailed testing of the radome materials and fabricated 3-D structures for reaching the desired electrical, thermal, and mechanical requirements stated above for hypersonic vehicles. Demonstrate a scalable manufacturing technology during production of the radome materials. Validate process repeatability and demonstrate the ability of the FGRMs to withstand the simulated aerothermodynamics heating/loading in hypersonic flight environments and to ensure reliability and structural integrity of the proposed materials. Deliver a prototype of the scale-down version of the optimized 3-D radome to US Army for evaluations. Provide complete engineering and test documentation for the development of manufacturing prototypes.

PHASE III DUAL USE APPLICATIONS: Expand on Phase II results by optimizing the functionally graded radome as necessary for integration into a hypersonic defense system/advanced target vehicle. Develop and execute a plan to manufacture the functionally graded hypersonic radome developed in Phase II, and assist the transitioning this technology to the appropriate missile defense prime contractor(s) for the engineering integration and testing.

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KEYWORDS: Radome, hypersonic vehicle, functional graded, hypersonic aerothermodynamics environment

A20-009 TITLE: Transient Combustion Effects on Observable Signatures of Maneuvering Hypersonic Configurations

TECHNOLOGY AREA(S): Battlespace

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Development of modeling tools that properly account for transient combustion effects on the observable signatures of maneuvering hypersonic configurations during extreme maneuvers.

DESCRIPTION: The Army has in interest in the observable signatures of hypersonic configurations during extreme maneuvers. Such configurations may employ liquid or solid propellant devices to provide thrust during said maneuvers. However, the associated accelerations are severe and can alter thruster chamber pressure and thrust level significantly. Such variations also occur near the end of liquid or solid propellant burns. As a result, the thrust characteristics, aerodynamic maneuverability, and observable signatures vary significantly from expected steady state conditions. Such changes in behavior must be taken into account when designing survival tactics for offensive assets or when designing and testing detection, track, and guidance algorithms for defending assets. Consequently, the Army seeks modeling tools that can predict the transient combustion effects on the observable signatures of liquid and solid rocket motor thrusters employed by hypersonic configurations during extreme maneuvers.

PHASE I: Develop a physics-based modeling technique that fully accounts for the three-dimensional flowfield and chemical kinetics combustion processes that occur within liquid and solid propellant motors during extreme maneuvers and produce observable effects, to include soot and smoke trails, on the resulting exhaust plume signatures. It is expected that the technique will also incorporate the ability to address in-flight ignition transients and thrust tail-off.

PHASE II: Integrate the model from the Phase I effort into the current DoD plume flowfield modeling tools. Demonstrate the capability for several transient configurations of interest to the Army. Assess the integrated modeling suite against available plume signature data (visible/IR). Deliver the modeling software in source code and executable format along with all files needed to compile and successfully execute to serve as a prototype for evaluation and cybersecurity assessment by the Government. Deliver technical and software user documentation, model demonstrations and assessment cases with results for Army use. Maximum practical use of existing plume flowfield modeling software is desired to reduce development and validation costs.

PHASE III DUAL USE APPLICATIONS: Demonstrate applicability of the newly developed capability for multiple configurations of interest to the Army. Commercialization: The capability to accurately account for transient combustion effects on the observable signatures of maneuvering hypersonic configurations will enable the DoD, including MDA, to significantly improve their respective abilities to predict what US configurations will look like to its adversaries and what threats to US assets will look like to sensors on-board defending assets.

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KEYWORDS: Transient, combustion, liquid rocket engines, solid rockets, observable signatures, hypersonic, maneuver

A20-010 TITLE: Optimization of Ceramic Matrix Composite (CMC) Interfaces

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Demonstrate a computational tool for material and process development of ceramic matrix composite (CMC) that can assist in minimizing production time and optimize density, compression and tensile strength, toughness and thermal stability of the resulting CMC composites for missile structures. The computational tool will be informed by an enhanced understanding of the effect of time, temperature and processing conditions on the fiber/matrix interphase region which is in direct relation to the mechanical properties of the composite.

DESCRIPTION: Army missile systems strive to improve performance while maintaining affordability. Lightweight, high-temperature composite materials are required to continue system performance improvements. A key parameter contributing to the performance of CMC structures is the interaction between the fiber and matrix during production and operation. Gaining an enhanced understanding of the fiber/matrix interphase region will support development of computational tool for material and process development of CMC structures.

PHASE I: Develop a proof of concept for a computational tool, based on a comprehensive understanding of the CMC's fiber/matrix interphase variables of effect as they relate to time, temperature and processing conditions. Baseline the cost for a material and process system (for an applicable missile structure). Optimize the cost of materials and processes in pursuit of a 40% reduction in costs as compared to baseline. Performance will be measured by the material characteristics of the resultant mechanical properties generated by the tool to include tensile and compressive strength, as well as density and void content.

PHASE II: Demonstrate the ability to fabricate an applicable CMC missile structure at a processing cost of 40% less than baseline. The solution should be tailored to optimize the composite tensile and compressive strength, toughness and thermal stability for temperatures ranging from 500°C to 1500°C. The tailored properties should be demonstrated by testing and documented to include fiber/matrix interphase properties, compressive strength, tensile strength, void content, and density. Deliver comprehensive engineering and test documentation of the applicable structure.

PHASE III DUAL USE APPLICATIONS: Demonstrate a commercially-viable CMC solution in a representative missile structure with tailored mechanical and physical properties generated by the optimization tool. The tailored properties should be demonstrated by testing. The fiber/matrix properties should be evaluated and documented. Additionally, support transitioning the technology to suitable prime contractors for further engineering development, integration, and testing.

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KEYWORDS: Ceramic, Fiber/matrix interaction, Interface region, Surface Science, Carbon

A20-011 TITLE: Anomalous Dispersion Enhanced Inertial Sensors

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions.

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OBJECTIVE: Develop a prototype optical inertial navigation sensor that exploits anomalous dispersion to enhance the overall signal to noise performance of the inertial sensor.

DESCRIPTION: Much work has been performed in recent years on exploring the potential of utilizing anomalous dispersion to enhance the sensitivity of optically-sensed inertial navigation sensors such as Ring Laser Gyroscopes (RLGs), Passive Cavity Gyroscopes, and optically sensed accelerometers. Theoretical calculations and laboratory experiments have confirmed that sensitivities can be enhanced through the use of anomalous dispersion. While theoretical calculations have shown that it should be possible to anomalous dispersion to result in a net increase in sensor performance, in laboratory experiments to date, the attenuation in the optical signal (introduced by the absorptive media that also introduces the anomalous dispersion) has been larger than the increase in the sensitivity enhancement, resulting in a net decrease in overall inertial sensor performance. This solicitation seeks innovative approaches to this challenge to develop an optical inertial sensor design and readout architecture wherein the employment of anomalous dispersion results in laboratory and prototype demonstrations of an inertial sensor that has a net increase in the overall signal to noise. Incorporation of anomalous dispersion enhancement to optical inertial sensors has the potential to significantly increase the performance of inertial navigation systems at relatively low cost, resulting in a decreased dependence on the Global Positioning System (GPS).

PHASE I: In Phase I the offeror shall research and develop a theoretical model of an optically sensed inertial sensor (gyroscope or accelerometer, active or passive) whose net signal to noise ratio should increase when anomalous dispersion enhancement is introduced into the optical system. The offeror shall develop a laboratory experiment that demonstrates consistency with the theoretical predictions of the developed model including a demonstration of an increase in the overall signal to noise ratio when anomalous dispersion enhancement is introduced into the optical system.

PHASE II: In Phase II the offeror shall research and develop a theoretical model of an integrated prototype of the optically sensed inertial sensor (gyroscope or accelerometer, active or passive) demonstrated in Phase I. The offeror shall fabricate the prototype sensor and demonstrate that the prototype sensor demonstrates consistency with the theoretical predictions of the developed model including a demonstration of an increase in the overall signal to noise ratio when anomalous dispersion enhancement is introduced into the optical system. Potential military and commercial applications will be identified and targeted for Phase III exploitation and commercialization.

PHASE III DUAL USE APPLICATIONS: The use of inertial navigation sensors is pervasive in commercial applications including automobiles, gaming consoles, and mobile phones. Successful demonstration of anomalous dispersion enhancement could lead to significant improvements in the performance of these sensors which could lead to a significantly expanded application space in both the commercial and military industries

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KEYWORDS: Inertial sensor, gyroscope, accelerometer, anomalous dispersion, dispersion enhancement, positioning, navigation, PNT, GPS-denied navigation.

A20-012 TITLE: Metal Matrix Feedstock for Additive Manufacturing

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: Develop a metal matrix composite (MMC) feedstock that can be used in additive manufacturing to produce metal matrix composite parts. The desired feedstock would be analogous to the slit tape used in the polymer composites industry for tape placement. This MMC tape can then be used in ultrasonic additive manufacturing (UAM), or similar process, to create MMC components. The feedstock should have greater than

50% fiber volume and have no fibers present on the surface of the tape.

DESCRIPTION: The Army has a need for strong lightweight structures across multiple Cross Functional Teams (CFTs). Not only in primary structures such as gun tubes, muzzle brakes, and air frames but also in other components such as projectile bodies. Polymer composites are often called on for these applications but they lack high temperature capability and are often weak in the matrix dominated direction. Metal Matrix Composites (MMC) offer the possibility to obtain steel like strength and stiffness in the fiber direction with the density of aluminum. At the same time, the MMC retains aluminum level strength and stiffness in the matrix dominated direction.

The problem with MMC's has always been fabricating them. Generally this has been done by either consolidating powder or infiltrating molten aluminum into a ceramic fiber architecture. Both of these tend to be expensive processes and severely limit the size of the part that can be fabricated. What is needed is a feedstock / process that is analogous to the fiber / tape placement process used in polymer composites. In that process a fully consolidated tape of either thermoset or thermoplastic material is used to build a composite structure one layer at a time via sheet lamination. For thermosets the part is cured after this process. For thermoplastics the part is fully consolidated during the process.

There have been attempts to use Ultrasonic Additive Manufacturing to create MMC components out of sheets of MMC material. These efforts have met with mixed results. To date the MMC feedstock has fibers on its surface which are broken during the UAM process and damage the sonotrode. The work around for this was to use a thin sheet of pure aluminum between the MMC feedstock and the sonotrode but that severely lowered the possible fiber volume fractions.

This topic seeks to develop an MMC feedstock that can be used via UAM (or similar solid state joining process) to fabricate MMC parts of arbitrary size while maintaining a fiber volume fraction greater than 50%. The feedstock and manufacturing process should retain the Additive Manufacturing capabilities of UAM in that interior voids and features are capable of being produced.

PHASE I: Develop a process to fabricate metal matrix composite (MMC) feedstock with a fiber volume greater than 50%. The feedstock should be in tape form with a thickness on the order of 0.005" to 0.015" thick and a width on the order of 0.25" to 0.5". The preferred composite composition is an aluminum matrix with continuous aluminum oxide fibers (Nextel 610 or equivalent). The fibers should be uniformly dispersed throughout the tape but the surfaces should be pure matrix material. ASTM tests should conducted to demonstrate good adhesion between the fibers and matrix, and to determine the mechanical properties of the feedstock. These properties should be compared to theoretical predictions for the same fiber loading. Several layers of the MMC feedstock shall be consolidated via an additive manufacturing process and assessed for layer adhesion, fiber volume, fiber distribution and mechanical properties. The deliverable shall be 5 lbs of the MMC feedstock.

PHASE II: Refine the feedstock and produce it using a process representative of plant-scale production manufacturing. Increase the fiber volume with a threshold of 55% and a goal of 65%. No fibers should be visible on the tape surface. Sample MMC parts will be made and tested for mechanical properties. Minimum set of properties that shall be tested for are: longitudinal strength and modulus, transverse strength and modulus, Poisson's ratio, shear strength and modulus, compressive strength and modulus, and fiber volume. Minimum levels for longitudinal stiffness and strength are 30 Msi (207 GPa) and 210ksi (1450 MPa) respectively. All tests will be conducted according to relevant ASTM standards. Tests should be done to adhere the MMC feedstock to a steel substrate via additive manufacturing methods. The material deliverable will be a mutually agreed upon MMC part with a volume exceeding one cubic foot and with internal features. Additionally 25 lbs of feedstock shall provided.

PHASE III DUAL USE APPLICATIONS: In collaboration with the prime contractor and Benet Labs, apply a wrap to a complete gun tube for live fire testing in an operational environment. Explore automotive, down-well piping, and manufacturing technology applications for
the material. Adapt the low-cost manufacturing process to material applications with less stringent temperature requirements.

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KEYWORDS: Advanced composites, additive manufacturing, high temperature composites, metal matrix composites

A20-013 TITLE: Low Thermal Touch Display

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Design, develop and demonstrate a digital touch display that is capable of operating at very low temperatures and has minimal input power requirements.

DESCRIPTION: Small ruggedized electronic devices have been and are being developed for use by the warfighter and will play a critical role in most of the CFT capabilities to be fielded. Further these displays will be required to allow artificial, machine learning and the Internet of the Battlefield to enhance the warfighter and become a reality. These devices need to have the capability to operate in a wide range of environments and temperatures. Temperature range shall be described for this SBIR as 60°C to -40°C for operating and 71°C to -40°C for storage. Along with operating in server environments the warfighter is always looking to reduce the weight of his equipment and the length of time that the equipment can operate before batteries need to be replaced. Because of this the equipment being developed is looking for components that have minimal power needs and do not use heaters to achieve low temperature requirements. Minimal power consumption shall be described for this SBIR as a maximum of 10mW. This SBIR focuses on common displays that are used on these devices. A common display is described with (but not limited to) the following features: night readable, allow touch screen interface, 4K resolution, minimum 5 inch diagonal screen, capable of displaying common charter set at 18-Font, monochrome, readable from distance of 2 feet. The technology being developed should look to be scalable to match current displays on the market.

PHASE I: Investigate innovative approaches to develop displays to meet the topic requirements. Develop and document the overall component design and accompanying software interfaces.

PHASE II: Develop and demonstrate a prototype that can operate while meeting the above requirements.

PHASE III DUAL USE APPLICATIONS: Develop and demonstrate the technology developed in Phase II that is capable of being inserted into an existing ARDEC supplied system. Conduct testing to demonstrate feasibility of the component for operation within a simulation environment, and with actual fielded hardware.

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4. M777/M119 Howitzer

KEYWORDS: Display, Low, Temperature, Power, Electronic, Device, LCD, OLED, LED, Vacuum, Florescent, E-paper

A20-014 TITLE: Counter Swarming

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Design and prototype counter swarm algorithms. This is a three part objective – (1) the prototype should be able to pick up on adversary swarm behavior based on sensor data; (2) The prototype should have algorithms that are able to translate the data associated from the adversary's swarm behavior into logical input into its own swarm; (3) create a swarm of autonomous agents that constantly ingest data from (2) and dynamically decide its action and try to counter the adversary swarm.

DESCRIPTION: Swarm technology—the ability of autonomous agents to autonomously make decisions based on shared information—has the potential to revolutionize the dynamics of conflict. And we're inching ever closer to seeing this potential unleashed. In fact, swarms will have significant applications to almost every area of national and homeland security.
There is a gap for detection, tracking and effective defeat of incoming threat swarm with the use of friendly swarm. The focus of the prototype should be the development of the algorithms that can decipher the swarm behavior of the adversary swarm, develop its own expert and effective Counter swarm algorithm and then implement its own swarm that targets the adversary swarm.

PHASE I: Investigate innovative methodologies and design concepts that can achieve the criteria for the system listed above. Develop design documents for the potential implementation of the system. Demonstrate a proof of principle of the design using simulated environment for a simple swarm pattern.

PHASE II: Further design, develop and demonstrate a prototype capability that meets the following three sub-objectives – (1) decipher simple and complex incoming swarm behavior based on simulated track data; (2) develop counter swarm algorithm in the same simulated environment that demonstrates the friendly swarm to effectively defeat the incoming threat swarm; (3) implementation of a small swarm that can ingest the counter swarm algorithms as input. Government will provide the threat swarm scenarios for (1).

PHASE III DUAL USE APPLICATIONS: Demonstration of full up swarm on swarm (n to n) field exercise – simple and complex. Government will provide the threat swarm scenarios.

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KEYWORDS: CUAS, counter, unmanned, aerial, systems, swarm, network, drone, detection, tracking

A20-015 TITLE: Laser Enhanced Aerodynamic Drag Reduction (LEADR)

TECHNOLOGY AREA(S): Weapons

OBJECTIVE: To investigate, test and prototype the ability to reduce drag on a munition body by using laser energy/ discharge in order to decrease gun launched munition time of flight.

DESCRIPTION: This effort looks to research, prototype and demonstrate the ability to use off-body laser discharge to effectively reduce the drag and significantly decrease the time of flight of gun fired munitions. This effort has applicability to at least four (4) Army Modernization Priorities which have expressed the need for gun fired munitions to have more range. Initial efforts will be conducted within medium caliber munitions form factors (20mm to 50mm in diameter) but ultimately having applicability across munitions calibers and types. System effectiveness analysis will also be conducted in order to quantify operational utility and increases to system lethality.

PHASE I: Analysis and concept feasibility report analyzing the technology within medium caliber muniton (20mm to 50mm) form factors. Required power levels, possible drag reductions and preliminary mechanical and electrical integration feasibilities are to be determined. Analysis should be supported by relevant data.

PHASE II: Wind tunnel models for phase one chosen form factors, with functioning power generation and ability to create off-body laser discharge and resulting drag reduction within gun launched munition relevant Mach numbers.

PHASE III DUAL USE APPLICATIONS: TRL6/7 Technology demonstration of a gun launched munition, with onboard power generation, and LEADR system integrated into chosen munition form factors demonstrating the reduction of drag and increases in flight performance. Investigate the utilization of commercial components and manufacturing processes to ensure low cost munitions.

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KEYWORDS: Drag reduction, munition guidance, munition, munition lethality, gun launched

A20-016 TITLE: Integrated Radar and Electronic Surveillance (ES) system

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Design and prototype a combined radar and ES system to detect, track, and identify UAS’s to be integrated with a weapon system. The system should be able to detect and track a UAS system using a radar and then transition to an ES mode at a much higher bandwidth to determine the UAS link characteristics to be able to correctly identify the threat. The system should be able to interleave both ES and Radar dwells as well as have a large enough bandwidth to accommodate all UAS bands.

DESCRIPTION: The combined Radar and ES system will help determine intent of UAS for site protection. Both ES and Radar systems can provide unique attributes of a UAS system to the operator. Radars are able to detect and track multiple UAS systems in order to provide a precise 3D location of the UAS system. ES systems can determine UAS transmitter characteristics in order to correctly identify the UAS system and also detect intercommunication between two UASs. Hence, the combined ES and Radar system will provide the operator with the necessary situational awareness of the UAS’s that are around the protected site. In addition, having one integrated system vs multiple systems integrated together will shrink the kill chain time line.

PHASE I: Investigate innovative methodologies and design concepts that can achieve the criteria for the system listed above. Develop design documents for the potential implementation of the system. Demonstrate a proof of principle of the design using simulated environment for a simple UAS system.

PHASE II: Further design, develop and demonstrate a prototype capability that meets the following objectives – (1) Develop hardware and software that is able to operate as both a radar and ES system. (2) Detect and track a UAS system and interleave both radar and ES dwells to gather information on the UAS system and intercommunication between two.

PHASE III DUAL USE APPLICATIONS: Demonstration of full up radar and ES system that can track and identify multiple UAS systems. Also develop signal processing algorithms to extract additional information from the UAS system.

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KEYWORDS: UAS, Radar, ES, bandwidth, systems, detection, tracking

A20-017 TITLE: Harvesting Thermal Energy for Novel Power Sources in Long Range Precision Fired Artillery

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Investigate and develop innovative solutions for harvesting and converting heat generated during aerodynamic flight into electrical energy and power for precision guided munitions. The technology should be capable of surviving typical artillery gun launch loads and should conform to fit within an artillery projectile.

DESCRIPTION: The Army's Long Range Precision Fires mission expands the current portfolio of conventional artillery to advanced munition technologies with extended range capability (>70km). Extended range requires the projectile to fly to higher velocities and altitudes as well as longer flight times. At high Mach speeds the projectiles may be exposed to high temperatures and heat fluxes up to 3500°C and 1000 W/cm2 respectively. Additionally, due to extended flight times, the electronics required for precision guidance require more power in order to maintain operation throughout the flight. The presence of high heat fluxes results in waste heat into the projectile which could potentially damage critical electronics. This coupled with the need for new power sources to sustain operational capability of onboard electronics systems creates a new opportunity for the investigation of novel energy harvesting technologies that can remove the excess heat from the airframe via conversion to electrical energy. The new source of electrical energy can thus be used to power fuzes, guidance, navigation, and control technologies, actuation systems, and staging technologies.

The Army is currently looking for novel thermoelectric materials and thermoelectric generators (TEG) that extend the current state of the art in thermal limits (>1500F) and thermoelectric effectiveness (ZT>2). Materials of interest include, but are not limited to, low dimensional materials, nanocrystalline and nanocomposite materials, organics (conducting polymers), inorganics (tellurides, oxides, Half Heusler alloys, skutterudites, silicides, etc.,), and organic-inorganic composites.

PHASE I: During the Phase I contract, successful proposers shall conduct a proof of concept study that focuses on thermal energy harvesting materials and energy conversion technologies that can withstand and operate within varying thermal loads ranging from 5 W/cm2 to 700 W/cm2 and temperatures ranging from ambient to 2000°F (objective). Investigations should include analysis of material performance under transient thermal loading, potential power output (threshold of 100W and objective 250W), and generator efficiency (ZT>2). A final proposed concept design, including a detailed description and analysis of potential candidate electronics packages for the new power source, is expected at the completion of the Phase I effort.

PHASE II: Using the data derived from Phase I, in Phase II the proposer shall fabricate and integrate a prototype of the technology into a nominal projectile form-factor. Specifically the TEG shall conform to a volume = 1 in3. The proposer shall further their proof of concept design by demonstration that the technology can sustain power to a representative electrical component or system under thermal loading up to 15 minutes (objective) and by performing mechanical and thermal testing on the proposed materials and power generator architecture. Upon evaluation of the design through a critical design review, the prototype hardware's survivability shall be demonstrated via high G testing in an air launched munition and aerothermal ground testing. Information and data collected from these tests will be used to validate operational performance.

PHASE III DUAL USE APPLICATIONS: Phase III selections shall ruggedize the final design, identify large scale production alternatives, and fabricate 20 prototypes that can be integrated into a nominal projectile form-factor to be identified by the SBIR: Army 20 Topics and Concepts Government. Live fire tests will be conducted and the prototype integrated with projectile form-factor will have to withstand shock loads approaching 35,000g's. Phase III selections will develop of a cost model of expected large scale production to provide estimates of non-recurring and recurring unit production costs. Production concept for commercial application will be developed addressing commercial cost and quality targets. Phase III selections might have adequate support from an Army prime or industry transition partner identified during earlier phases of the program. The proposer shall work with this partner (TBD) to fully develop, integrate, and test the performance and survivability characteristics of the design for integration onto the vendor's target platform. COMMERCIALIZATION: High efficiency energy harvesting and conversion technologies are continually in demand by the aerospace and automotive industries. Commercial and dual applications of this technology include electrical power supplies for satellites, fuel cells and combustion engines such as for aircraft and ground transportation.

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KEYWORDS: Energy Harvesting, Energy Conversions, Thermoelectric Efficiency, Seebeck effect

A20-018 TITLE: Novel Energy Harvesting Technology for Unattended Sensors

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: The goal of this effort is to determine the feasibility, develop concepts and demonstrate novel technology for harvesting 10-100 mW of power (average) in close proximity to energized conductors or overhead power lines.

DESCRIPTION: The Army's modernization priority for Network Command, Control, Communications and Intelligence (NC3I), requires a variety of sensing assets capable of intelligent, autonomous and reliable processing and communications. Unattended sensors have become more capable with technology advances, and can integrate with networks to provide raw, processed or fully analyzed sensor data. The sensors, processing and communications require power which can be provided by batteries, but even sub-Watt sensing assets require large, heavy batteries to operate for extended periods of time.

Advancements in technology have driven improved efficiency and cost in energy harvesting, especially with solar-based methods [1]. However, solar is not viable in many cases and is highly dependent on environmental conditions. Energy harvesting for many unattended technologies must be dependable in a variety of environments, especially indoors where sun exposure is unlikely. In addition, RF methods for Internet of Things (IoT) devices that harvest wifi/bluetooth signals are only applicable to a small sub-set of use cases. Such sensing assets are often located in close-proximity to strong 50 or 60 Hz electric and magnetic-fields produced by conductors providing power to loads or overhead power lines. These devices are ideally sustained by power extracted from these fields, enabling extended operation, although energy-harvesting from any ubiquitous source would enable in-situ placement of low-power sensing devices with no need for energy-related maintenance [2][3][4].

Viable energy-harvesting methods for low-frequency fields do not currently exist to provide enough power in a form

factor suitable [5][6] for the majority of unattended sensing applications. The development of this technology would greatly expand the number of viable permanent installation points for a future Army network of assets, and ensure minimal maintenance with respect to the powering of the devices. Low-power sensing devices typically consume 10-100 mW, depending on the application, which informs the amount of harvesting needed to operate the sensors indefinitely. Harvesting technology capable of sustaining sensing assets in the majority of emplacement scenarios near powered conductors (e.g., high/low-temp, day/night/indoors) will enable unattended operation and eliminate the logistical difficulties of wiring power or swapping batteries.
Phase I: Briefly describe expectations and desired results/end product. (Please spell out any acronyms. Save your work after each narrative.)
The Phase I effort will research concepts and determine the technical feasibility of harvesting energy in close proximity to overhead power lines or powered conductors. This effort should identify and define the physics of energy harvesting to be explored and the enabling technologies to capture and store that energy. The research will include studies on the effects of indoor and outdoor environments on the technology, to include extreme temperatures. The theoretical limits of energy extraction for form factors up to a maximum volume of 100 cm3 (no dimension to exceed 15 cm), factoring in all known/expected losses, will be determined. A successful technology design will be capable of producing at least 10 mW consistently in a 100 cm3 volume or less. This effort will produce a conceptual design for a harvesting technology that can be demonstrated in the Phase II effort.

PHASE I: The Phase I effort will research concepts and determine the technical feasibility of harvesting energy in close proximity to overhead power lines or powered conductors. This effort should identify and define the physics of energy harvesting to be explored and the enabling technologies to capture and store that energy. The research will include studies on the effects of indoor and outdoor environments on the technology, to include extreme temperatures. The theoretical limits of energy extraction for form factors up to a maximum volume of 100 cm3 (no dimension to exceed 15 cm), factoring in all known/expected losses, will be determined. A successful technology design will be capable of producing at least 10 mW consistently in a 100 cm3 volume or less. This effort will produce a conceptual design for a harvesting technology that can be demonstrated in the Phase II effort.

PHASE II: In the Phase II effort, the harvesting technology preliminary design from the Phase I effort will be finalized, fully designed and demonstrated. The system build will be capable of demonstrating sustained power output of at least 10 mW in a design volume of less than 100 cm3. The technology will be built and demonstrated in laboratory experiments and in a variety of environmental conditions. The demonstration will include testing at a variety of potential locations expected to provide reasonably large field strength, (e.g. near the exterior of 3-phase cables under load, under power distribution lines). Measurements of the power extracted during these test scenarios will be presented to demonstrate the technologies' viability as a sustaining source of energy for sensor operation. The system design, five functional units, and detailed performance evaluations will be delivered for government evaluation with the Phase II final report.

PHASE III DUAL USE APPLICATIONS: Following a successful system development and demonstration in Phase II, Phase III will extend the effort to refine the design. The finalized design will be suitable for the manufacturing of production quantities for both military applications and commercial markets. Commercialization would be of great interest to the electric power industry while also providing a new technology to assist in military efforts concerned with long-life unattended sensors

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KEYWORDS: electric, magnetic, field, battery, power, energy, sensor, solar, harvesting

A20-019 TITLE: Development of a Robust and Reliable Ignition Assistance System for Multi-fuel Capable Engines

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: To develop and demonstrate a highly robust and reliable ignition system for an aviation diesel engine capable of igniting low ignition quality jet fuels.

DESCRIPTION: The Army has a critical need for an ignition source for Army Unmanned Aerial Vehicle (UAV) engines that can burn fuels with low ignition quality, characterized by the cetane number. Defense logistics agency’s (DLA) fuel analysis has shown a wide variation in fuel properties including samples with poor ignition behavior. Combustion instability derived from low ignition quality fuels can lead to increased maintenance, loss of aircraft and capability, and increased risk to the Warfighter. A robust system for ignition energy assistance is critical to enable operation of propulsion systems using a wider range of fuel, allowing Army propulsion systems to be more tolerant to low ignition quality fuels. This will enable semi-independent operation for future Warfighters with reduced logistics burden. The highest priorities for this SBIR are that the ignition system be robust, similar in size and shape to existing glow plug technology, easy to install, and capable of operating in a military environment using a variety of fuels. Historically, glow plugs have been used to assist ignition of diesel engines during cold start conditions by increasing the combustion chamber temperature before fuel injection. However, existing glow plugs are not designed for long duration ignition-assistance because of operating temperature limitations and energizing response times. The proposed ignition assistance system should have similar geometrical, and weight restrictions as a glow plug. It should be capable of enduring engine environments which are prone to vibrations, pressure cycles and thermal stresses. A new ignition system design employing novel materials should be considered that will ensure consistent engine ignition, regardless of operating conditions and fuel types. The primary challenge of this application is the development of materials suited for each component of the device that are capable of withstanding the harsh environment. Current existing materials have potential to handle the high temperatures or high strengths, but have not yet been evaluated for the desired application. Through research and investigation, an optimal combination of materials can be identified that meets the restrictions imposed in this ignition system. The part of the device inside the engine block, should use materials capable of withstanding combustion temperatures, with surface temperatures reaching higher than 1600°C. The primary body material should be resistant to temperatures higher than 800°C, with the material for the transition section between the part inside the engine and the body having a tolerance of higher than 1000°C. A fracture toughness of higher than 15 MPa m1/2 is desired since the system is expected to perform at high reliability for no less than 1000-hr under such conditions. The system should have a response time of less than 1 sec and the igniter should be powered by aviation standard 28 Volt DC power. The system should also be capable of adjusting its output energy to match the requirements of the input fuel. The unit should operate in the extreme environments found at altitude, where pressures may be as low as 30 kPa (absolute) and temperatures as low as -40°C. With these requirements met, a new ignition system could be incorporated into compression ignition engines, allowing for their operability with different fuels, while mitigating the risks of engine damage and flame blow-out. With this risk abated, Army UAV engines will perform more reliably, enabling highly sought capabilities. The new ignition system will support the Future Vertical Lift Cross Functional Team (FVL CFT) via the “Multi-fuel capable hybrid electric” task within the Future UAS project in the Advanced Unmanned Aircraft System Line of Effort (AUAS LOE). Commercialization of this technology can allow for higher combustion reliability when used in terrestrial engines, and a high degree of insensitivity to variations in fuel properties for aerial applications.

PHASE I: Develop and design a new ignition assistance system concept that can meet the Army requirements of igniting low cetane number fuels (20-40) in extreme environmental conditions. The designed system shall be powered by 28 Volt DC. It shall operate at high surface combustion temperatures exceeding 1600°C, where output energy is controllable, and a fast response time of less than 1 sec from 400°C to 1600°C is attainable. It shall embody dimensional and operational characteristics that would enable its integration into compression ignition engines via a typical glow plug port for an existing system of comparable weight. Novel materials with suitable properties for the part inside the engine, main body, and transition section should be identified with measured fracture toughness (>15 MPa m1/2), and maximum allowable temperatures exceeding 1600°C, 800°C, and 1000°C, respectively. Additional operating requirements may be provided by the Army once contract award is made. The awardee shall provide a comparative analysis between the concept ignition assistance system and existing off-the-shelf technologies. CAD models should be supplied to the Army to determine interface compatibility with existing Army engines. The manufacturability of the proposed technology shall be assessed, identifying crucial fabrication process elements and projected production costs. The expected result is a thorough feasibility study, design, and proof of concept of an ignition assistant system. The success of Phase I will be judged based on the metrics of energy deposition level, response time, and fatigue analysis.

PHASE II: Develop and demonstrate the technology and manufacturing methods of the assisted ignition system. Assess and quantify the capabilities of the ignition system in realistic diesel engine operating conditions with a variety of Army supplied aviation fuels. Implement new materials that meet the Army requirements for fracture toughness and maximum allowable temperatures as part of the ignition assistant system. Parameters for assessment include the Army requirements of less than 1 sec response time, ignitability of low cetane number fuels (20-40), operating on a 28 Volt DC power supply, weight restrictions of less than 0.5 lbs and ability to perform with high reliability for no less than 1000-hr within conditions of a compression ignition engine. In addition, system complexity and ease of installation will be assessed. Manufacturing assessment will evaluate the method, repeatability, materials and tolerance-holding capability. Deliverables include a formal report, test and analysis results and (10) prototype sensors and hardware.

PHASE III DUAL USE APPLICATIONS: This technology, as envisioned, can be commercialized for terrestrial and aerial vehicles by increasing fuel insensitivity and therefore overall fuel efficiency, as well as providing a high degree of combustion reliability. A more direct impact will be on small manned and unmanned aircraft systems, which is a rapidly growing industry. A reliable ignition assistance system would allow for further development of multi-fuel capable aviation engine systems. This in-turn could facilitate the development of higher efficiency, reliable small UAV engines fueled with heavy fuels such as F-24, Jet A, diesel, and alternative, bio-derived heavy fuels. Success of the project would lead to more advanced and reliable propulsion systems for future commercial and DoD UAV systems.

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KEYWORDS: Ignition assistance system, igniter, multi-fuel capable engine, unmanned aerial system, compression ignition, altitude, aviation, performance, reliability, unmanned ground system

A20-020 TITLE: Integrated Hybrid Gear/Shaft Technology for Rotorcraft Drive Systems

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: The goal of this program is the development and application of innovative methods to design, build, and test a prototype composite integrated bevel gear/shaft design that is sized for a helicopter intermediate gearbox. This effort is expected to enhance the state-of-the-art and cover all aspects of hybrid gear development, including composite material selection, tooling, joining, and molding techniques, leading to the delivery of working prototypes.

DESCRIPTION: Propulsion systems on military (and commercial) helicopters are a key contributor to the overall weight of the aircraft. In some instances it accounts for almost 30% of the aircraft's empty weight. This percentage is expected to be even higher in the Army's future vertical lift (FVL) aircraft that employ more advanced variable speed transmissions due to the need for improved operational flexibility. Unfortunately, transmissions with variable speed capabilities are heavier than the fixed ratio transmissions currently in use due to the weight from the additional components. To counter the added weight and help meet Capability Set #1 and #3 requirements in FVL, the Army is currently pursuing innovations in hybrid gear technology where the steel hub is replaced by a strong, lightweight composite material. Recent experiments have successfully demonstrated the technology on a representative hybrid bull gear that was able to transmit 5000 Hp in a simulated transmission environment while weighing 20% less than the full steel counterpart. This approach is expected to reduce operating costs while increasing performance in terms of greater speed range and payload.

In an effort to reduce drive system weight even further, research is focusing on the concept of an integrated design by fabricating the gear hub and its adjoining steel shaft as one piece from a strong, lightweight composite material and then joining it with a steel gear. This approach builds on previous hybrid gear achievements and is the next logical step in reducing weight in rotorcraft drive systems. It also poses new challenges for the designer to identify the proper molding techniques and tooling to fabricate the composite material into an integrated, one-piece design. Both the Army and Navy are very interested in utilizing hybrid technology to reduce the overall weight of a rotorcraft's main transmissions. However, demonstrating the viability of the technology in an actual main transmission would be expensive due to the high costs of running such a specialized test facility. For this research topic, the Army and Navy have selected a helicopter intermediate gearbox (IGB) as the technology demonstrator because of its relatively simple single gear pair reduction stage design that features two meshing bevel gears with integrated shafts supported by bearings. The bevel gear configuration adds complexity that should advance the state-of-the-art of hybrid gear technology. Whereas the hybrid bull gear was a double helical design with predominately torsional loads, the forces associated with bevel gears in the IGB are complex and include tangential, radial, and axial loads. This load environment requires advanced fabrication and joining techniques, especially at the composite material-bevel gear interface. The integrated assembly must meet the precise gear dimensional and performance specifications for aerospace applications and the tight dimensional tolerances on the shaft inner and outer diameter for balance requirements and the accommodation of tapered rolling element bearings.

The goal of this program is the research, development, and application of innovative technology and methods to design, fabricate, and experimentally evaluate a prototype composite integrated hybrid bevel gear/shaft technology that is applied to a helicopter IGB. This effort is expected to enhance the state-of-the-art and cover all aspects of hybrid gear development, including composite material selection, tooling, composite-metal joining, and molding techniques, leading to the fabrication and delivery of working experimental prototypes. The success of this effort will elevate the TRL to 6 and accelerate the implementation of integrated hybrid gear/shaft systems into rotorcraft drive systems.

PHASE I: Phase I should identify potential lightweight composite materials, tooling requirements, and molding processes that will enable the design and fabrication of an integrated hybrid bevel gear/shaft assembly that can withstand the speeds and loads present during endurance qualification tests for Army helicopter IGB's. The qualification tests for IGB's simulate normal cruise and more aggressive flight maneuver conditions. To simulate normal cruise the IGB transmits 524 shp with the input pinion operating at 4114 rpm and the output gear operating at 3318 rpm. Total time at this condition is 60 hrs. To simulate more aggressive flight maneuvers the gears are required to transmit 630 shp with the pinion operating at 4114 rpm and the output gear 3318 rpm. Total time at this condition is 30 hrs. Dimensional drawings for the pinion and gear assemblies will be provided by the government for design purposes. Each all-steel gear assembly (pinion and gear) currently weighs approximately 5.5 lbs. Major focus points of the effort should include maximizing strength while minimizing weight, identifying adequate joining techniques to connect the composite material to the steel bevel gear, and developing molding processes that can meet the strict dimensional tolerance requirements. The geometry of the hybrid gear/shaft assemblies should closely mimic the current all steel designs sufficiently to be drop-in replacements. Based on previous results it's expected a weight savings of at least 20% over the current design should be achievable. The final report shall identify the composite material, tooling, and molding processes for fabrication of the hybrid gear/shaft assemblies along with structural analysis to demonstrate the viability of the composite design to successfully complete the qualification tests.

PHASE II: Demonstrate the ability to fabricate and deliver at least two integrated hybrid gear/shaft prototypes based on the lessons learned in Phase I. The steel gear portion of the hybrid prototypes will be made available from all-steel input pinion and output gear assemblies from previously flown IGB's. The prototypes should be able to transmit 524 shp with the pinion operating at 4114 rpm and the output gear at 3318 rpm for at least 60 hrs. The prototypes should also be able to withstand the aggressive flight maneuver load of transmitting 630 shp for 30 hrs with the input pinion operating at 4114 rpm and the output gear at 3318 rpm. Their geometry should closely mimic the current all steel designs sufficiently to be drop-in replacements. The prototypes will be delivered to the Army and undergo flight qualification testing in the Helicopter Drive System (HeDS) Facility at Naval Air Station, Patuxent River, Maryland. The flight qualification tests will be conducted by the Army and any test data will be shared. It's expected successful completion of Phase II should boost the technology to TRL 6.

PHASE III DUAL USE APPLICATIONS: Commercialization of the technology enabling integrated hybrid gear/shaft designs should find a large market in both the military and commercial sectors. Major helicopter manufactures will use the technology to reduce weight, decrease operating costs, improve operational flexibility, and extend mission range. Successful integration will also propel the technology into other areas requiring power transfer and distribution

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KEYWORDS: Gear, Hybrid Gear, Composite, Transmission, Drive System, Future Vertical Lift, Rotorcraft

A20-021 TITLE: MId-wave infrared PIC-based coherent beam combining

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: To create a monolithic, chip-scale mid-wave infrared photonic circuit that emits an order of magnitude more single mode average power than single emitters. Lasers should be directly coupled to the beam combining components either on the same chip or by effectively creating one “super-chip” containing the lasers and the beam combiner

DESCRIPTION: The coherent beam combining of semiconductor lasers has been pursued thru a number of methods. Major efforts have been pursued at near infrared diode laser wavelengths near 1 micron, with some success. Examples include the evanescent super-mode concept recently attempted for mid-wave infrared quantum cascade lasers which built upon prior work with shorter wavelength lasers. Although this approach may still be viable to a certain level, it is complex. More straight forward approaches are seen that leverage advances in low loss integrated photonics whereby lasers can be combined coherently from individual lasers spaced at any given degree as dictated most likely by thermal management consideration. Thus, the beam combining can leverage designs and processes developed over the past decade for the very best high power single mode mid infrared lasers to create a combined single mode output of ten times or more continuous wave power (from continuous wave input lasers). Research is progressing on these methods in the near infrared, but should now be investigated for U. S. Army needs at longer wavelengths. Much improved SWaP (Size, Weight, and Power) systems can be envisioned for a number of relevant applications.

Other approaches to direct diode near-IR beam combined lasers rely upon the spatial multiplexing of broad-area diode lasers through beam shaping optics. These approaches cannot provide the desired high brightness (or high coherence) since at best they can achieve the beam quality of a single high-power broad-area diode laser, which has a M2 value of ~10 or higher. In addition, these systems are usually realized by use of free space and/or fiber optical components, not suitable for chip-scale integration. However, it is well known that photonic integrated circuits (PICs) can significantly reduce the SWaP of many optical and laser systems and are under large scale research and development for use in telecommunications and data centers. Thus, the aim is to hereby use PICs to replace the bulk optics approaches in the current beam combining systems by encompassing recent advances in coupling from lasers to integrated waveguides and by use of low-loss silicon nitride or other very low loss integrated photonics materials that could significantly reduce the system SWaP and improve the beam quality. The potential research topic includes creating a PIC-based beam combining architecture, improving the coupling between semiconductor lasers and PICs, and increasing the power handling capability of PICs. Thermal management of closely spaced mid-infrared lasers including some kind of cooling may be a concern for studying the ultimate limits of such chip-scale approaches but would probably not be too challenging for a significant order of magnitude improvement over a single laser emitter.

Another consideration for one of the key applications would be achieving high modulation speed. Therefore, once the beam combining has been established one would also like to pursue the high speed modulation of such an array. Other considerations such as distributed feedback cavities for improved linewidth and modulation performance and coherence lengths may also be pursued.

PHASE I: Conduct research, theoretical analysis, and numerical studies on PIC based beam combining systems for high power single mode mid-wave infrared semiconductor lasers (3-5 micron wavelengths), develop measures of expected performance, and document results in a final report. The phase I effort should investigate specific PIC based laser beam combining system architectures and include modeling and simulation results supporting performance claims. The proposed beam combining system should use coherent beam combining and leverage state-of-the-art semiconductor lasers (average power and wall-plug efficiency of at least 1 W and 15% or more) at the chosen wavelengths. Simulations should show capability to scale the coherent combining of at least 10 lasers on chip of about 1 cm2 with close to 90% combining efficiency.

PHASE II: 1) Demonstrate PIC based beam combining of multiple (10 or more) 3-5 micron single mode semiconductor lasers with high beam quality (near diffraction limited) and experimental combining efficiency >85%; 2) Demonstrate high coupling efficiency (>90%) between the lasers and the beam combining PIC; 3) Explore the power scaling limits and power handling capability of the integrated beam combining systems. The data, reports, and tested hardware will be delivered to the government upon the completion of the phase II effort. 4) Begin studies of high-speed modulation of such beam combined arrays. Modulation speeds of at least 1 Gb/s are requested as the phase II goal at the 10 W power level.

PHASE III DUAL USE APPLICATIONS: Further scaling of power level and modulation speed can be pursued in the phase III. Applications of such mid-wave infrared lasers can be pursued for various military and civilian applications. Free-space laser communications systems can be developed and tested, and narrow linewidth distributed feedback or external cavity systems may be pursued for coherent lidar or other uses. Directed energy countermeasures type of applications would also be of interest. Industrial applications for material processing and fabrication may be desirable depending upon the power scaling potential. Scaling to much high power levels by using 100s of lasers (possibly with multiple PIC stacks) can be investigated experimentally.

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KEYWORDS: coherent beam combining, mid-infrared lasers, photonic integrated circuits, free-space laser communications

A20-022 TITLE: Scalable Process for Novel Nanomaterials with Infrared Filtering Properties

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop a scalable process for the manufacture of nanoparticles that enable a narrow band of transmission within a broadband of infrared attenuation.

DESCRIPTION: Nanoparticles with tunable electromagnetic properties have the potential to impact a wide range of technologically relevant applications for both the Army and society as a whole. These particles play a vital role in technologies such as drug delivery, solar energy conversion, sensors, smart windows, and optical filters, to name a few. A subset of this research is the design and synthesis of nanoparticles, or collections of nanoparticles, that attenuate a broad region of the electromagnetic spectrum, while allowing for a narrow band of transmission. In recent years, research has demonstrated nanoparticles or collections of nanoparticles that exhibit a narrow band of transmission within a broadband of attenuation. These approaches have included: 1) nanoparticles with multiple resonances, e.g. multilayered particles that exhibit plasmon-plasmon coupling or plasmon-exciton coupling; 2) collections of nanoparticles that exhibit multiple resonances, e.g. mixtures of disparate nanoparticles that exhibit disparate resonances based on size and refractive index; and 3) nanoparticles that exhibit the Christiansen Effect at a given frequency, i.e. particles that have a refractive index that is close to the refractive index of the medium. While these nanomaterials have demonstrated promising optical properties, large-scale production and aerosolization challenges have not been resolved. Enabling the transmission of this narrow band of “light” is particularly attractive for those technologies in which “unwanted” or “harmful” bands of radiation are filtered out, thus enabling the “desired” radiation to reach a given substrate or receiver. For example, a glass-based smart window contains nanoparticles embedded in the glass designed to attenuate a vast region of the infrared region (thereby reducing heat in a given building), while simultaneously allowing for the transmission of a discrete band of IR radiation (e.g. a CO laser operating at a wavelength of 4 µm).

There is an essential need to research and develop a scalable process for manufacturing nanoparticles and associated powders that enable the transmission of a narrow band of infrared radiation while simultaneously attenuating broadband IR radiation as a whole. This will require a unique large-scale production process that can precisely control both particle size and shape. Additionally, the developed process should enable the removal of certain particle sizes and shapes from a given batch, enabling the generation of a potential transparency band. Hence, tunability of nanoparticle size and shape, and the ability to selectively remove various sizes and/or shapes from the manufacturing process are highly desirable. In this project, nanoparticles, or a collection of nanoparticles, are sought to enable the transmission of a narrow band of infrared radiation within any of the following infrared bands: near-IR (0.9-1.5 µm), shortwave IR (1.5-3.0 µm), mid-wave IR (3-5 µm), or long-wave IR (8-12 µm). In addition to the transmission requirement, broadband attenuation in all other regions of the infrared regions (NIR, SWIR, MWIR, and LWIR) is desired. Latitude will be given to the proposer in choosing the wavelength of transmission. This wavelength will largely be dependent on the physics and chemistry of the chosen nanoparticle(s). Preference will be given to those proposals that address manufacturability, and demonstrate the desired transmission can be exhibited as both a colloidal suspension and as an aerosol with minimal or no agglomeration. Demonstration of specific applications (e.g. smart windows) is not sought in this topic.

PHASE I: Demonstrate nanoparticles(s) with a transmission peak at a specific wavelength in the IR region and a transmission band with a bandwidth of 50 nm or less (full width at half maximum). A minimum pass to block ratio of 5:1 (in terms of transmission) is desired. Develop a process to fabricate 500 milligrams of the given nanoparticles, and using materials from this process, demonstrate the transmittance/extinction spectra as a colloidal suspension. Extinction of the particles(s) in the “block” region should be a minimum of 5 m2/g (as a colloidal suspension). Here, we define extinction as the sum of the absorption and scattering cross-sections, per unit mass of material, i.e. m2/g. This extinction term is typically determined via Beer’s Law, when the particle concentration (g/m3), the path length (m), and the transmittance are known. At the conclusion of phase I, provide 1 gram of fabricated powder to CCDC Chemical Biological Center.

PHASE II: Demonstrate a scalable process to achieve a minimum of 100 gram batches (up to 1 kilogram batches) of nanomaterial. Demonstrate the desired transmittance/attenuation spectra as an aerosolized powder, using samples taken directly from the batch process. Extinction of the particles(s) in the “block” region should be a minimum of 5 m2/g (as an aerosol). CCDC Chemical Biological Center will assist in the testing of the aerosolized materials. Provide CCDC Chemical Biological Center with 1 kilogram of material and manufacturing plans to achieve greater than 1 kilogram batches.

PHASE III DUAL USE APPLICATIONS: The proposed technology has a broad range of civilian and military applications. It is envisioned that these materials can be integrated into current and future military platforms which include laser protection systems, smart windows on vehicles, signature management, and camouflage systems. This technology could impact additional DoD interest areas in biomedical applications, sensors, and decontamination. In the civilian sector, advanced smart windows, catalysts, sensors, filtration systems, biomedical devices, and drug delivery systems are envisioned.

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KEYWORDS: Nanoparticles, Christiansen Effect, Multi-resonant nanoparticles, Fano Resonance

A20-023 TITLE: Ultra-low Size Weight and Power-Cost (SWAP-c) Tactical Free Space Optical Communication System

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop an ultra-low space, weight, and power-cost (SWaP-c) Free Space Optical (FSO) communications capability for individual solider tactical operations in contested radio frequency (RF) environments.

DESCRIPTION: It has become imperative that the Army develop alternative capabilities to communicate with reduced electro-magnetic footprint, while assuring low probability to detect and low probability of incept (LPD/LPI) capability and supporting necessary bandwidth for modern battlefield operations. The Free-Space Optical (FSO) communication concept provides an alternative pathway for inherent LPD/LPI communications, while providing significant bandwidth and low electro-magnetic (radio frequency)emissions. One of the inhibiting factors preventing widespread use of traditional FSO communication systems based on macro-scale optics can be linked to their size, weight, complexity and overall cost per link. An ultra-low SWAP-c, FSO communication system could provide accessibility of this technology geared toward the Army need for ensured communication while on the move and at the lowest echelon.

Challenges associated with accomplishing this goal are many-fold and will require modern-day automated photonics technology manufacturing to achieve the long-term goal of a low cost while overcoming specific issues associated with pointing-and-tracking (PAT), transmitter beam divergence, receiving aperture size limitations, and low signal detection at GHz-level speeds. Given these challenges is it envisioned that one of the few solutions would be derived from modern integrated photonics technology

ARL is seeking a small business to demonstrate an ultra-compact FSO communication system. This demonstration should be capable of high bandwidth (Gb-level), low bit error rate (BER)(10-6), automatic PAT in an extremely compact form factor (< 100 cm3, 100s of grams, < 10 Watts of power consumption). There have been several rudimentary demonstrations of one necessary aspect for this program (e.g. wide-field of view beam steering) in a chip-scale form factor [1-2]. These systems might have the potential to address the SWAP-c requirements due to inherent size and long-term high volume fabrication pathway. Although these systems are interesting, none have demonstrated FSO communication functionality and there remains many impediments to embodiment of a full communication system that needs innovative and applied research and development to overcome. These ultra-compact FSO systems must overcome technical hurdles which the macro-scale system have done in past, including: aperture limits, low-signal detection at high data rate, full implementation of PAT with required field of view (FOV) and slew rates and finally low power consumption.

PHASE I: Complete a conceptual system design for a ultra-low space, weight, and power-cost (SWAP-c), (< 100 cm3, 100s of grams, < 10 Watts of power consumption), Free-Space Optical (FSO) communication system with delineation of critical elements and associated risk poised to meet the Phase II and III goals. Detail the key design considerations and trade-offs associated with the approach including scalability for cost. Develop prototype plans for Phase II. Demonstrate proof-of-concept of core link technology including rudimentary beam steering and modulation functions.

PHASE II: Demonstrate an initial prototype Free-Space Optical (FSO) communication system with data bandwidth of 1 Gbps, automatic pointing-and-tracking (PAT) function with 30 degree field of view (FOV) and maximum FOV slew time of 500 microseconds, bit error rate (BER) of 10-6 over 1-hour interval at 90% network capacity at an outdoor-range exceeding 200 meters in a modem form factor of 100 cm3 or less, weighing less than 400 grams and consuming 10 Watts or less power. Technology should be at the level of TRL 4/5 at the end of this phase with a dedicated plan toward fabrication scaling for reduced unit cost.

PHASE III DUAL USE APPLICATIONS: Advance prototype Free-Space Optical (FSO) communication system to TRL 7/8 with data bandwidth of 2 Gbps, automatic pointing-and-tracking (PAT) function with 45 degree field of view (FOV) and maximum FOV slew time of 500 microseconds, BER of 10-6 over 1-hour interval at 90% network capacity at an outdoor-range 1000 meters in a modem form factor of 50 cm3 or less, weighing less than 200 grams and consuming 5 Watts or less.

It is envisioned that this technology will enable near range dispersal of secure FSOC network for US tactical ground forces, which could also provide a dual-use commercial application pathway for local area networks in highly congested urban environments. Similarly a system of this type and capabilities would greatly reduce the cost of setting up urban Local Area Networks in developing areas. Applications of FSO communication system have direct pathway to transition through existing Army development investments currently underway for the alternative communication space. Finally, it is expected that the core of this technology will mature aspects of beam steering and integrated receivers, which could have direct dual-use in low SWAP-c laser ranging (LADAR) application for military and civilian use on autonomous platforms

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KEYWORDS: Photonics, Free-Space Optical Communications - FSOC, Optical, Communications, Local Area Network - LAN, Network, Laser, Light, Free-Space

A20-024 TITLE: Laser Formed Fabrication of Conformal and Non-Conformal Millimeter and sub-Millimeter Wave Antennas

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: The objective is to leverage recent advances in laser forming of metals to develop a cost effective manufacturing capability for conformal and non-conformal millimeter and sub-millimeter wave antennas that have complex shape, smooth surfaces, micron scale features, and bulk metal conductivity.

DESCRIPTION: Of interest to the Army is the potential for a given technology to merge capabilities and operate in contested environments which is a goal of the Network C3I Army Modernization Priority with which this topic aligns. Ultra-wideband (UWB) antennas that operate with several decades of bandwidth and cover millimeter and sub-millimeter wave (mmW and s-mmW) frequencies enable backend hardware flexibility without replacing the antenna. What’s more, UWB antennas with complex shape that have polarization diversity can merge capabilities that require different polarizations and operate at different frequency bands. Fabricating antennas at mmW frequencies is challenging given the small features, especially when the antenna has a complex shape, such as a double curved surface. MMW antennas require micron-scale precision and high electrical conductivity. Additive manufacturing (AM) techniques are the current cost effective means for fabricating antennas of the prior description at sub-mmW frequencies, but the capability of AM to fabricate mmW antennas is limited.

While AM offers a fine level of control such that complex 3D geometries can be manufactured, the technology does have some particular limitations such as less than bulk metal conductivity inks and pastes that require plating and rough surfaces which can be detrimental to the antenna performance [1] – [4]. Multi-scale prints, where a large antenna has small features, can also pose a challenge for AM techniques, and the time to print multi-scale antennas can be extensive. Some of these challenges may not be so significant for some antennas, but is significant for antennas such as the ultra-wideband (UWB) and polarization diverse multi-arm conical sinuous antenna [5], the impulse radiating UWB TEM horn [6], or the high-power and high-gain slot array in waveguide [7] designed for millimeter and sub-millimeter wave (mmW and s-mmW) frequencies. As such, a technology gap exists.

A potential solution to the technology gap is a fabrication capability based on laser forming metal sheets. Laser forming is a method by which sheets of metal can be made to bend or buckle by the application of localized heat through a laser [8 – 9]. Judiciously choosing the locations and paths that the laser will heat can be used to create 3D shapes such as cuboids, coils, and doubly curved surfaces (e.g. the conical sinuous antenna and the TEM horn) [10].

Combining laser folding with laser cutting and welding allows for the manufacturing of closed geometries with features cut into them (e.g. the slot array in waveguide). Remaining research questions to be answered include thermal optimization of the process, improving sidewall roughness of cut surfaces, incorporation of welding, and process repeatability. In addition, developing the process such that the antenna technology developer can move a design from a computational electromagnetic modeling tool, such as HFSS, FEKO, or CST, to the laser device would better facilitate rapid prototyping of conformal antennas with small features.

Using laser induced heat to deform metallic sheets like copper, steel, and brass to make 3D shapes has been demonstrated [10 – 13]. Application of the technique to a slot array in waveguide at w-band was also attempted but the lack of a combined laser welding function prevented the antenna from being completely closed [13]. It has also demonstrated that aluminum foam can be bent using laser heating [14].

The laser formed fabrication of antennas would prove beneficial to the commercial sector. The new fabrication capability could prove cost effective and would expand the domain of antenna types that can be fabricated at mmW frequencies. The capability would also allow for the fabrication of smoother, more precise, and subsequently better performing conformal antennas.

PHASE I: Phase I shall explore the technical merit and feasibility of a laser forming based fabrication concept for mmW and s-mmW antennas to be executed in Phase II. The concept should prioritize commercially available laser systems. A study will address the research questions regarding optimal laser parameters for forming steel, aluminum, brass, and copper sheets with thickness ranging from 10 um to 1 mm to predict laser settings (i.e. power, exposure time, etc...) that are needed to optically cut, form, and weld the metal sheet into a 3D geometry and quantify the angle of resolution for bending and buckling. The laser cutting must achieve positional accuracy of no more than 10 microns, RMS surface roughness and line edge roughness less than 1 micron for both internal and external features, and minimum line width and spacing of 10 um. Laser forming angle resolution must be no more than one degree. The welding process must be within roughness spec, structurally robust, and maintain high electrical conductivity (>50% bulk conductivity). Documented process demonstration and study results are the primary deliverable.

PHASE II: Phase II will build on the Phase I concept by refining the process to fabricate and deliver two RF antenna prototypes that demonstrate the precision and repeatability of the Phase I process. The antenna designs are an upper W-band longitudinal shunt slot array and a 4-arm C- to upper Ka-band conical sinuous antenna. Antennas should be characterized through laboratory measurements of the reflection coefficient, radiation pattern, and efficiency. The measured results of the antennas and devices should be compared to simulation results acquired by using computational electromagnetic software such as CST, FEKO, or HFSS. The measured reflection coefficient should be better than -10 dB and the gain should be within 3 dB of the simulated results. The end of Phase II should demonstrate antennas using a complete laser forming manufacturing capability and deliver said antennas for evaluation.

PHASE III DUAL USE APPLICATIONS: Phase III will focus on the commercialization of fabrication technology for mmW and s-mmW antennas. The final process should demonstrate consistency and repeatability in manufacturing antennas for both military and commercial applications. Commercialization of the technology would be of use to the antenna development community as a whole by providing a cost effective means to producing high performance conformal antennas at mmW and s-mmW frequencies.

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KEYWORDS: laser forming, sub-millimeter wave, millimeter wave, conformal, antennas, manufacturing processes

A20-025 TITLE: Probabilistic Genotyping Software for Mixture Deconvolution of Next Generation Sequencing Data

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: Develop an expert probabilistic genotyping software system to reliably interpret next-generation sequencing (NGS) data using a fully continuous approach.

DESCRIPTION: Forensic DNA laboratories are preparing for the implementation of NGS technologies to supplement and eventually replace current capillary electrophoresis (CE)-based human identification. The advances in sequencing technology provided by NGS approaches allow interrogation of the human genome in new ways, enabling both short tandem repeats (STRs) and single nucleotide polymorphisms (SNPs) to be analyzed for forensic purposes within a single workflow. Utilizing NGS technology to analyze STRs allows the sequence of the repeat region to be viewed, enabling identification of isoalleles, alleles with the same length that contain unique sequences, which can further differentiate individuals who would otherwise have the same allele designation at a particular locus when analyzed using a CE-based analysis. These capabilities make NGS a powerful tool for forensic human identification and may ultimately enable resolution of even more complex mixtures than is currently possible [1] [2], but the transition to this technology also presents challenges. Data gathered from NGS analysis is more complex than CE-based data, and to take full advantage of the advanced capabilities in resolution of mixtures new software solutions are required.

Multiple software platforms exist to analyze raw NGS data and create a visual representation where mixtures and low-level samples can be interpreted manually by a DNA examiner. These software platforms, however, do not address how to reliably and objectively interpret complex DNA mixtures commonly seen in forensic DNA analysis, particularly for limited or degraded samples collected in operational environments. To enhance the amount of actionable information collected from DNA evidence and fully utilize the sequence information NGS offers, an expert probabilistic genotyping software system designed to analyze sequence information must be developed. The software must be compatible with data generated by currently available NGS STR and SNP chemistries. Furthermore, the software should enable data-in to answer-out analysis with minimal user interaction. The software must be capable of utilizing statistical theory to calculate likelihood ratios (LRs) from published allele frequencies. In addition, computer algorithms and biological modeling must be used to infer genotypes from mixed DNA profiles entered into the software system. These capabilities should be optimized to computationally model NGS data and maximize the number of true positives while minimizing false positives.

PHASE I: Develop a prototype expert probabilistic genotyping system that can ingest NGS data from at least one NGS STR and SNP chemistry/platform type. The software must demonstrate the ability to analyze clear two-person mixtures with input from a reference profile for inclusion. A fully continuous approach is required, incorporating biological parameters such as peak height ratio, mixture ratio and stutter. The output file should deconvolute the mixture into potential genotypes, providing weights to each genotype inferred, display sequence information for both contributors, and contain a likelihood ratio for two competing hypotheses using published allele frequencies from a single population. It is highly desirable that the software parameters include population allele frequencies, drop-out, drop-in, stutter, and kit variance. Ideally, these parameters will be customizable to allow laboratories to use any NGS STR and SNP technology available. Design of the software platform must not prohibit backward compatibility with CE data. Preferably the software platform will run on commercially available computing systems. Ideally at the end of the phase I effort, the analysis of at two-person DNA mixture can be demonstrated in minutes.

PHASE II: Extend the methods and computer algorithms developed in Phase I to allow for ingestion of NGS data from all currently available NGS STR chemistry/platform types. Improve the software system to interpret at least four-person mixtures and low-level DNA samples. Calculate the likelihood ratio for each genotype using allele frequencies from user-selected population groups (typically Caucasian, African American and Asian) in a single run. Establish a training set of samples to evaluate the software system performance. For guidance on testing probabilistic genotyping systems, please refer to the “SWGDAM Guidelines on Validation of Probabilistic Genotyping Systems” [3]. Incorporate the developed methods and computer algorithms into a mature software system with a user-friendly interface and the ability to allow integration of data output into case reports. The software must be designed to allow backward compatibility with CE data. Prior to mixture deconvolution, it is highly desirable that the software has the ability to utilize NGS SNP and STR information to infer the number of contributors (NOC). Ideally the analysis of a complex four-person mixture could be completed within hours.

In addition to monthly technical progress reports, deliverables will include: a detailed report demonstrating specifics on how the software obtains its answer (black box systems are unacceptable), a user guide for the software including set-up and troubleshooting, and a report describing the results of the Phase II sample set testing.

PHASE III DUAL USE APPLICATIONS: The development of an expert probabilistic genotyping software system that reliably interprets NGS data using a fully continuous approach will have a significant impact in the forensic science community at the federal, state and local levels. The software will fully utilize the sequence information that NGS affords, allowing for the objective and reliable interpretation of more complex DNA mixtures than is possible with capillary electrophoresis-based methods. Software developed under this topic will initially be tested and evaluated in Government forensic laboratories to assess applicability within forensic analytical workflows. There are a number of commercial applications for analysis of samples that will directly benefit from this new software capability including: research purposes, law enforcement, and medical diagnostics.

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KEYWORDS: next-generation sequencing, probabilistic genotyping, fully continuous, forensic DNA analysis

A20-026 TITLE: Graphene-Based Composite EMI Shielding for RF Device Protection

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Develop a graphene-based composite EMI shielding material capable of replacing metal shielding in IC packages and printed circuit board components.

DESCRIPTION: As soldier electronics and their components operate at faster speeds, smaller size, and in closer confinements a substantial increase in Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) can lead to system failures. This effort supports the FREEDOM ERP as it enables enhanced technologies to protect next generation of highly mobile RF communications for battlefield dominance in the broad bandwidth frequencies X-band (8-12 GHz) to the Ku-band (12-18 GHz). Metal EMI shields in IC packages and printed circuit board components have limitations in poor chemical resistance, oxidation in long term harsh environments, high density, flexibility, and form factor. Current strategies to obtain the desired EMI shields mainly rely on increasing the material's thickness to prolong the EM wave absorption routes or loading large amounts of fillers in order to increase its electrical conductivity [1]. However, these factors inevitably increase the production cost and limit scalability.

Generally, conductive fillers have high aspect ratio and large specific surface area, such as carbon nanofibers (CNF), multi-wall carbon nanotubes (MWCNT), stainless-steel fibers (SSF), and graphene layers offer advantages without the limitations imposed by pure metals. Fillers are preferred because they can be dispersed in lightweight polymers to establish efficient conductive paths in the composites and form sufficient interfaces with the polymer matrices, leading to enhanced electrical conductivity and interfacial polarization that are beneficial to the EMI shielding performance. Among the conductive fillers, graphene has the best conductivity, lowest density, and highest thermal conductivity [2]. Silver and cooper have excellent conductivity but the aging stability of metallic nanostructures is big concern for long term storage of electronics in systems for harsh environments.

The development of graphene filler ink formulation offers a major opportunity for improving the deposition of composite shielding materials. Graphene filler ink materials can be dispensed economically by drop casting or using printing technologies with controlled patterning capabilities leading to new technologies, and applications. The inks can be deposited on substrates by methods such as drop casting, inkjet printing, and aerosol-jet printing [3-5]. A path forward lies in the improvement of ink formulation. Ink formulations rely on factors including selection of flake size, solvents, and surfactants that provide the best combination for direct exfoliation of pristine graphene. Several factors limit achieving the high theoretical conductivity 10exp8 S/cm of graphene, which is 3 orders of magnitude higher than highly conductive metals such as copper. These factors include inter-flake percolation, type of binder that hold the fillers together, and post decomposition by annealing. Also, there is a lack of “pristine” graphene flakes in the market [6] that can be improved. The ultimate goal is to deposit a shielding material with properties that would be capable of replacing metal shielding fully in printed circuits.

PHASE I: The responsive proposal shall develop a shielding material. Identify an ink formulation and description of above mentioned factors (i.e. graphene content, inter-flake percolation, surfactants, selection of ink binder, drying agents, and annealing process for binder decomposition) with a printing approach that forms a composite shield on a substrate. For all solutions the ability to block the greatest amount of incident EMI waves by the deposited shielding material is a driver.

METRICS:
Graphene-based composite material (less than 1mm thick) on Kapton or Mylar substrate:
-Electrical conductivity greater than 100,000 S/m
-Substrate or annealing temperature less than 250°C
-Good flexibility and film adhesion to substrate after manual bending, and no micro cracking.
-EMI shielding efficiency (EMI SE) greater than 50dB across broadband frequencies (8-18 GHz)

During the phase-I the contractor shall report and deliver on the following:
(1) Report on the material selection, process development, challenges, and accomplishments.
(2) Document the method of deposition, and minimum size linewidth achieved.
(3) Characterize the composite structural properties, composition and size of the nanostructures.
(4) Document the binder, surfactants, solvents used including the effects of annealing/sintering temperature or post chemical treatment on the conductivity of the deposited composite.
(5) Conduct EMI shielding efficiency studies, record the scattering parameters using a vector analyzer with two port measurement techniques or an equivalent method in the frequency range 8-18 GHz to validate performance claims.
(6) Delivery of deposited material samples on Mylar or Kapton substrate with pattern size 0.5”x1.5” for validation:
(a) Deposition single layer of uniform film on sample as a baseline. Include data of the measured film uniformity, roughness, thickness, resistivity, conductivity, and EMI SE.
(b) Deposition multiple layers (up to a maximum total thickness of 1mm) that demonstrates best achieved conductivity and EMI SE. Include data of the measured film uniformity, roughness, thickness, resistivity, conductivity, and EMI SE.
(7) Propose improvements for phase-2, challenges, solutions, and applications.

PHASE II: This phase addresses a current needs relevant to the US military: a lightweight and durable EMI shield on IC packages and printed circuit boards components that protect against radio frequency interference (RFI). Develop a scale-up demonstration/validation program, on an application relevant to the US military based upon the previous phase I requirements and on-going proprietary developments.

METRICS:
-Ability to the composite film adhere to variety of electronic substrates and packaging (Mylar, Kapton, Si, SiO2, glass, ceramic, paper), determine the limitations.
-Repeatability of printing square shield patterns (1 mm, 1 cm, 5 cm, 10cm), determine the limitations.
-Reliability of formulated solution for printing without clogging the printing head, determine the number of cycles.
-Storage of ink formulation beyond 3 months without observable segregation and settling, determine the maximum time within contract period.
-Stability of composite film at mil specification temperatures -65 degrees F to 165 degrees F.

This phase is intended produce a full scale 3D prototype EM shielding. The full scale system will also address key factors in maintaining an effective shield, such as conformal coating that allows for continuity of conductivity over integrated circuits. The main technical objectives:
(1) Demonstrate/validate a system that is capable of repetitive or continuously coating.
(2) Fabricate a full-scale 3D prototype of the shielding on IC’s and PCB components.
(3) Validate that the EMI shielding performance meets the specified requirements.

PHASE III DUAL USE APPLICATIONS: Implement a business case and partner with a DOD supply chain to commercialize the EMI shielding material system to a TRL 7 System prototype demonstration in field environment. We envision use of shielding in military applications such as solider radios, prognostics/diagnostics, unmanned air vehicles (UAV’s), drones, unattended ground sensors, security access/entry, RF ID tags, and air defense systems. For commercial applications in cell phones, computers, and medical equipment.

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KEYWORDS: Shielding, Electromagnetic interference (EMI),Radio Frequency (RF),Flexible Shielding effectiveness (SE)
Conformal

A20-027 TITLE: Advanced Ceramic Matrix Composite Gas Turbine Engine Research Combustor

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: Explore, fabricate and evaluate ceramic matrix composite combustor research prototype for gas turbine engine and other air breathing propulsion applications, using advanced innovative design and manufacturing methods, to identify and mitigate SiC-SiC ceramic matrix composite materials and manufacturing vulnerabilities for CMC combustor operating in austere environments.

DESCRIPTION: To meet the demands of current and future requirements, military gas turbine engines (GTEs) are required to operate at ever higher temperatures. Current engine temperatures can exceed 1500 °C, with future engines projected to exceed 2000 °C. Implementation of Silicon Carbide (SiC-SiC) ceramic matrix composite (CMCs) components including CMC combustor in propulsion engines of interest to the US Army is now a tangible reality, representing the most fundamental change in design and manufacturing practices for gas turbine engines since the introduction of single-crystal superalloys [1]. Advanced CMCs offer significant advantages over the current set of superalloy-based systems, but these materials can be brittle and will degrade over time, due to high temperature creep, thermal shock and cyclic thermomechanical loads. Specific innovation research focus areas include increased thermomechanical durability, increased resistance to environmental interactions, cost-effectiveness of processing and manufacturing, and improved approaches to CMC combustor component fabrication and integration. Computational tools and integrated experimental/computational methods are sought, including models/tools to predict degradation and failure mechanisms within CMC combustor.

Application of SiC-based CMCs in combustion environments for gas turbine engine combustors operating at 1310° C or higher require significant scientific advancement in the SiC-SiC CMC material system. Unfortunately, exposures of these materials to high temperature combustion environments limit the effectiveness of thermally grown silica scales in providing protection from oxidation and component recession during service. The nature of the SiC based ceramic recession issue dictates that the combustor material system must provide prime reliant performance to ensure full component lifetime [1-13]. Thus the CMC combustor requires SiC-SiC bulk material system with improved state of the art thermal/environmental barrier coatings (EBCs) for limiting oxygen/water vapor transport, and high temperature phase stability, integration with metallic engine components mitigating thermal coefficient of expansion mismatch and optimized effusion combustion liner holes.

PHASE I: Research and formulate innovative CMC combustor analysis and design methods leading to the development of affordable, high speed with high throughput manufacturing of SiC-SiC ceramic matrix composite materials for gas turbine combustors. Beyond a combination or standalone SiC-SiC manufacturing methods such as conventional chemical vapor deposition, pyrolysis infiltration process, and melt infiltration process, explore advanced manufacturing processes of CMC components including additive manufacturing methods and Field

Assisted Sintering Technologies (FAST). Perform combined computational fluid dynamics and computation structural dynamics modeling and high fidelity simulation of CMC combustor concepts under combined effects of aerodynamic, thermal, combustion chemical reactance and structural loads. Using the proposed advanced manufacturing processes and preliminary design, fabricate at least three prototype curved CMC specimens with embedded impingement holes and thermal/environmental barrier coating and subject to at least 20 hot/cold two hour duration thermal cycles of steady-state combustion flame temperature of 1482 deg Celsius or higher to identify potential CMC material vulnerabilities at combustion temperatures. Post-test material characterization of the CMC curved specimens will be performed to identify any manufacturing defects and material degradation due to thermal cycling. Prototype ceramic matrix composite coupons will be delivered to CCDC Army Research Laboratory (ARL) for high temperature strength testing, fluid flow characterization, and microstructure analysis. A preliminary research grade CMC combustor analysis and design shall be conceived and delivered to CCDC – ARL at the end of Phase I.

PHASE II: Explore, develop and validate the innovative SiC-SiC CMC research combustor using design and fabrication approaches of Phase I. Partnership with an Original Equipment Manufacturer (OEM) of gas turbine engine is encouraged. The proposer shall conduct high fidelity modeling and design analysis of the research grade CMC combustor prototype (e.g. representative medium lift rotorcraft turboshaft engine combustor prototype) including computational thermal fluid structural analysis with conjugate heat transfer methods to develop the combustor pattern factor and identify potential hotspot and highly stressed zones. Explore innovative methods for SiC-SiC CMC component integration with hot metal superalloys and advanced manufacturing of optimized embedded impingement and effusion holes within the combustor liners with thermal/environmental barrier coatings. Fully instrumented jet burner rig ground based experimental tests need to be conducted on the CMC combustors at CCDC-ARL Hot Particulate Ingestion Rig (HPIR) or another federal government or industry test facility subject to thermal cycling of at least 100 hot/cold two hour duration thermal cycles of steady-state flame temperature of 1550 deg Celsius or higher to identify CMC combustor material state vulnerabilities at engine relevant austere environment and explore possible mitigation solutions. The proposer shall perform pre and post experimental test nondestructive evaluation of the CMC combustor and post-test material characterization of the CMC combustor material system to explore and identify embedded defects including fiber and matrix cracks, identify zones of SiC fiber agglomeration, SiC matrix silica pools, large void spaces within the CMC substrate, and durable interphase materials. The proposer will research methods to alleviate the aforementioned possible defects in CMC combustor material system. Additionally, ceramic matrix composite combustor prototype(s) will be delivered to the CCDC - ARL for further full field high temperature characterization and research development including CMC microstructure analysis and further enhancement.

PHASE III DUAL USE APPLICATIONS: The proposer will partner with an Engine OEM and conduct validation testing including full scale engine ground testing. The CMC combustor technology can be transitioned as prototype CMC combustor for a medium size rotorcraft turboshaft engine to PM Advanced Turbine Engine, PEO Aviation, Huntsville and CCDC – Aviation and Missile Center at Corpus Christi, TX. The end result of this research effort will be a validated approach for development of CMC Combustor transitioned to medium size future vertical aircraft propulsion system.

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KEYWORDS: Ceramic Matrix Composite Materials, SiC-SiC (Silicon Carbide - Silicon Carbide), CMC combustor design, interphase layer, Jet Burner Rig Test.

A20-028 TITLE: On-Site Formate Production

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: Develop and demonstrate methods to enable distributed production of potassium formate.

DESCRIPTION: The ability to manufacture materials near their point of use is a priority for the crosscutting Sustain and Train Cross Functional Team (CFT) in the Army Modernization Priorities. For example, chemical deicing represents about one-third of winter maintenance expenditures for bases and municipalities. Currently sodium chloride is often used to deice road surfaces despite concerns about corrosivity, to both motor vehicles and infrastructure, and environmental impact including vegetation damage through chloride uptake, soil damage through sodium accumulation, and drinking water contamination. This effort seeks the development of methods for onsite production using waste carbon dioxide from point source at moderate conditions (low pressure and temperature) on posts/bases of potassium formate which is an environmentally friendly/low corrosion deicing material (reference 2). Recent results show that electrochemical reduction of carbon dioxide to form formates is possible. This approach could enable systems that utilize inexpensive and readily available materials and would economically produce potassium formate in a form readily usable for roadway and runway deicing.

PHASE I: Explore catalysts and processes to electrochemically reduce carbon dioxide to produce formate under moderate conditions. Characterize system efficiency and byproducts as a function of reaction conditions to achieve >75% process efficiency. Provide 5 lbs of formate generated using the laboratory system. Determine system degradation mechanisms to enable system life of >8000 hours. Demonstrate at laboratory scale a system capable of producing potassium formate under moderate conditions (<100 psi, and <100 degrees Celsius), Prepare analysis of cost/pound of formate focusing on the use of nonflammable, inexpensive, readily available starting materials. Estimate scaled up production costs.

PHASE II: Continue process/catalyst optimization. Build and deliver a system capable of generating 20 lbs/day of potassium formate under moderate conditions using waste carbon dioxide and low cost/readily available materials in a cost effective manner. Demonstrate operation of the system for a minimum of 5 days, generating 100 lbs of material. Determine and optimize operation costs and system efficiency which should be >85%. Ideally the system will be capable of utilizing intermittently renewable energy sources. Goal should be to achieve production cost including cost of starting materials of <$800/ton of potassium formate.

PHASE III DUAL USE APPLICATIONS: Build a system capable to producing 100s of lbs/day of potassium formate using renewable energy sources under moderate conditions that uses safe, readily available, and inexpensive starting materials. Goal should be to achieve production cost <$800/ton of potassium formate. This system could be used on posts/bases or municipalities and airports for roadway and runway deicing and reduce corrosion and environmental impact associated with road salt.

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KEYWORDS: potassium formate, deicing, on-site production, manufacturing at point of need

A20-029 TITLE: Non-Intrusive Pressure Measurement in Cannon Gun Tubes

TECHNOLOGY AREA(S): Weapons

OBJECTIVE: Develop an innovative, remote sensor technology for measuring peak pressure and dynamic pressure differentials inside large caliber gun tubes.

DESCRIPTION: For propellant engineers and internal ballisticians, accurate measurement of internal cannon pressures (during a firing event) is crucial for research and development purposes. Of special importance are the measurement of the peak pressure in the chamber and the calculation of differential pressure [1] (the difference in pressure between two points) across the chamber section of cannon gun tubes.

Currently, internal chamber pressure is measured using piezoelectric transducers [2]. The transducers are installed such that the piezoelectric sensor is exposed to the internal volume of the chamber, thus requiring the gun tube and/or breech assembly to be drilled and tapped. Ballistic pressure data is recorded at high frequency (>250 Hz) and plotted to form Pressure vs Time Graphs. For prototype weapons, it may be impractical to drill the gun tube to accommodate traditional pressure gages. This topic seeks an innovative solution for collecting internal ballistic pressure data, without modifying the system under test.

The measurement of the peak pressure in the chamber and the calculation of differential pressure may be achieved by one application of the remote sensor technology or by two different applications/methods.

The system developed under this effort must meet the following key system attributes (KSAs):

Pressure Range: 0 – 150kPsi
Sampling Frequency: = 250 Hz
Resolution: = 0.5%
Temperature Range: 0 – 3,600 °F
Ability to withstand explosive shock and high G-forces resulting from explosive charge detonations
Robust design capable of surviving impacts by foreign materials during detonations

PHASE I: Evaluate novel applications of advanced pressure sensor materials and data acquisition technologies for use in a ballistic environment. Desired outcomes; Design a concept for remote monitoring of internal pressures, with the potential to meet the KSAs, without requiring any modification to the gun tube (e.g., drilling a hole), further refine the KSAs and conduct an analysis of alternatives to select the best combination of materials and data acquisition technologies for prototypes to be delivered in Phase II.

PHASE II: Subject the most promising material solutions (identified in Phase I) to testing, simulating live fire conditions. Desired outcomes; Produce at least one prototype using the selected sensor / data acquisition system combination, subject the “as manufactured” prototype to simulated firing conditions to assess performance against the KSAs and perform final design refinements. Document the final solution and manufacturing process in the form of a technical data package. TRL: (Technology Readiness Level) TRL Explanation Biomedical TRL Explanation TRL 6 - System/subsystem model or prototype demonstration in a relevant environment.

PHASE III DUAL USE APPLICATIONS: Conduct a live fire demonstration of the final prototype in an operational environment with participants from various U.S. Government agencies and contractors from the weapons and defense industry. Explore potential applications for both military and private sector customers. This technology could be used for monitoring pressure vessels, steam turbines, oil & gas pipelines, and aerospace applications.

REFERENCES:
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2. PCB Group, Inc. “Ballistic Pressure Sensors Reference Guide.” PCB Piezotronics, 2014, www.pcb.com/contentstore/MktgContent/LinkedDocuments/Aerospace/BallisticPressureGuide.pdf

KEYWORDS: pressure, differential, transducers, artillery, cannon, chamber

A20-030 TITLE: Independent Gun Location and Gun Tube Pointing Device

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Design and build a system that can remotely and independently determine the location of a howitzer and the orientation (azimuth and elevation) of the gun tube, display the position and pointing data, in real time to a terminal/monitor at the control center and other remote locations located as far as 25 km.

DESCRIPTION: During certain types of large caliber firing tests, the weapon pointing is done automatically by the system under test and or by the system operators. The tactical nature of these events makes it very difficult to perform an independent verification of the gun tube pointing prior to firing. There is a need, from a range safety standpoint to verify the location of the howitzer and orientation of the gun tube during such events to ensure weapons are fired within the established safety corridors. A system is required that is portable/mobile/deployable and operates independent of the weapon platform. The system then needs to be able to determine and transmit the location and pointing data to a control center and other remote locations which may be located as far as 25 km away. The data must be transmitted in real time and must consist of weapon location, gun tube horizontal angular measurement and a gun tube vertical angular measurement. The system must enable the user to input custom maps for graphical display purposes. At the control center and the remote locations, the terminal or display must numerically and graphically display the data in real time. The reference azimuth for the angular measurements must be user selectable (i.e. azimuth with respect to true north, geodetic north, etc.)

The system developed under this effort must meet the following performance goals:

Vehicle location accuracy: ± 1 meter
Gun tube azimuth accuracy: ± .1 degree
Gun tube elevation accuracy: ± .2 degrees
Rugged & mobile:

- Temperatures from -40 to +140°F
- Water and dust proof
- Deployable in rough desert terrain, portable via pickup truck or similar and self contained.

PHASE I: Perform a feasibility study in support of the development of a Remote gun location and Gun tube pointing determination system which meets the specification above. Evaluate innovative technologies which may be used to build, integrate the system and leverage existing technologies. Perform trade-off analysis to determine the best approach for howitzer location and gun pointing determination system, and develop a preliminary design for the system.

PHASE II: Develop a prototype system. Demonstrate the system technology and characterize its performance.

PHASE III DUAL USE APPLICATIONS: The system developed under this topic could be used by other test and training ranges to increase safety when firing large caliber weapons. The system could also be marketed to foreign militaries for use on their training and test ranges.

REFERENCES:
1. Army AL&T magazine

2. Field Manual 3-09.8 Field Artillery Gunnery

3. Field Manual 6-40 Tactics, Techniques, and Procedures for Field Artillery Manual Cannon Gunnery

4. Technical Manual 9-2350-314-10, Operator’s Manual, Howitzer, Medium, Self-Propelled: 155MM, M109A6

KEYWORDS: artillery, fire control, quadrant elevation, azimuth of fire, range safety

A20-031 TITLE: Soft Catch System for Large Caliber Ammunition

TECHNOLOGY AREA(S): Weapons

OBJECTIVE: Design and build a system that can stop large caliber ammunition with minimal damage to the external and internal features and components.

DESCRIPTION: During various phases of large caliber ammunition development, there is a requirement to assess internal ballistics, strength of design, and function of critical components, requiring a need to perform "soft catch" testing, where the munition can be fired at operational velocities, and captured in a way that does not damage the projectile. This is often needed to assess the performance of munition behavior during setback and the effect on fuze function, or that subcomponents (such as deployable fins) survive firing and launch. Current soft catch methodologies use hay, water, sand, and ballistic gelatin. Although there has been a limited level of success using these methodologies, a significant portion of test munitions are damaged during firing and recovery, which requires additional testing and prototype munitions, causing a medium risk to systems under test, due to increased cost and timelines. The system developed under this effort must be able to consistently catch large caliber ammunition regardless of the features and fill such as pyrophoric white phosphorus, high explosive agents, sensor heads and other electronics, deployable aerodynamic features, submunitions, and depleted uranium (DU) penetrators with minimal damage to munition's external and internal features.

The system developed under this effort must meet the following performance specifications:

Stop munitions up to 400 lbs
Stop munitions up to 16" in diameter
Stop munitions with kinetic energies of 20 MJ at a minimum
Must be able to catch and recover up to 10 munitions in a 10 hour period
Rugged:
- Temperatures from -40 to +140°F
- Water and dust proof

PHASE I: Perform a feasibility study in support of the development of a soft catch system for large caliber ammunition which meets the specifications above. Evaluate innovative technologies which may be used to build, integrate the system and leverage existing technologies. Perform trade-off analysis to determine the best approach to the soft catch system, and develop a preliminary design for the system.
Metrics:
Develop a model of concept design with detailed analysis and predicted performance.
Provide modeling and simulation analysis on key components along with limiting factors of the materials to be used.

PHASE II: Develop a prototype system. Demonstrate the system technology and characterize its performance.
Metrics:
design and develop a prototype based on Phase 1 modeling.
Prototype must be able to:
Stop munitions up to 400 lbs
Stop munitions up to 16" in diameter
Stop munitions with kinetic energies of 20 MJ at a minimum
Must be able to catch and recover up to 10 munitions in a 10 hour period

PHASE III DUAL USE APPLICATIONS: The system developed under this topic could be used by other test and training ranges to increase safety and reliability when firing and recovering large caliber ammunition. The system could also be marketed to foreign militaries for use on their training and test ranges.

REFERENCES:
1. Technical Manual 43-0001-28, Army Ammunition Data Sheets

KEYWORDS: artillery, large caliber, soft catch, recovery, internal ballistics

A20-032 TITLE: Laser Site Propagation Turbulence Profiling and Forecasting

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and demonstrate a system for turbulence profiling from a laser ground station for propagation to ground, air, and space targets given real-time optical measurements with integrated forecasting capabilities.

DESCRIPTION: The propagation of laser sources through the atmosphere from a ground site is affected considerably by atmospheric turbulence conditions surrounding the laser transmitter, in addition to turbulence conditions aloft. Turbulence conditions are affected by prevailing meteorological conditions in addition to local topography for the laser operating site, or at the target if located on the ground. For airborne targets, the turbulence conditions depend on the drop-off of turbulence with altitude near the ground and wind-shear conditions aloft. Propagation to space targets may involve long paths where inhomogeneous conditions exist over a range of altitudes. For laser propagation paths to ground, air, and space targets, the turbulence profile will determine the properties of atmospheric effects on laser illumination, and the ability to correct of an atmospheric channel with adaptive optics (AO) compensation systems. A system is desired for measuring existing turbulence conditions in the volume surrounding a laser installation site, as well as forecasting turbulence conditions at later times. The system may involve auxiliary sources, sensors, and platforms which work cooperatively with the ground station for turbulence profiling.

PHASE I: Develop new approach or employ existing techniques for turbulence profiling from a ground site to ground, air, and space targets. Quantify the capabilities of the turbulence profiling method through numerical simulations. Illustrate how the measurements may be used to aid turbulence forecasting capabilities. Develop a preliminary design for field testing to be conducted during Phase II.

PHASE II: Using the results from Phase I, develop prototype turbulence profiling hardware for use in field testing. Conduct field tests for ground and air targets out to 10 km range. Devise methods to extend operation ranges for space targets. Demonstrate the turbulence profiling and forecasting capability through field testing at an appropriate laser operating location.

PHASE III DUAL USE APPLICATIONS: Military laser systems operating at ground sites will be provided environmental turbulence conditions for assessing performance limitations. Optical communication systems may be environmentally adapted for optimized performance given measured or forecast turbulence conditions.

REFERENCES:
1. T.C. Farrell, D.J. Sanchez, P. Kelly, A. Gallegos, W. Gibson, D. Oesch, E.J. Aglubat, A.W. Duchane, D.F. Spendel, T. Brennan, “Characterizing Earth’s Boundary Layer (CEBL),” Proc. OSA, Propagation Through and Characterization of Distributed Volume Turbulence (2014).

2. D.H. Tofsted, “Modeling Turbulence Generation in the Atmospheric Surface and Boundary Layers,” U.S. Army Research Laboratory report, ARL-TR-7503 (2015).

KEYWORDS: communication, lasers, meteorology, sensing

A20-033 TITLE: Application of Artificial Intelligence/ Machine Learning/Deep Learning to the Test and Evaluation of Command, Control, Communication and Intelligence (C3I) systems

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Design and create a tool that automates and optimizes planning and test execution of Artificial Intelligence/ Machine Learning/Deep Learning enabled Command, Control, Communication and Intelligence (C3I) network and systems.

DESCRIPTION: Recent advances in the areas of artificial intelligence/ machine learning/deep learning (AI/ML/DL) have provided the opportunity to automate time-consuming manual processes in C3I network Test and Evaluations (T&E). Specifically, the incorporation of such things as neural networks and training processes has elevated AI/ML/DL as key innovation areas to improve test planning and reduce validation/verification of test infrastructure prior to test execution. This effort would mature these AI/ML/DL concepts to develop a planning/execution tool to generate a location specific network (system under test) architecture recommendations (based upon number of nodes, topography, Radio Frequency propagation, number of communication hops, etc.). Node locations will ensure that testing of the performance edges are verified (e.g. number of communications hops is selectable 1 – N drives node location). Additionally, this tool will recommend an optimal data collection infrastructure, perform the data collection, analysis and presentation. Real-time performance monitoring, analysis and feedback during test operations will enable improvements to the data collection and test processes. The collected dataset(s) will provide inputs to the AI/ML/DL tool enabling learning and improvement of tool functionality over time. The tool will also provide root-cause analysis for anomalies identified during test, improving use case implementation and execution. The system would follow a Modular, Open Systems Approach (MOSA) to allow T&E of a variety of Army systems. The MOSA approach would also provide extensible AI/DL/ML functions to identify and expand upon critical characteristics of the C3I systems. This tool will enable non-deterministic approach to C3I T&E. This tool must also provide C3I T&E community results expressed in statistical terms for comparison to historical C3I systems performance. Expected uses of the tool outputs are:

Descriptive analysis - data aggregation/mining provides insight into what has occurred
Predictive analysis – statistical models/forecasting to understand what may occur
Prescriptive analysis – optimization/simulation provides course of action recommendation
Note: Model validation, learnability, algorithm efficiency and empathy are among the key features of this tool.

PHASE I: Develop a tool design that includes artificial intelligence (AI) machine learning (ML), and deep learning (DL) algorithms and concepts, hardware and software specifications, and protocol operation (both internal and external).

PHASE II: Develop and demonstrate a prototype artificial intelligence (AI) machine learning (ML), and deep learning (DL) tool in a realistic environment. Conduct testing to prove feasibility over extended operating conditions.

PHASE III DUAL USE APPLICATIONS: End-state of this effort is transition of this tool to military Command, Control, Communication and Intelligence (C3I) programs of record and the commercial market. This tool is envisioned to optimize incorporation and application of artificial intelligence (AI) machine learning (ML), and deep learning (DL) capabilities in the decision-making process. This will provide verification and validation of AI/ML/DL algorithms and confidence in the increasing independent autonomy of Command, Control, Communication and Intelligence (C3I) systems.
DUAL-USE APPLICATIONS: This system could be used in a broad range of military and civilian Command,

Control, Communication and Intelligence (C3I) applications where equipment and systems must be optimally located - for example, in military exercises/operations or in enhancing critical industrial/commercial operations in congested/convoluted topographical environments.

REFERENCES:
1. "SUMMARY OF THE 2018 DEPARTMENT OF DEFENSE ARTIFICIAL INTELLIGENCE STRATEGY: Harnessing AI to Advance Our Security and Prosperity". February 12, 2019. Online at https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/1/SUMMARY-OF-DOD-AI-STRATEGY.PDF

2. Pandey, 2nd Lt. Sameer, "Opportunities to use artificial intelligence in Army logistics". 22 January 2019. Online at https://www.army.mil/article/216389/opportunities_to_use_artificial_intelligence_in_army_logistics

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6. United States Government Accountability Office, Report to the Committee on Science, Space, and Technology, House of Representatives. March 2018. "Technology Assessment: Artificial Intelligence, Emerging Opportunities, Challenges and Implications". Online at "https://www.gao.gov/assets/700/690910.pdf.

KEYWORDS: Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), Test and Evaluation (T&E), Command, Control, Communication and Intelligence (C3I)

A20-034 TITLE: Voice Quality and Call Completion Rate for an Operational Radio Test

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Provide comprehensive call completion rate determination during an operational radio test by obtaining objective measures of the voice quality of each call made. This requires instrumenting radios/operators and automatically grading the voice quality and call completion rate.

DESCRIPTION: This effort requires developing instrumentation to collect the voice traffic; harvest, manage, and correlate the voice data; and automatically determine the quality of the received voice traffic to determine call completion rate. The requirement can be subdivided into the following four areas:

- Voice Collection: The ability to capture all outgoing and incoming voice calls with minimum to no interference with the radio operator. This requires any appended collection capability to have a very small size and weight while having enough power and data storage to not require battery changes or data harvesting within a 96-hour test window. This collection must capture the voice in a manner that is representative of what the Soldier hears. Collecting voice-over IP (VOIP) traffic will not meet this requirement because it does not address the quality of the system under test microphone or speakers which are key components of effective voice quality.

- Voice Data Harvesting and Management: The ability to harvest and manage all collected voice as well as capture key metadata about the voice data (e.g. time collected, location, unit, radio identification, etc.).

- Voice Data Correlation: The ability to correlate all outgoing/sent voice calls with their corresponding received calls. A call is considered a single transmission sent/received pair. The metadata collected must be sufficient to perform this correlation of the voice data files.

• Voice Scoring: The ability to automatically apply a scoring algorithm to compare the sent with received voice data. An example of a scoring algorithm is the OPTICOM Perceptual Objective Listening Quality Analysis algorithm. The voice scoring algorithm must be adjustable to allow for calibration to a user-determined acceptable level. This would be done by conducting a manual voice quality test and comparing the manual scoring to the automated scoring algorithm result. From this comparison, a pass or fail value would be determined and the voice scoring algorithm would be calibrated to that user-determined acceptable level.

Finally, the system will need to generate reports showing call origination and reception over time and call-completion rates over time based on the pass/fail value provided.

PHASE I: Develop a concept for a prototype voice collection capability and present how it will be capable of meeting size, weight, and power constraints in an operational environment. Develop a design for voice data harvesting, management, and correlation to allow for voice scoring. Demonstrate a voice scoring algorithm using government-supplied sent/received voice traffic.

PHASE II: Develop and demonstrate a prototype voice collection capability. Develop a prototype voice data harvesting, management, and correlation capability to allow for voice scoring. Implement a prototype voice scoring algorithm and reporting capability.

PHASE III DUAL USE APPLICATIONS: The end-state of this effort will be to transition and mature this research and prototype capability to deployable test instrumentation for evaluating voice communications during operational testing of new tactical radio systems (e.g. Leader Radio, Manpack).

Commercial applications: Conducting voice assessment of customer service call center agents to verify they can be easily understood. Automated assessment of students learning to speak a new language.

REFERENCES:
1. Beerends, John & Schmidmer, Christian & Berger, Jens & Obermann, Matthias & Ullmann, Raphael & Pomy, Joachim & Keyhl, Michael. (2013). Perceptual Objective Listening Quality Assessment (POLQA), The Third Generation ITU-T Standard for End-to-End Speech Quality Measurement Part I-Temporal Alignment. AES: Journal of the Audio Engineering Society. 61. 366-384.

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KEYWORDS: voice collection, voice scoring, Call Completion Rate, radio, Operational Test, Voice correlation

A20-035 TITLE: High Energy, High Power 5V Electrochemical Energy Storage Solution

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: The objective of this topic is to develop an electrochemical cell capable of 5.0 V operation without capacity fade to support high power/energy demand of situational awareness devices in support of the Soldier Lethality Cross Functional Team (CFT).

DESCRIPTION: Lithium-ion batteries are a ubiquitous solution for portable energy storage for military applications. Their high energy density and recharge-ability at a reasonable cost make them very attractive for use in portable systems such as the centralized power source on the Next Generation Squad Weapon or on the

Warfighter to enable the Integrated Visual Augmentation System. However, this chemistry is presently limited to lower voltage operation due to the voltage stability of the cell-level components. Traditional lithium-ion batteries utilize carbonate-based organic electrolytes that degrade at elevated voltages above 4.4 V that result in CO¬2 generation, increased cell impedance, and active material consumption which prevent longevity of the cell. Other liquid electrolyte systems with high voltage stability often fail to achieve a suitable anode SEI (solid electrolyte interphase) to allow for continued cycling without capacity fade. In addition to electrolyte limitations, because selected anode potentials are often already close to the potential of lithium, the voltage of the cell is primarily dictated by cathode potential. Therefore, selection of a suitable cathode is critical to achieving the high voltage targeted by this topic. The C5ISR Center is interested in a cell system of electrolyte and electrodes that yield a high energy, high power 5 V electrochemical energy storage solution. Such a solution will directly apply to Soldier Lethality systems but can be leveraged to meet the demands of the Integrated Tactical Network, radio batteries, or incorporated into a storage component for pulsed power applications.

The resultant cell chemistry must perform across a wide temperature range between -30°C and 60°C. The cell must target a specific energy density greater than 400 Wh/kg at C/5 rate or 300 Wh/kg at a 5C rate at the cell level in order to achieve high performance at a battery level. Cell chemistry must demonstrate < 2% irreversible loss (on 3rd cycle at C/5) after 1 month of storage fully charged at 55°C. Considerations must be made to optimize cell efficiency to prevent wasteful charging conditions. The resultant cell must achieve 50% of capacity at -20 °C at C/10 rate.

PHASE I: Investigate various electrolyte/electrode systems to optimize the electrochemical performance at operating voltages at or above 5.0 V. Demonstrate high voltage operation with greater than 150 cycles in a laboratory cell and begin testing across a range of temperatures between -30°C and 60°C with emphasis on low temperature performance. Deliver 10 representative laboratory coin or single-layer pouch cells to C5ISR Center for preliminary electrochemical performance testing.

PHASE II: Refine and optimize the cell-level materials selected in Phase I and develop and deliver prototype cylindrical cells or multi-layer pouch cells to meet target performance requirements in the specified temperature range with rate capability outlined in this topic.

PHASE III DUAL USE APPLICATIONS: Transition technology to the U.S. Army for packing into a battery system in appropriate physical and electronic configuration. Integrate this technology into portable military devices that require high energy density power sources. Alternatively, integrate this technology into an energy storage component for pulse power applications.

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2. Army Warfighting Challenge #16

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KEYWORDS: Energy storage, high energy, portable power, high power, pulse power, soldier lethality, future vertical lift

A20-036 TITLE: Network Assisted Positioning, Navigation and Timing (PNT) in Low RF Signal Power Environments with Bandwidth Efficient Techniques

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and demonstrate a Positioning, Navigation and Timing (PNT) capability intended to enable Warfighters operating in low RF signal power environments (under tree canopy, vehicles, buildings, and other RF challenged areas) based on a network assisted techniques and time transfer but minimizes the utilization of the network. The primary goal is maximizing access to the PNT source (acquisition/tracking) in low RF signal environments; secondary goals are anti-jam, precision accuracy, and integrity.

DESCRIPTION: Prior work has developed and demonstrated Network Assisted GPS; however, there is a concern for the appreciable load for the function on the network required to accomplish the function. At the current time, the PNT ecosystem is growing well beyond just GPS with respect to the number of services, technologies, and users. Under this topic, research will be devoted to the services, the aiding data and sources, a means to support efficient data transport, storage of the data at the receiving side, techniques for signal acquisition/tracking, security concerns, and the system approach to resolve the problem. System trades will be conducted. The metrics that will be examined (not exclusive) will be time to first fix (TTFF), carrier to noise levels (characterizing environments in which the technique[s] are found useful), amount of data bytes required to be sent via the network to accomplish acquisition and continued tracking, efficacy of the aiding with respect to the time since the aiding information was last received, and ability to acquire with sparse information/time accuracy. Secondary goals are anti-jam (J/S), precision accuracy including positioning, velocity, and timing (PVT), and integrity (ability to sense a failure). Investigations will be conducted with regard to the integration of this capability with Joint Battle Command-Platform (JBC-P) and Nett Warrior.

PHASE I: Conduct the trades and analyses necessary to determine the functional system approach. Reduce risk in Phase I through prototyping and/or system modeling. Conclude Phase I with the definition of the Phase II system specification.

PHASE II: Develop, build, and demonstrate a system prototype. Initial concentration of the prototype can be to use just a few PNT services; however, the scalability of the system to include multiple PNT services should be proven. Use cases to be demonstrated are dismounted Soldier's access to PNT services in forested/jungle, residential, urban, and within buildings (required). Additional use cases are the demonstration of anti-jamming, precision accuracy, and integrity (desired).

PHASE III DUAL USE APPLICATIONS: The endstate for this topic is that there is potential to scale and continue to grow and support the entire Army (perhaps DOD) PNT ecosystem. Continued development and refinement, system will be further expanded in function to cover additional use cases and environments. In the commercial domain, similar parallels exist, for instance in the cellular network today where users need PNT access virtually anywhere, and as the PNT ecosystem continues to evolve, this system will need to be flexible to incorporate them.

REFERENCES:
1) "Network Assisted GPS … Coming Soon to a Precision Fire Mission Near You!", Paul Manz, US Army, PEO Ammunition, https://asc.army.mil/web/news-network-assisted-gps-coming-soon-to-a-precision-fire-mission-

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2) “Urban/Indoor Navigation Using Network Assisted GPS”, Brown, Alison K, Navsys Corporation; Olson, Paul, US Army, CCDC, C5ISR Center, Technical Report, Defense Technical Information Center, https://apps.dtic.mil/dtic/tr/fulltext/u2/a444157.pdf

3) “SPOT in Location Based Emergency Services, LBES Detailed Analysis”, Ali Sarwar, Binghao Li, Andrew G. Dempster, UNSW, Australia, https://www.researchgate.net/profile/Andrew_Dempster2/publication/242781684_SPOT_in_Location_Based_Emergency_Services_LBES_Detailed_Analysis/links/00b7d5383cbfaa064b000000/SPOT-in-Location-Based-Emergency-Services-LBES-Detailed-Analysis.pdf

KEYWORDS: Positioning, Navigation and Timing (PNT), Assured Positioning, Navigation and Timing (APNT), Network Assisted PNT, Network Assisted GPS, Global Navigation Satellite System (GNSS) PNT Ecosystem

A20-037 TITLE: Dynamic Frame Rate Throttling for High Resolution Low Light Cameras

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and demonstrate a Si:CMOS chip that is sensitive to low light applications that demonstrates frame rate throttling based on ambient light level conditions.

DESCRIPTION: Current Si:CMOS low light imaging technology has matured to the point where it is relevant for military missions. However, at the lowest light levels, these sensors still suffer from a lack of photons in the VIS-NIR waveband. For the dismounted Soldier, this can cause a lack of situational awareness in the lowest light conditions (overcast starlight, building interiors, etc.). This topic will address this shortcoming by demonstrating the feasibility of frame rate throttling based on ambient light conditions. Using a Si:CMOS chip that is sensitive to low light conditions, the associated readout integrated circuit (ROIC) should be capable of dynamically changing frame rates based on the amount of available light in order to maximize Signal-to-Noise ratio (SNR) while avoiding saturation. This should support frame rates from 240 Hz down to 15 Hz based on the light level available and be able to throttle in two frame times or less. Solutions that also provide dynamic pixel area aggregation are preferred, but not required. This would have sufficient resolution for situational awareness applications and would be able to fit on a small UAV or be carried on a helmet. These and other potential applications align closely with the Soldier Lethality Army Modernization Priorities.

PHASE I: The vendor shall show technical feasibility through design, modeling, and analysis. The design shall be optimized to operate in low ambient light conditions. Demonstrate a clear path to achieving manufacturability and to meeting small SWAP-C goals.

PHASE II: Produce the ROIC solution designed in Phase I and integrate into prototype imager system. Accompany the imager on at least one field event to observe frame rate throttling performance.

PHASE III DUAL USE APPLICATIONS: Refine product developed in Phase II into a Standards Compliant Low Light Level Camera (SCL3C)-type module for integration into military applications. Military applications can include dismounted Soldier and autonomous vehicle mobility. This topic supports SL (e.g., IVAS/Digital Soldier, SBS, Smart Sight, ENVG-B), NGCV (e.g., OMFV, RCV), and FVL (e.g., FARA). Nonmilitary commercialization opportunities would include autonomous navigation and integration into scientific CMOS imaging systems.

REFERENCES:

1. Choi, B.-S, et al. (2017). A Low-power CMOS Image Sensor Based on Variable Frame Rate Operation. Journal of Semiconductor Technology and Science. 17. 854-961.

2. Choi, Jaehyuk, et al. (2007). A Spatial-Temporal Multi-Resolution CMOS Image Sensor with Adaptive Frame Rates for Moving Objects in the Region-of-Interest. 502 - 618.

3. Chuang, K. (2016). Dynamic Frame Rate: A Study on Viewer Perception of Changes in Frame Rate within an Animated Movie Sequence. ACM SIGGRAPH 2016 Posters, 81.

KEYWORDS: LLL, low light level, imaging, camera, ROIC, frame rate

A20-038 TITLE: Cyber Terrain and Electromagnetic Operating Environment (EMOE) Scenario Generation Toolkit (CTAEMOESGT)

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Develop a Cyber Terrain and Electromagnetic Operating Environment (EMOE) Scenario Generation Toolkit (CTAEMOESGT) software that can generate various real world scenarios/use cases/vignettes. This capability will enhance and aid in planning with the use of simulation Cyber Electromagnetic Activities (CEMA) Tactics Techniques Procedures (TTP) within Doctrine, Organization, Training, Material, Leadership and Education, Personnel, and Facilities (DOTMLPF) environment.

DESCRIPTION: Develop a predictive tool that is able to enhance Cyber understanding and increases situational awareness within various types of terrains and Electromagnetic Operating environments. The increased ability shall be flexible enough to acquire various types of data inputs that encompass geolocations, relationship of organizational groups, types of urban and rural infrastructures (such as building structures, roads, and traffic flow of people and vehicles), and electromagnetic spectrum usage. This tool will provide trends and support the tactical and strategic decision making process.

PHASE I: Research and draft a feasibility study in a technical report that includes an approach to develop prototype software with the following considerations: 1) samples of scenarios with tips, hints, checklists, examples; and the specific information needs and justifications within the context of the operational intentions by decision-makers; 2) pre-emptive display of template for creating scenarios based on the selection of the fidelity levels, mission types, and events/scales of operations; 3) accurate identification of persons of interest and their malicious activities via multi-source collection/processing; 4) the mechanisms/features for aiding analysts with automation of template and workflows of intelligence driven scenarios based on requirements of the intelligence needs and mission planning; 5) Common Operational Picture (COP) to exhibit realistic activities and modes of conducts under various urban operational environments within Concepts of Operations (CONOPs); and 6) assessment of the lessons learned via the standard schemas/tools and interface with the selected government models and database together with the user friendly Human Machine Interface (HMI). The events and activities in each scenario should be modeled in generic and extensible modules to support creation of specific details and building of libraries of event/activity portfolio by the users. The models should be realistic and diversified to support pattern and link association for trend analysis. The technical report shall include all findings and technical approaches to develop a software prototype to proceed to Phase II.

PHASE II: Research and develop a prototype software and a technical report that capture and allow operators to simulate realistic and diversified scenarios in an urban environment. The prototype shall be able to predict the capabilities, intentions, and potential actions of persons of interest based on lessons learned and support a Course of Action (COA). The software will generate CEMA information for analysis in a usable format to support automated reasoning and a rationale to the user in order to support a decision. The technical report needs to identify the development findings and outcomes, along with the strengths and limitations for each software model, database, algorithm, and technique that was explored and used. In addition there should be a plan to enhance and transition the capabilities of the technology to a U.S. Army Program of Record.

PHASE III DUAL USE APPLICATIONS: The software developed in this effort may be leveraged in a broad range of potentially high payoffs for military and civilian applications. The predictive analysis capability will assist the military with decision aids to support U.S. Army Program of Record regarding force protection, mission command, surveillance, maneuverability, and training. The commercial potential could be used in modeling building infrastructures, determining the placement of communication systems, transportation, and industrial security. Overall the modeling and simulation tool would be an asset for short- and long-term planning to recognize and deter threats.

REFERENCES:

1. https://publicintelligence.net/us-army-cema/

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3. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp6_01.pdf

KEYWORDS: Cyber Terrain, Electromagnetic Operating Environment (EMOE), Cyber Electromagnetic Activities (CEMA)

A20-039 TITLE: Air Surveillance Radar Classification Improvement

TECHNOLOGY AREA(S): Electronics

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OBJECTIVE: Develop and demonstrate an advanced target classification algorithm that will allow a ground-based Multi-Mission Radar to discriminate among UAS, manned aircraft, and clutter (i.e., birds, vehicles, ground clutter, etc.) by using signatures, target track characteristics, and other features.

DESCRIPTION: With the emerging threat of Unmanned Aerial Systems (UAS), the ARMY is enhancing its ground-based Counter Target Acquisition (CTA) Radars with the ability to detect and track UAS. These ground-based Multi Mission Radars (MMR) are able to detect and track airborne objects, such as rockets, artillery, mortars, UAS, manned aircraft, and clutter (i.e., birds, vehicles, etc.). The MMR radars are currently limited in their ability to accurately discriminate among UAS, manned aircraft, and clutter. Misclassifying targets can cause an incorrect responsive action by U.S. forces in critical situations. Significantly improving the classification accuracy of MMR radars is a high Army priority. The main purpose of this effort is to investigate, develop, and demonstrate a classification algorithm that uses target features to discriminate between UAS, manned aircraft, and clutter with high confidence.

PHASE I: Identify candidate algorithms that address the challenge described in the objective section of this document. Investigate current classifier functionality, develop more suitable parametric models, conduct studies on candidate algorithms (size, power consumption, speed, and complexity, relative to available computer processing resources), investigate high resolution waveforms and the frequency at which they should be scheduled to be effective, and perform laboratory testing on viability of candidate models and algorithms. At end of Phase I, prepare and present a study report to do the following: (1) identify algorithms that improve classification, (2) provide process and schedule for productization into the software baseline, and (3) demonstrate a plan for Phase II.

PHASE II: Develop and demonstrate improvements to classify UAS, manned aircraft, and clutter into target type and sub-type categories using previously collected Radar Data and during Live Test Events at Yuma Proving Ground, AZ utilizing current ground based ARMY radar systems.

PHASE III DUAL USE APPLICATIONS: Productization of improvements into the software baseline: provide analysis, design updates, implementation support, and systems engineering testing for proposed algorithmic updates developed under Phase I and demonstrated in Phase II. Additionally, update the software and firmware to accommodate the final design and provide the following: software source code and executable files, system/subsystem specification updates, and performance specification document updates. Lastly, prepare lab tests, engineering test plans, and procedures to demonstrate the performance of the algorithms during a test event.

Effective deployment of this advanced classifier may serve to enhance the performance of current and future ARMY Air Surveillance and Multi-Mission radar systems such as the AN/TPQ-50 and AN/TPQ-53. Both Programs of Record are funded annually for modernization efforts, commonly referred to as Modernization Development Efforts (MDE), which provide a conduit for the integration of improved hardware and emerging software algorithms. This includes initial design and development efforts, laboratory design, productization into the software baseline, and field testing. The general classifier approach also has applicability in non-military radar systems. The same algorithm improvements planned for DoD Radar Systems can be utilized by FAA radar systems and commercial systems to help with bird strike avoidance and UAS detection around airports.

REFERENCES:
1. Bilik, Igal, Joseph Tabrikian, and Arnon Cohen. "GMM-based target classification for ground surveillance Doppler radar." IEEE Transactions on Aerospace and Electronic Systems 42.1 (2006): 267-278.

2. Duda, Richard O., Peter E. Hart, and David G. Stork. Pattern classification. John Wiley & Sons, 2012.

3. Christopher, M. Bishop. Pattern Recognition and Machine Learning. Springer-Verlag New York, 2016.

KEYWORDS: Multi-Mission Radar, Target Classification

A20-040 TITLE: Mitigation of GMTI Radar False Alarms Due to Wind-Blown Foliage with Machine Learning Techniques

TECHNOLOGY AREA(S): Electronics

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Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: The objective of this task is to develop a machine learning technique for Ground Moving Target Indicator (GMTI) radars that will mitigate false alarms caused by windblown foliage and other nonstationary clutter while maintaining the ability to detect slowly-moving ground targets. GMTI radars will typically adapt a Constant False Alarm Rate (CFAR) threshold and/or form a conventional clutter map system. This clutter map contains the Radar Cross Section (RCS), Doppler bandwidth of the clutter return, the extent of region in which the persistent false alarms occur, and the probability density functions of the clutter data. Radar operators will commonly desensitize particular areas of coverage due to these high false alarms. While this approach will minimize the false alarms caused by dynamic clutter, large portions of the radar coverage area can be desensitized. This desensitization can allow an area to be penetrated by hostile forces.

The objective of this topic is to determine whether machine learning techniques are able to differentiate between areas of dynamic clutter that are unoccupied from those that contain ground moving targets. This effort will compare the performance of the machine learning approach versus that of a CFAR / conventional clutter map system as a function of the clutter characteristics (e.g., RCS, Doppler bandwidth, and temporal variability), the target speed, heading, RCS, time required to make an initial detection, and the tracking accuracy.

DESCRIPTION: Airborne and ground-based MTI radars are designed to detect, locate, and track slowly moving targets such as walking dismounts. A critical issue for these radars is persistent false alarms caused by nonstationary clutter such as windblown foliage, moving water, and rotating objects. This effort will design a machine learning technique that will improve radar detection, location, and tracking performance by first using simulation, and then demonstrating the technique on collected radar MTI data. A thorough understanding of both machine learning techniques and the operation and performance of GMTI radar must be demonstrated to successfully perform this effort.

PHASE I: Demonstrate through simulation a viable and robust machine learning technique to mitigation of GMTI radar false alarms. The simulation is expected to use statistical clutter based on user-specified RCS and Doppler bandwidth. Targets are expected to be simulated as constant speed with a user-specified RCS. The developer will compare these simulations against a conventional clutter map approach.

PHASE II: Further develop the machine learning technique to process various dynamic clutter / ground moving target data. Data sets will be provided by the Government or obtained by the performer from any available sources including a customer-owned GMTI radar. The developer will compare these simulations against a conventional clutter map approach.

PHASE III DUAL USE APPLICATIONS: Work with Army and industry partners to incorporate the machine learning technique within an existing or developmental radar system. The offeror will demonstrate the capability and applicability of the machine learning technique for both government and commercial applications. The offeror will provide a comprehensive commercialization program plan to ensure transition of this technology from military to commercial applications such as perimeter security, border security, or other military or civilian application.

REFERENCES:
1. Skolnik, Merrill. Introduction to Radar Systems. McGraw-Hill Inc, New York, 1992, Pp. 392-395.

2. Conte, E. et al. “CFAR detection of distributed targets in non-Gaussian disturbance,” IEEE Transactions on Aerospace and Electronic Systems, 38, 2 (2002).

3. Guo, Sai, et al. “Sea Clutter and Target Detection with Deep Neural Networks,” 2nd International Conference on Artificial Intelligence and Engineering Applications, 2017

KEYWORDS: GMTI Radar, Clutter Suppression, Machine Learning

A20-041 TITLE: Low Probability of Intercept Sense Thru Wall Radar

TECHNOLOGY AREA(S): Electronics

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OBJECTIVE: Build and demonstrate a Low False Alarm, Low Probability of Intercept (LPI), Thru Wall Radar System

DESCRIPTION: U.S. Army requires the tactical capability to quickly detect, locate, and discriminate hidden chambers and people. The automated sensor system must be able to distinguish between a normal space, for example the space between wall studs, and an occupied space to enable the operator to quickly focus their Sensitive Site Exploitation (SSE) operations. The system needs to operate with various common building materials, including brick, cinder block, concrete, wood, sheet rock, etc. The system needs to be automated, easy to operate, and not require specialized technical training to interpret. The urban Warfighter must be able to increase his/her situational awareness in an expeditious manner. This proposal will enable non-wall contact detection of hidden chambers and personnel. Critically important in sense thru the wall programs is achieval of a low false alarm rate due to complex clutter environments and multi-path. Thru Wall Radar System must be immune to interference (e.g., simple jammers). The radar signals must also be Low Probability of Intercept (LPI) and Low Probability of Detection (LPD).

PHASE I: Offeror will demonstrate their knowledge and understanding of state-of-the-art RF systems and their practical application. Offeror will highlight their understanding of operational parameters facing the dismounted and mounted Soldier, as it relates to thru wall detection, in the modern Army. The Offeror will design a radar system with LPI/LPD characteristics and low false alarm rate.

PHASE II: Design, develop, build, and test a mounted and dismounted RF prototype radar for thru wall applications.

PHASE III DUAL USE APPLICATIONS: Offeror will work with the Army and industry partners to create a commercialization and manufacturing plan for the system to support fielding by an Army program of record. The Offeror will illustrate a comprehensive commercialization program plan to ensure transition of the technology from military to commercial application.

REFERENCES:
1. Walton, “Ultrawide-band noise radar in the VHF/UHF band” - Jul 1999 · IEEE Transactions on Antennas and Propagation

2. Walton, “Random Noise Radar” – Live Science 2006

3. Skolnik, Merrill. Introduction to Radar Systems. McGraw-Hill Inc, New York, 1992

KEYWORDS: Low Probability of Detection, Low Probability of Intercept, Anti-Jam, RADAR

A20-042 TITLE: Federated/Encrypted Biometrics System (FEBS)

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Research and develop a federated identity management software system that leverages techniques to match encrypted biometrics (such as fingerprint, face, iris, Deoxyribonucleic Acid (DNA), etc.) data and utilize multiple techniques that encompass biometric template protection. The work will leverage a feature transformation and multi-biometric cryptosystems utilizing secure biometric schemes to create derived biometric templates. This approach will create revocability/renewability and un-linkable identification information that is not directly traced back to the original biometrics, thus increasing data security.

DESCRIPTION: The integrated biometric capabilities across the Joint, Interagency, International, Multinational (JIIM) communities greatly increase overall Identity Activity mission readiness in Biometric Enabled Intelligence (BEI) analysis, in support of theater operations with mission enablers for force protection, intelligence, physical and logical access control, identity management/credentialing, and interception operations. Therefore, there are urgent needs, such as maintaining confidence and strengthening our relationships with international communities by demonstrating a wider array of biometric protection capabilities to partner nations. The overall security of this development will minimize or prevent access to biometric data. In the enrollment stage, biometric data is stored as a reference template in a standard format. The biometric data of the person of interest is transformed (or rather derived) into a candidate biometric template for matching against the reference template and cross-matching templates from different databases. The derived biometric template is designed to reveal little or no information about the original biometrics of an individual. The derived biometric template from the original template should conform to the requirements of irreversibility, revocability/renewability, and un-link-ability. “Irreversibility” emphasizes that it is impossible to generate the original template from a person’s derived biometric template. “Revocability/Renewability” implies the ability of revoking and re-issuing the derived biometric template. “Un-link-ability” prohibits the trace of the multiple derived biometric templates to the same original template. The optimal solution is the federated biometric software system with novel techniques to identify/verify invaluable and irreplaceable identity information within an enterprise environment. To maximize protection, the proposed federated software systems should be able to run application software tools at various local storage of derived biometric templates that use encrypted protection schemes/mechanisms in the multi-biometric cryptosystems.

PHASE I: Research and list various types of technologies associated with the proposed approach to develop a prototype software and a technical report that has the following considerations: 1) leveraging existing technologies and upcoming technical advances that address the technical challenges; 2) provide a detailed description of the problem areas and the associated solutions with full explanation of the proposed disciplines, procedures, techniques, capabilities, and resources; 3) describe the operational constraints, feasibility of each approach, capability, applicability, assumption, and restrictions of the outcomes of the proposed effort; 4) indicate which software architecture and development environment (software tools, interface requirements, specifications of input/output data, etc.) would work optimally in a Windows (laptop and desktop) environment; and 5) list the methods and criteria for the performance measurements. Deliver a technical report on the study findings, algorithms, models, techniques, and software architecture of the proposed software system for the next phase development along with the implementation and evaluation plan of the proposed capabilities.

PHASE II: Research and develop a prototype software and technical report that captures the following focus areas: 1) encrypted-derived biometric templates; 2) multi-biometric cryptosystems; 3) processes of encrypted biometric data via application tools at the local storage level for identification and verification of people of interest; 4) enhancement of models of running multiple application tools at various local databases; and 5) development of scientifically sound methods (metrics, experiments, etc.) to evaluate the overall capability of the software. The technical report shall list the strengths and limitations of all algorithms, software models and techniques, and proposed architectures that were explored.

PHASE III DUAL USE APPLICATIONS: The techniques and algorithms developed in this effort may be leveraged in a broad range of potentially high payoff military and civilian applications. The prototype system will increase the protection of data and enhance the identification of people of interest. The focus is to transition the development into U.S. Army Programs of Record that support the commander’s decision and increase situational awareness. In addition to supporting not only military and other government agencies to identify, track, and reunite civilian populations during Security, Stability, Transition, and Reconstruction (SSTR) and Humanitarian and Disaster Relief

(HADR) efforts. Law enforcement agencies and private companies will have the capability to enhance their security and protect Personally Identifiable Information (PII) data.

REFERENCES:
1. https://medium.com/syncedreview/federated-learning-the-future-of-distributed-machine-learning-eec95242d897

2. https://www.researchgate.net/publication/278671027_Identification_Using_Encrypted_Biometrics

3. https://pdfs.semanticscholar.org/83de/c5bff60692964a140180e71e6775ab54991e.pdf

KEYWORDS: Federated identity management, irreversibility, revocability/renewability, and un-link-ability

A20-043 TITLE: Innovative Approaches for Aided Target Recognition (AiTR) of Army Targets

TECHNOLOGY AREA(S): Electronics

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OBJECTIVE: Develop approaches for AiTR that advance the state-of-the-art for specific military applications, sensors, and operating conditions.

DESCRIPTION: In recent years the research area of computer vision, a subfield of Artificial Intelligence (AI), has received significant attention and investments from both commercial and Department of Defense (DoD) sources. The principal trend has been to use deep learning-based approaches to automate both feature generation and object classification. While this approach has many advantages, especially in commercial applications, it has many disadvantages and limitations in DoD problem spaces. This is due largely to dynamic and unpredictable operating environments, uncooperative targets (e.g., partially concealed or in tree lines), and of course a shortage of data relevant to the problem space.

The Army desires innovative approaches for improving performance, robustness, and/or training efficiencies for Army AiTR systems. Possible improvements could be, but are not limited to the following:
- Improved probability of detection and false-alarm rates for AiTR algorithms against Army relevant targets with infrared (IR) imagery
- Approaches to train algorithms using reduced amounts of data (e.g., transfer learning, synthetic data)
- Manually created features that perform as good, or better, to deep learning automated features against Army relevant targets with IR imagery
- Algorithm improvements to increase robustness to unpredictable and untrained on environments and backgrounds
- Methods to quickly update a trained algorithm to a new target of interest without requiring the algorithm to retrain on previous target data

Solutions proposed to this topic should describe an innovative and novel approach to current state-of-the-art AiTR algorithms. The proposal should explicitly describe the innovative aspect of the proposed solution and specify how and why this innovation is helpful to the Army AiTR mission. Where possible provide quantitative metrics.

PHASE I: The proposer shall complete a proof-of-concept AiTR algorithm. This proof-of-concept shall demonstrate the proposed solution and the improvement it provides against the current state-of-the-art. For this phase the proposer shall use their own data. Government Subject Matter Experts (SMEs) will evaluate the proposer's design and results to determine utility against Army problem sets.

PHASE II: In Phase 2 the proposer will be provided IR data against targets and environments relevant to Army operations. During this phase the proposer will mature the AiTR approach to a TRL 6 level. In this phase the proposer shall evaluate improvements provided by this solution over current state-of-the-art commercial approaches. Army SMEs will evaluate the final solution against an Army sequestered dataset to determine improvements over current Army approaches.

PHASE III DUAL USE APPLICATIONS: Transition the developed approach to Army programs of record (PORs) and Army Futures Command (AFC) Cross Functional Teams (CFTs). In this phase the algorithms will be integrated into on-board processing hardware and platform software systems. Additional maturation of the algorithms using actual platform sensor data will take place.

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1. Haykin, S., [Neural Networks and Learning Machines], Pearson Education, Inc., (2009)

2. James A. Ratches, "Review of current aided/automatic target acquisition technology for military target acquisition tasks," Opt. Eng. 50(7) 072001 (1 March 2011)

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KEYWORDS: ATR, AiTR, artificial intelligence, machine learning, computer vision, image processing

A20-044 TITLE: Novel Single Plane Optics for Lightweight, Compact Imaging Systems

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and demonstrate an innovative optical element with broadband color correction with applicability in the MWIR (3-5 micrometer) or LWIR (8-12 micrometer) wavebands. The element should be capable of meeting high optical performance using flat surfaces on a thin (<1 mm) substrate with sub-wavelength or super-wavelength sized features formed on the surface.

DESCRIPTION: As the Army continues to develop focal plane array (FPA) technology, it moves in either the direction of smaller, lighter electronics or larger formats and therefore physical size. In the first instance, these FPAs can be utilized by the Warfighter as situational awareness devices in conjunction with lightweight personal drones. Their performance in this application can be limited by the optics required to form an image onto the FPA. Conventional optics exceed the SWAP payloads these extremely small devices are able to accommodate and the system’s full potential will remain unrealized. In the second case, FPA sizes grow and the optics required for them also grow proportionally. The larger FPAs with greater pixel counts can enhance the situational awareness, survivability, and lethality of the Warfighter. However, the larger optics required and the weight associated can put a strain on the Soldier and decrease their ability to accomplish their mission.

Innovative technologies have appeared that allow for novel optical elements that can be on flat substrates of less than a millimeter thickness. The elements, alone or paired with another flat planar optic or a conventional optical element, will allow for very lightweight optics that maintain a high level of optical performance. The technologies that allow for this are features on the scale of the wavelength of light (sub-wavelength or super-wavelength) that can be formed on the surface of the substrate using photolithography or similar techniques as well as increased computing power and sophisticated software to allow for the design and optimization of these features.

As the technology development organization for the Army's FPA and IR camera programs, the U.S. Army CCDC C5ISR Center NVESD provides research, development, and engineering support to programs such as Integrated Visual Augmentation System (IVAS), Soldier Borne Sensors (SBS), and Enhanced Night Vision Goggle (ENVG). In this role, C5ISR Center NVESD is seeking to partner with a small business to develop optical elements that can focus broadband wavelengths with an element that has a thickness of less than 1 mm. Wavebands of particular interest to the Army are the SWIR (1-2 micrometers), MWIR (3-5 micrometers) and, particularly in the short term, LWIR (8-12 micrometers). To support uncooled operation, these lenses will require diffraction-limited or near diffraction-limited performance at low f-numbers (F/0.9 to F/1.2) with high efficiency (>80%) across the waveband.

PHASE I: Identify the key parameters and requirements associated with military optical systems. Conduct initial studies and design effort related to producing a planar lens on an appropriate substrate for MWIR or LWIR wavebands. Determine necessary equipment and manufacturing process to fabricate planar optical elements. Produce initial proof-of-concept lenses using the design and manufacturing processes to show viable path to meeting Army program requirements.

PHASE II: Produce planar optical elements on appropriate substrate. Demonstrate diffraction-limited or near diffraction-limited optical performance across a large waveband with high-efficiency at a low f-number. Demonstrate ability to maintain performance across a 30 to 50 degree horizontal field of view. Subject planar optical elements to necessary environmental tests, such as temperature, to show applicability to military systems. Demonstrate path to manufacturing planar optical elements at production quantities. Deliver prototype lenses to C5ISR Center NVESD for further testing and application.

PHASE III DUAL USE APPLICATIONS: Design and manufacture planar optics applicable to specific Army programs. Most likely applications for insertion include Soldier Borne Sensor (SBS), a handheld drone for squad level airborne recon and surveillance, Integrated Visual Augmentation System (IVAS), an augmented reality system for individual Soldiers, Enhanced Night Vision Goggles (ENVG), night vision goggles with LWIR camera imagery overlaid, or miniature cameras for covert persistent surveillance.
Dual-use applications for planar lenses include any application where thermal cameras are used. Potential applications include law enforcement, fire-fighting, hunting, and paranormal research.

REFERENCES:
1. N. Mohammad, M. Meem, B. Shen and R. Menon, "Broadband imaging with one planar diffractive lens," arXiv:1712.09179 [physics.optics]

2. P. Wang, N. Mohammad and R. Menon, "Chromatic-aberration-corrected diffractive lenses for ultra-broadband focusing," Nature Scientific Reports 6, 21545 (2016)

3. W. Chen, et al., (2018, March) "A broadband achromatic metalens for focusing and imaging in the visible," Nature Nanotechnology, Vol. 13, pp. 220-226

KEYWORDS: Optics, Planar Optics, Metalenses, IR Lenses, Diffractive Optics

A20-045 TITLE: Additive Nanostructured Arrays (ANA) for Broadband Anti-Reflectivity (AR)

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and deliver optical elements that minimize reflection and improve light transmission by the additive fabrication of nanostructured arrays. The fabrication of ANA should include growth methods for IR lensing materials including Ge, ZnS, GaAs, and CaF_2.

DESCRIPTION: U.S. Army sensor systems are complex optical instrumentation with rigorous requirements related to their function and operational environments. These requirements lead to very complex optical designs, particularly for imaging systems in the inferred operating at broadbands such as 3-12 µm. For complex systems with many optical elements, it is imperative to reduce unwanted reflections and maximize transmission to the focal plane array. A promising method of reducing reflection is an array of subwavelength features on the surface of an optical element. These features effectively create a gradient refractive index reducing reflection leading to higher transmission. This method is inspired by nature and is often referred to as a “moth eye coating” and has many advantages over other means of AR coatings, including being broadband, omnidirectional, and polarization-insensitive.

The Army desires methods of creating additive nanostructured arrays on IR lensing materials. These methods should effectively grow crystals of the substrate lens material at a high aspect ratio perpendicular to the surface to create the desired anti-reflective effect. These methods can include but are not limited to colloidal growth and chemical vapor deposition. Proposed methods should limit lithography and etching methods.

A method is required for each of the IR lensing materials, Ge, ZnS, GaAs, and CaF_2, with the resulting ANA reducing reflection to below 1% in the 3-12 µm band at incident angles of up to 60°. The method should be able to accommodate substrates from 12-155 mm in diameter and with a curvature of twice the radius. The high-rate production should not significantly increase the cost of optical elements and should be able to be applied to uncoated COTs lens. Successful ANA AR strategies will be supported and implemented through the appropriate Army Cross-Functional Teams and Program Offices. This topic would have particular benefit to the 3rd Gen FLIR Program of Record and its support to the Next Generation Combat Vehicle Cross Functional Team (NGCV CFT).

PHASE I: The proposer shall complete an exhaustive literature search and report to the Army experimental strategies for fabrication of ANA for each of the IR lensing materials. The report shall also include design parameters for the ANA that will make effective AR coatings. These conclusions should be supported by modeling efforts and peer-reviewed literature.

PHASE II: Using the results of Phase I, fabricate and deliver a flat and cured examples of all the IR lensing materials for Army evaluation. Each method of ANA manufacture should be well documented and the resulting features thoroughly characterized. Examples of each will be subject to the Army environmental and durability testing procedures.

PHASE III DUAL USE APPLICATIONS: Transition applicable techniques and processes to a production environment with the support of an industry partner if needed. Finalize a methodology production for elements with appropriate performance metrics. Determine the best integration path as a capability upgrade to existing or future systems. Commercially, this technology will be widely applied in devices in the telecommunications and aerospace industries.

REFERENCES:
1. Boehme, M.; Ensinger, W. “From Nanowheat to Nanograss: A Preparation Method to Achieve Free Standing Nanostructures Having a High Length/Diameter Aspect Ratio” Advanced Engineering Materials 2011. 13, 373. DOI 10.1002/adem.201000346

2. Qi, D. et al. “Bio-inspired Antireflective Heter-nanojunctions with Enhanced Photoactivity” Nanoscale 2013. 5, 12383. DOI: 10.1039/c3nr04011a

3. Cai, J. et al. “Self-cleaning, Broadband and Quasi-omnidirectional Antireflective Structures Based on Mesocrystalline Rutile TiO2 Nnanorod arrays” Energy Eniron. Sci. 2012. 107, 321. DOI: 10.1039/C2EE03573A

4. Ravipati, S. et al. “Broadband and wide angle antireflection of sub-20 nm GaAs nanograss” Energy Environ. Sci., 2012. 5, 760. DOI 10.1039/C2EE2155*F

KEYWORDS: Optics, Anti-Reflective Coating, Infrared Sensor

A20-046 TITLE: Self-Healing Optical Elements

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and deliver optical elements that will independently repair damage. The self-healing optics should be capable of returning to their originally manufactured performance after receiving either physical or laser damage. The repair mechanism should be initiated by the damage and require no human triggering and be completed within seconds.

DESCRIPTION: U.S. Army sensor systems consist of the most advanced technology available and are routinely subjected to extreme environments including heat, cold, sand/dust, high winds, and intense lasers which can result in their damage. It is a burden upon the Army in terms of materiel and labor to replace these elements but an even greater threat is the tactical disadvantage of a system becoming inoperable during maneuvers. The Army desires a method of creating self-healing optics that can be applied to its sensor systems. The self-healing mechanism can be implemented in either of two ways: as a coating that can be applied to existing optics or as the development of a new material suitable in high-performance optical elements including mirrors and lenses. Self-healing coatings or materials should be designed to be as broadband as possible, including as much of the 0.2-20 µm spectrum as possible. The self-healing capability should repair damage up to 0.5 mm deep from the elements surface within 2 seconds. Self-healing elements should be able to span sizes from 12-155 mm in diameter. The functional lifetime of an element should exceed 5 years or 10,000 damage repairs before a 2% degradation in performance.

The high rate production should not significantly increase the cost of optical elements and total cost of an element should be below $1 per mm2. Unrequired features of interest include compatibility with anti-reflective nanostructured array coatings, greater than 95% reflective mirrors in the 3-10µm band, and mirrors with tunable laser damage thresholds. Successful self-healing strategies will be supported and implement through the appropriate Army Cross-Functional Teams and Program Offices. This technology would be particularly useful for the NGCV and FVL CFTs due to the stressing environments that exposed optics encounter as these vehicles traverse dust, smoke, dirt, fog, soot, rain, etc.

PHASE I: The proposer shall complete a conceptual design of a self-healing system for effectiveness against physical and laser damage and demonstrate experimental proof of principle.

PHASE II: Using the results of Phase I, fabricate and deliver a fully functioning prototype meeting the performance metrics. The prototype should meet all the requirements for TRL 5: "basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment," and be on the way to meeting TRL 6: "prototype system, which is well beyond that of TRL 5, is tested in a relevant environment." At the end of Phase II, the selection and demonstrated implantation of this technology into an Army system is desired.

PHASE III DUAL USE APPLICATIONS: Transition applicable techniques and processes to a production environment with the support of an industry partner if needed. Finalize a methodology production for elements with appropriate performance metrics. Determine the best integration path as a capability upgrade to existing or future systems. Commercially, this technology will be widely applied in devices such as cell phone screens, eyeglasses, sporting optics, and automotive glass.

REFERENCES:

1. Smimov, E. et al. "Self-healing gold mirrors and filters at liquid–liquid interfaces" Nanoscale 2016. 8, 7723 DOI:10.1039/C6NR00371K

2. Edel, J. et al. "Self-Assembly of Nanoparticle Arrays for Use as Mirrors, Sensors, and Antennas" ACS Nano 2013. 7, 9526. DOI: 10.1021/nn405712r

3. Luo. X. et al. 'Shape Memory Assisted Self-Healing Coating" ACS Macro Lett. 2013. 2, 152. DOI 10.1021/mz400017x

KEYWORDS: Self-Healing, Optics, Laser Damage

A20-047 TITLE: Energy Storage with an Embedded Battery Management and Inverter Subsystem

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: The objective of this effort is to investigate, develop, and fabricate a scalable, modular, highly energy dense, smart battery solution set comprised of an energy storage source (6T format) with an embedded battery manager and inverter subsystem. Successful execution of this effort will result in benchmark reliability and operational flexibility characteristics critical to Soldier, robotic enablers, and remote system (weapons and communications) applications in support of Soldier Lethality, Network, and Next Generation Combat Vehicle (NGCV) CFTs.

DESCRIPTION: To ensure successful outcomes in the tactical battlespace, all operations require the capability of, and reliability from, electrical power. Therefore, to enable and support the initial phases of offensive and defensive tasks, Soldiers typically use a hybrid power/energy configuration comprised of portable batteries, renewable power supplies, low-voltage generator sets, and the associated hardware to support electro-mechanical interfaces. While a viable approach, it is not always practical in terms of the operational compatibility of a given battery chemistry within varying tactical environments, of the functional interfaces between the battery and inverter, and of Soldier carry, mobility, and ease of use. Commonly available low-voltage COTS batteries may not be immediately suitable for use in certain tactical environments or applications. Energy inefficiency, parasitic power loss, and thermal management issues can arise if the power electronic inverters, battery management system, and selected battery chemistry are incompatible. Finally available COTS inverters are not designed to handle the impact of nonlinear loads and are many times too large and heavy for tactical applications.

To take advantage of a true hybrid power and energy solution, the Army seeks a Soldier portable (lift/carry) smart battery with an embedded battery manager and inverter subsystem for tactical applications in a multi-domain operating space. Solutions sought shall be modular and scalable to support operations requiring 2 to 5 kW. Final results shall enable a less complex system configuration with minimal to no interface hardware.

PHASE I: Develop conceptual component, subsystem, and system-level scalable (2 – 5 kW) / modular smart battery with embedded inverter and battery manager design in accordance with the following metrics.

Battery:
• COTS Li Ion – 6T format
• 24 V module w/programmable DC or AC output

Embedded Inverter:
• Scalable serial connection: 24 V increments
• Parallel connection: to enable multiple battery
• Variable DC voltage: 3.6 - 48 VDC,
• Fixed AC: 1-Phase: 120 VAC
• Fixed AC: 3-Phase – 120/208 VAC
• Variable AC frequency: 50 and 60 switch selectable

Battery Management: Cell-level voltage, cell temp, and SoC monitoring; module/string voltage and current; failure isolation

Communication Interface: ModBUS TCP/IP; CANbus with progression to TMS as it becomes available

Transport: Ability to be safely transported by commercial and military vehicles and aircraft

Results of Phase I shall support battery selection and its integration with the appropriate battery management system and inverter circuitry to realize a scalable, modular hybrid intelligent battery system design for execution in Phase II. Phase I discussions and design should include the following elements:
a. Narrative and graphical depiction of the design
b. Projected physical attributes
c. Projected performance metrics
d. Identification of the Technology Readiness Level of the technology

PHASE II: Design and develop a fully integrated proof-of-concept Energy Storage System with an Embedded Battery Management and Inverter Subsystem based on the Phase I results. Integrate and demonstrate operation and function with the Army 2 kW GenSet. Conduct operational/functional tests to confirm performance. Provide an interface design to support the subsequent scaling to outputs commensurate with integration/interface onto Soldier, robotic enablers, and remote weapon/communication platforms.

PHASE III DUAL USE APPLICATIONS: Finalize development of a modular Energy Storage System with an Embedded Battery Management and Inverter Subsystem. Identify target markets for the system and an industry partner for production of the system. Determine feasibility of teaming with a battery OEM (original equipment manufacturer) for development of an Advanced Technology Demonstrator. Develop partnerships with individual companies and Platform PMs (such as PM-E2S2 and PM-SWAR) for rapid fielding of results into the STEP procurement effort by FY25 and the Network and NGCV demonstrations for FY24.

REFERENCES:
39th Chief of Staff of the Army's Modernization Priorities #1

2. Performance Specification, Batteries, rechargeable, Sealed General Specification, MIL-PRF-32383

3. Hitz, G. T., Mcowen, D. W., Zhang, L., Ma, Z., Fu, Z., Wen, Y., . . . Wachsman, E. D. (2019). High-rate lithium cycling in a scalable trilayer Li-garnet-electrolyte architecture. Materials Today, 22, 50-57. doi:10.1016/j.mattod.2018.04.004

4. MIL-STD-1332B - Definitions of Tactical, Prime, Precise, and Utility Terminology for Classification of the DoD Mobile Electric Power Engine Generator Set Family (DoD Power Quality Metrics)

5. MIL-HDBK-454 - Standard General Requirements for Electronic Equipment

KEYWORDS: Energy Storage, Embedded BMS and Inverter, Soldier Lethality, Next Generation Combat Vehicle – Robotic Enablers, Portable, Tactically Compatible.

A20-048 TITLE: Next Generation Hybrid Power Technologies for 2 – 5 kW Power Systems Supporting Soldier Applications in the Multi-Domain Battlespace

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: The objective of this effort is to develop and integrate a small, lightweight JP-8 fuel burning engine into a power generation system capable of providing a variable output of 2 to 5 kW of full continuous power at 4000' 95oF. Successful execution of this effort will result in benchmark mobility (portability), reliability, and survivability characteristics critical to Soldier, unattended ground sensors (UGS), and remote system (weapons and communications) applications in support of the Soldier Lethality CFT. Successful results can also be leveraged to support power requirements for Network and Next Generation Combat Vehicle (NGCV) priorities.

DESCRIPTION: The Army has a great need for highly power dense (< 120 lbs), variable output JP-8 fuel burning power generation systems in the < 5 kW range to enable unmanned ground sensors and Soldier systems and operate remote weapons and communication systems. However, there are numerous difficult, technical challenges with the use of heavy fuel in conventional, small engines. Since the '90s, the Army has pursued various solution paths to realize a versatile power source that is man-portable and operationally and functionally compatible within the tactical environment. In the less than 9 hp range, gas turbines become extremely inefficient, and IC engines have difficulty burning JP-8. Small IC engines run at high speeds and have very short "strokes" in their power producing process, making efficient diesel combustion difficult. To address issues with fuel atomization and the injection/burning process, the Army invested in two approaches. Investments focused on the development of external combustion engine concepts (such as the Stirling cycle), but at the cost of increased mass and weight and reduced power density. The Army also invested in the adaptation and scaling down in size of reformers, high pressure pumps, and atomizing nozzles to realize fuel processors that enabled the combustion of JP-8 fuel within an existing small sized gasoline engine. This came at a cost of reduced operational environments and power quality, starting difficulties, severe engine derating, and unknown potential long-term maintenance issues.

This solicitation seeks
1) innovative concepts to efficiently atomize/vaporize unmodified (no additives) JP-8 fuel, per the Army's One Fuel Forward Policy
2) engine configurations that allow for longer burn times
3) external burning concepts combined with cycles other than the Stirling cycle
Note: Spark ignition and gas turbine engines are also explicitly excluded from this solicitation. The proposed variable speed engine must be fuel-efficient, power-dense, and able to readily burn unmodified heavy fuel (JP-8).

PHASE I: This effort will include the use of a model/simulation tool to evaluate alternative electromechanical and hybrid prime mover technologies to include emerging novel rotary diesels, fuel cells, etc. which can be integrated into a system configuration to generate a variable output of 2 to 5 kW of tactical electric power for Soldier, UGS, and remote applications. The function and operation of a given prime mover will be evaluated to determine its mechanical and electrical response under various loading conditions, control inputs, and environments. The effort will yield a proof-of-concept variable output power system based on emerging engine technology selected for its operational / functional suitability within a tactical environment. Develop conceptual component, subsystem, and system-level design in accordance with the following metrics:

- Fuel: JP-8,
- Output: 2 – 5 kW continuous output up to 4000', 95 F

- Signature: < 70 dBA at 7 m; < 60 dBA at 0.9m
- Environment: full-spectrum military environment (AR70-38 temperature extremes, MIL-STD-810 shock & vibration, sand & dust, humidity, blowing rain)
- Transport: Ability to be safely transported by commercial and military vehicles and aircraft

Results of Phase I shall support engine selection and its integration with optimal combinations power systems components / subsystems to realize a variable output (2-5 kW) power system design for execution in Phase II. Phase I discussions and design should include the following elements:
a. Narrative and graphical depiction of the design
b. Projected physical attributes (power density, energy density)
c. Projected performance metrics (fuel consumption, power output, etc.)
d. Identification of the Technology Readiness Level of the technology

PHASE II: Design, develop, and demonstrate a proof-of-concept variable output (2 – 5 kW) power source based on the Phase I results and provide an interface design to support the subsequent integration/interface with Soldier, UGS, and remote weapon/communication platforms.

PHASE III DUAL USE APPLICATIONS: Finalize development of a variable output 2 – 5 kW power system. Identify target markets for the system and an industry partner for production of the system. Determine feasibility of teaming with a generator set OEM (original equipment manufacturer) for development of an Advanced Technology Demonstrator. Develop partnerships with individual companies and Platform PMs (such as PM-E2S2 and PM-SWAR) for rapid fielding of results into the Small Tactical Electric Power Program (STEP) by FY25.

REFERENCES:
1. US EPA, 2003, Proposed Tier 4 Emissions Standards, EPA Document Number EPA420-F-03-008, http://www.epa.gov/nonroad/f03008.htm#q2

2. Front End Analysis of Mobile Electric Power Research and Development for 2015 - 2025 (July 2002);http://www.ee.uidaho.edu/ee/power/hhess/FrontEndAnalysis.pdf

3. Small Tactical Electric Power Specification (Draft - 28 June 2019). https://arpa-e.energy.gov/sites/default/files/Matthew_CERDEC_GENSETS_FINAL.pdf

KEYWORDS: Variable output generator set, man-portable power, soldier lethality, remote weapons/communication system power, UGS power, integrated tactical network

A20-049 TITLE: Small Arms Bullet Tracking Techniques and Algorithm Developments for Improved Soldier Lethality

TECHNOLOGY AREA(S): Electronics

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OBJECTIVE: Develop and demonstrate ability to track small arms ammunition projectiles in real time from the platform point of origin to point of impact, using passive or active imaging techniques with any associated algorithms and/or image processing, with an objective to improve Soldier Lethality and eliminate or reduce the need for tracer rounds.

DESCRIPTION: Using weapon-mounted, or close proximity, video from standard or specialty imagers in a variety of wavebands, determine the best method for tracking small arms ammunition projectiles from the weapon point of origin, in flight, to their impact point. Approaches may use passive or actively illuminated techniques, and may include bullet modifications, for both day and night applications with potential to correct or adjust reticule aim point. All techniques will be subject to size, weight, power, and cost concerns associated with Army fielding and Dismounted Soldier requirements.

PHASE I: Phase I investigates advantages and disadvantages of approaches and techniques to imaging and/or tracking small arms projectiles in flight, from origin point at weapon to include impact point, with specific imager selections and imaging modalities. Approaches may include passive or active illumination, with image processing, for both day and night applications. While techniques using existing ammunition are desired, approaches may also include modifications to the projectile itself, but the modifications must be compatible with the cost and manufacturing of small arms ammunition. Radiometric/photometric analysis, with signal to noise ratios, should be included to indicate compatibility of bullet tracking capability with selected Electro Optic imagers and various backgrounds in support of recommended solution space.

PHASE II: Phase II develops and integrates a brass board prototype system for data collections and determination of viability for selected techniques.

PHASE III DUAL USE APPLICATIONS: Phase III determines potential applicability to law enforcement and Department of Homeland Security (DHS), while developing and integrating a prototype system for demonstration. Size, Weight, Power, and Cost will be the focus of final system design, with further emphasis on ease of user operation.

REFERENCES:
1. Austin A. Richards and David M. Risdall "Passive thermal imaging of bullets in flight", Proc. SPIE, vol. 5405, p. 258-263 (2004).

2. Roberts, Randy S, and Breitfeller, Eric F. System and method for bullet tracking and shooter localization. United States: N. p., 2011.Web.

3. Murray, Kevin H., BULLET DETECTION AND TRAJECTORY ESTIMATION, Thesis paper, George Mason University, 2017.
http://mars.gmu.edu/jspui/bitstream/handle/1920/10944/Murray_thesis_2017.pdf?sequence=1&isAllowed=y

KEYWORDS: small arms, bullet tracking, tracer, active imaging, image processing

A20-050 TITLE: Dual-Band Lens SWAP Reduction and Increased Optical Throughput with Calcium Lanthanum Sulphide (CLS)

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Design and fabricate a dual-band relay imager lens assembly which leverages newly discovered infrared material, Calcium Lanthanum Sulphide (CLS), and/or a curved focal plane array (FPA). The relay imager lens assembly should demonstrate the impact of CLS or a curved FPA on overall size, weight, number of elements, and performance.

DESCRIPTION: The Army is acquiring dual-band FLIR thermal imaging systems for use on airborne platforms and ground-based platforms wherein the optics image both the MWIR and LWIR infrared spectrums. This includes the 3rd Gen FLIR Program of Record that supports the Next Generation Combat Vehicle (NGCV) Cross Functional Team (CFT). There are a limited number of materials which transmit both the MWIR and LWIR. Dual-band optical elements must correct aberrations to ensure all desired rays entering the optical assembly image correctly onto the focal plane. Of those aberrations, chromatic aberration contributes the most to the optical blur observed on the FPA. Chromatic aberration is a wavelength-dependent aberration where each wavelength focuses to a different location. Lens materials with complementary chromatic dispersions, i.e., change in index of refraction versus wavelength, are needed to correct for chromatic aberration in dual-band systems.

While existing optics demonstrate the capability of achieving high performance in dual-band sensors, the number of optical surfaces needed to establish such performance is also high because the available materials do not possess the ideal dispersion relationships. The number of elements in an optical system impacts the transmission of the assembly. Each optical element will attenuate the energy impinging on the focal plane, thus limiting the system range performance. In addition, these elements contribute to the assemblies' overall weight, size, and cost.

Recently NVESD has discovered that the optical properties of Calcium Lanthanum Sulphide (CLS) may be well-suited for use in dual-band sensors. Introducing CLS or a curved focal plane into the imaging system may reduce the number of elements required to meet diffraction-limited optical performance. Because of the limited number of materials which transmit in the MWIR and LWIR, the new CLS material properties may directly reduce the chromatic aberration in the optical system. Furthermore, a curved focal plane could aid in aberration correction by defining a field dependent focus location. Research of optical designs that take advantage of the new material and curved focal plane architectures is required to identify optimal forms which meet sensor needs. The following table of first-order parameters represents a typical system level requirement:

Focal length	94.4mm
Entrance pupil location (ref L1)	35mm
Entrance pupil diameter	39.1mm
Waveband	3.5-5um & 7.6-10um
Total length	94.5mm
Cold stop diameter	10.4mm
Cold stop height	25.15mm
Image plane diagonal format	17.62mm
Distortion (f tan(theta))	<3%

Table 1.1 First Order Optical Parameters

PHASE I: Perform trade studies and develop optical designs using CLS material and curved focal planes for re-imaging optics per Table 1.1. Trade analysis shall address issues of reducing lens count, ease of fabrication, athermalization, total optical transmission, and minimization of “Narcissus” back-reflections assuming a cryogenic dewar around the cold stop. Size, weight, and cost shall also be criteria for evaluating best possible design options. The design forms shall assume simple aluminum housings, and passive athermalization techniques using materials with differing coefficients of thermal expansion may be considered. Optical elements near the intermediate image plane shall avoid beam footprint diameters less than 1 mm. Designs shall have diffraction-limited performance across most of the image plane footprint. The results of these efforts shall be documented in a deliverable electronic format final report.

PHASE II: Using the results of Phase I, choose the best design approach for proceeding to fabrication and test of a "proof of design" demonstrator hardware optical system. Execute prototype fabrication and deliver the assembly to the government. A test plan shall be developed and executed in this phase to confirm performance and assess compliance with designed performance parameters. In addition, the offeror shall determine a path for hardware fabrication to include identifying material vendors, coating shops, and component integrators. The Government does not intend to provide a focal plane dewar assembly; therefore, commercially available prodcts may be considered for test & demonstration purposes. Deliver a final report containing final as-built design and test information.

PHASE III DUAL USE APPLICATIONS: Transition applicable techniques, processes, and material sources of supply to a production environment with the support of an industry partner if needed. Finalize a sensor design with appropriate SWAP-C and form factor based on human factors and operational testing. Determine the best integration path as a capability upgrade to existing or future systems, including firmware and interfaces required to meet sensor interoperability protocols for integration into candidate systems as identified by the Army. This topic supports NGCV (e.g., OMFV, RCV) through the 3rd Gen FLIR POR and FVL (e.g., FARA, and any combined pilotage + ASE missions such as DDUS).

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1. Gentilman, R. L. (1988). Calcium Lanthanum Sulfide as a Long Wavelength IR Material. SPIE, 929, 57th ser., 57-64

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3. McCloy, J. S. (2013). Infrared-Transmitting Glass-Ceramics: A Review. SPIE, 8708, 1-20

KEYWORDS: Sensors, Optics, Imaging, Lens, Thermal

A20-051 TITLE: Algorithm-Based People Detection and Threat Determination from Passive Infrared and Visible Cameras

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: The U.S. Army requests algorithms to automatically detect people that pose a threat to Warfighters or civilians from real-time images acquired by passive cameras operating in mid-wave, long-wave and visible bands. Indictors of a threat situation are complex and may include scenarios where a person carries a visually identifiable weapon or a military equipment or a person abandons a bag in a crowded space. The proposed algorithm shall detect, recognize, and identify threat-level of personnel from sensor images.

DESCRIPTION: In combat, a Soldier needs to visually scan the battlefield quickly and detect, recognize, and identify threats. The accuracy and the speed of detection, recognition, and identification are of critical importance to the Soldier's ability to make tactical decisions. Computer vision algorithms can perform threat detection from visual data with speed unmatched by a human, and can therefore greatly aid the Warfighter on the battlefield by cueing the Soldier. In a military setting, optical or infrared cameras can be worn on a Soldier or mounted on a vehicle to

provide real-time data. In the civilian world, there exists an urgent need to detect persons with an intent to harm from surveillance videos to protect public safety. During recent mass shooting events such as Marjory Stoneman Douglas High School in Parkland, FL in Feb. 2018 and the Tree of Life Synagogue in Pittsburg, PA in Oct. 2018, the shooter in each event carried at least one visually identifiable weapon as he left his vehicle and walked to the building where the shooting took place. Algorithms designed to detect and recognize a person who carries a weapon from live surveillance video could mean earlier notification of the threat situation to the authorities and potentially stopping the person before the crime can be carried out.
Detection refers to an algorithm’s ability to distinguish the object of interest from background elements of the scene. The object may occupy few pixels when it is located at large distances. At this distance there may not be enough information to confirm what the object is. Recognition refers the algorithm’s ability to determine the object’s class. In this case class refers to person or non-person labels. Identification refers to an algorithm's ability to differentiate between objects within a class, for example, identifying whether the person is a Soldier or a civilian, is the person armed or unarmed, and is the armed person carrying a large or small weapon. In addition, algorithms provide contextual information about a person: is the person with a group, is the person waiting idly, walking, or running and at which speed and orientation. All of these elements inform a Soldier of the threat level of the detected object.
Algorithms developed for personnel detection and threat determination should address the complexity of the scenes in real-life scenarios. Threat targets may be occluded partially or fully from the sensor’s field of view by clutter sources such as trees, buildings, bright light, or moving crowds intermittently in time. Target visibility may also vary based on environmental factors such as lighting and time of the day. Training and testing data shall be collected to mimic scenes in which a person acts dangerously according to threat definitions. The algorithms shall provide accurate detection and low false positives on targets who fit these threat definitions.

PHASE I: The performer shall conduct a trade study of existing algorithms for personnel detection and threat determination using passive sensors. They shall collect preliminary data in at least two threat scenarios, urban and natural. This data shall be used to demonstrate algorithms and show a capability to identify threats (i.e., armed individuals) from non-threats.

PHASE II: The performer shall further develop algorithms that detect, recognize, and identify personnel that pose a threat. These algorithms shall be applied to additional scenario data collected by the performer and Government. The new scenarios shall have greater complexity, occlusions, and clutter. These scenarios should include realistic urban scenes that include urban objects and street level activities typical of this environment, e.g., unarmed civilians and commercial vehicles. The rural environments will assume a larger field of view with fewer pixels on target; implicit in this environment is vegetation ranging in scale from grass and shrubs up through forests. In both scenarios, the scenes shall include static and dynamic clutter that represent bystander human and non-human activity. The performer shall quantify detection results in terms of detection probability and false positive probability and confusion matrices.

PHASE III DUAL USE APPLICATIONS: Further develop demonstrator algorithms to meet detection performance target set by the Army. Demonstrate real-time feasibility of demonstrator algorithms. Field the demonstrator algorithms on a system of cameras. Implement the algorithm on field hardware in scenarios similar to those previously described.

REFERENCES:
1. Mahajan, R., & Padha, D. (2019, May). Detection Of Concealed Weapons Using Image Processing Techniques: A Review. In 2018 First International Conference on Secure Cyber Computing and Communication (ICSCCC) (pp. 375-378). IEEE

2. Chen, H. M., Lee, S., Rao, R. M., Slamani, M. A., & Varshney, P. K. (2005). Imaging for concealed weapon detection: a tutorial overview of development in imaging sensors and processing. IEEE signal processing Magazine, 22(2), 52-61

3. Bird, N., Atev, S., Caramelli, N., Martin, R., Masoud, O., & Papanikolopoulos, N. (2006, May). Real time, online detection of abandoned objects in public areas. In Proceedings 2006 IEEE International Conference on Robotics and Automation, 2006. ICRA 2006. (pp. 3775-3780). IEEE

4. Grega, M., Matiolański, A., Guzik, P., & Leszczuk, M. (2016). Automated detection of firearms and knives in a CCTV image. Sensors, 16(1), 47.

5. Range Performance DRI Ratings Explained, INFINITY White paper, https://www.infinitioptics.com/sites/default/files/attachments/Infiniti%20Thermal%20DRI%20Whitepaper_0.pdf

KEYWORDS: Target Detection and Recognition, Image Processing, Public Security, Machine Learning, Deep Learning, Sensor Fusion, Information Processing

A20-052 TITLE: Moving Target Designation

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and deliver prototype hardware capable of beam steering a laser designator on moving targets during typical handheld operations when coupled to a sighting optic.

DESCRIPTION: Ground designation events are typically static scenarios (non-moving targets; designators on stable platforms). This type of scenario increases carry weight (stable tripod) and restricts Concepts of Operations (ConOps). However, munition platforms are capable of flight corrections during designation events for a period of time up to terminal guidance. In order to capitalize on the munitions capability, technology must be developed to not only stabilize the beam but lock and track moving targets as well. The Army desires a device that can be paired with an appropriate see-spot (images the laser energy) camera, track and designate a target (4.6 m^2) moving >35 kpm at 3 km (Threshold) or >45 kpm at 5 km (Objective) for >30 seconds under typical User hand motion. The overall designator portion of the development, to include batteries, shall be <3.25 lbs, <100 in^3, and <15 W Steady State, >30 mJ output energy (3 km range) or >50 mJ output energy (5 km range). The device must also produce visual indicators to the operator pertaining to the limits of beam steering travel. Full rate production costs should be <$30k. In addition, the system shall utilize the statistical Effective Designator Range equation (EDR95) in order to deduce the appropriate beam divergence and designator jitter appropriate for the application. This equation can be provided once under contract if necessary.

This device would support primarily the Long Range Precision Fires CFT by providing increased standoff distance to aircraft/munition platforms by providing Laser Guided Bombs (LGBs) greater “fire and forget” capability against mobile threats. The expanded ability for guiding LGBs from the ground provide improved Multi-Domain Operations, with a tactical, layered approach possible when encountering a more mobile adversary. In addition, this effort directly supports the Lethality CFT as well by increasing Lethality (expanded Tactics, Techniques, and Procedures [TTPs] across air and sea assets), Mobility (less required equipment; less weight), and Protection (expanded direct overwatch).

PHASE I: The proposer shall provide a complete prototype design. An approximate bill of materials should be provided as part of the design, including necessary components, power, and cost; this bill of materials shall be refined in Phase II.

A complete and thorough understanding of the algorithms necessary, if any, to make the sensor successful shall be demonstrated. Rigorous modeling and data collection shall be performed to estimate system performance to include handheld motion, minimum SWaP (size, weight, and power) beam steering mechanisms, appropriate camera pairing for resolution and frame rates, etc.

PHASE II: Using the results of Phase I, fabricate and deliver a fully integrated prototype meeting SWaP and performance goals. Prototype should meet all requirements for TRL 5: “basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment,” and be on the way to meeting TRL 6: “prototype system, which is well beyond that of TRL 5, is tested in a relevant environment.”

PHASE III DUAL USE APPLICATIONS: Transition applicable techniques and processes to a production environment with the support of an industry partner if needed. Finalize a sensor design with appropriate SWAP-C and form factor based on human factors testing. Determine the best integration path as a capability upgrade to existing or future systems, including firmware and interfaces required to meet sensor interoperability protocols for integration into candidate systems as identified by the Army. Commercially, this could be used as part of a laser deterrent system for border patrol or police force when used with different laser wavelengths.

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1. Joint Chiefs of Staff, April 2019, Joint Fire Support - https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_09.pdf

2. Neal Bambha and Dan Beekman, Dec 2017, US Army Research Laboratory - https://www.arl.army.mil/arlreports/2017/ARL-TR-8243.pdf>

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KEYWORDS: Laser Designation, Forward Observer, Terminal Guidance, Missile Seeker

A20-053 TITLE: Cooperative and Coordinated Decentralized Warfare in Disconnected, Intermittent, Limited bandwidth (DIL) Environments

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Investigate and demonstrate an algorithmic approach to achieve cooperation and coordinated activity by a decentralized group of electronic warfare (EW) actors within a disconnected, intermittent, limited bandwidth (DIL) environment.

DESCRIPTION: Future operations within highly contested environments will drive the need for networks of systems able to rapidly adapt and respond to changing conditions, such as distributed EW systems for platform survivability. The intent is to field the EW systems onto Air Launched Effects (ALE) aerial vehicles, to enhance the capability of future aviation platforms to achieve dis-integrating effects through operating as a team with other manned and unmanned platforms to penetrate into the Deep Maneuver Area. The desired EW payload capabilities of the ALE include decoy and disruptive radio frequency electronic attack as well as passive and active threat detect, identify, locate, and report (DILR) electronic support. In order to accomplish these diverse missions within the Anti-Access and Area Denial (A2AD) environment, it is expected that these capabilities may reside on multiple different payloads. Novel methods of decentralized control of the EW payload behavior sets will be required for operation within the DIL environment enabling the individual EW system actors to infer the behavior of the other actors within the network.

Example missions include, but are not limited to, unmanned aircraft stand-in/stand-off jamming for aided survivability of manned aircraft, unmanned aircraft penetration and suppression of IADS to enable lethal effects and manned aircraft stand-in/self protect jamming.

PHASE I: Define a set of notional operational scenarios for implementing the EW behavior sets of the representative actors. Determine the global optimum for each scenario through optimizing the behavior of the actors for each scenario in a preplanned manner within a permissive communications environment.

PHASE II: Develop a set of algorithms to optimize the behavior of the EW actors in dynamic scenarios within a DIL environment. The algorithm needs to enable adaptation of actor behavior to changes in the optimization objective, resources and/or constraints of the EW actors, and the number and/or distribution of actors. Evaluate the performance of the algorithm across a variety of scenario permutations within a DIL environment.

PHASE III DUAL USE APPLICATIONS: Algorithms developed and tested during Phase II can be directly applied to future technology demonstrators to enable resilient operation of decentralized EW actors within dynamically changing operational scenarios under DIL conditions.

REFERENCES:
1. TRADOC Pamphlet 525-3-1

2. www.ted.com/talks/kevin_slavin_how_algorithms_shape_our_world.html

3. http://www.cs.cmu.edu/~sandholm/cs15-892F13/algorithmic-game-theory.pdf

KEYWORDS: Fratricide mitigation, resiliency, autonomous agents, artificial intelligence

A20-054 TITLE: High Fidelity IR Clutter Generator for Missile Warning Sensors

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: High fidelity background clutter generator is proposed for scene projection in Hardware-in-the-Loop (HITL) test and evaluation of Missile Warning Sensors (MWS).

DESCRIPTION: Performance testing of MWS sensors is hardware challenging due to the false alarm and realistic clutter environment background requirements. An MWS must be able to distinguish a threat against a clutter background and give a false alarm rate not greater than specified. A method of constructing high fidelity background clutter generator is proposed for scene projection in Hardware-in-the-Loop (HITL) test and evaluation of Missile Warning Sensors (MWS). Hardware performance testing, beyond benchtop component level, is designed to prompt and evaluate a desired response from the sensor to external stimuli (not injected scenes). To date, hardware test for 2 color MWS includes various models of 2 color scene projectors based on DMD technology with incremental improvements. The DMDs work well to achieve proper scene radiances and ratios and can be configured to provide high contrast by linear combination of modulator arrays and sources. Tests can be combined further to operate holistically with pointer/jammer HITL testing for combined system evaluation.

PHASE I: Study feasibility of novel high fidelity background clutter generation approaches, tuned specifically toward dual color IR clutter generator including all the IR wavelength regimes (SWIR, MWIR, and LWIR). Materials, efficiency, manufacturability, stability, and ruggedness on a flight motion table are all considerations. Specific designs and test results for mature implementation of new clutter generator will result.

PHASE II: As informed by Phase I, build a prototype dual color IR clutter generator. These prototypes would include any software items needed to test and develop IR models and scenes using this technology, which can then be used to stimulate IR sensors and countermeasure systems.

PHASE III DUAL USE APPLICATIONS: These projectors, once productionized, can support multiple Government test labs throughout DoD as well as Programs of Record.

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KEYWORDS: infrared imaging, infrared imaging scene projector, threat detection, sensors, hardware in the loop, testing and evaluation

A20-055 TITLE: Prioritized Tactical Data Exchanges

TECHNOLOGY AREA(S): Battlespace

OBJECTIVE: The objective of this topic is to develop mechanisms that dynamically determine the value of data and information to soldiers involved in tactical engagements in a distributed, disadvantaged network environment.

DESCRIPTION: The Army has emphasized and will continue to emphasize smaller and more mobile command posts, with the goals of decreased logistics and manpower support, sustainable operational tempo, outperforming the enemy’s command, and survivability of equipment and personnel. Those tactical conditions will also be characterized not only by limited computing resources, but by limited and/or sporadic bandwidth and well. As these themes are addressed, it will be challenging to supply effective Mission Command computing capability without a mechanism to dynamically determine the importance of data and information. As network and computing resources diminish, and the battlespace changes, it is imperative to prioritize information needs, in order to support decision making cycles.

Initial equipment and software allocation, battlespace sensing, threat analysis, systems and network availability, running estimates, forecasting, determination of related effects, current levels of situation awareness and understanding, redundancy and resilience across the formation, and capabilities and training of individual soldiers are examples of factors that might be considered in maintaining this assessment. Intelligent strategies for data and information creation, storage, routing, and mediation should be explored. This work would be a foundational piece of the data storage and transport strategies required to support dispersed Mission Command computing.

PHASE I: The goals of phase I are to identify the factors relevant to the dynamic prioritization of battlespace data and information, and to present those prioritizations across several use cases. The Brigade and Battalion echelons should be the initial focus of this study. All relevant and potential factors in determining data and information importance of as a military operation unfolds should be assessed. Mission Command systems, voice communications, face-to-face interaction, and the cognitive processes involved in maintaining operational tempo comprise an initial set of data and information categories for consideration. An initial scheme for adjusting priority levels as an operation unfolds, considering the factors listed in paragraph two of the Description above, is also desired.

PHASE II: Phase II work should begin with a maturation of the assessments performed during phase I. Updates to the factors considered, as well as the use case prioritization, are expected. Significant work on developing more sophisticated for adjusting priorities will be required. A concept demonstrator of the dynamic prioritization of a set of the data and information identified during Phase I is desired during a representative operation is desired. Initial designs of schemes for data/information retrieval, creation, storage, caching, and forwarding are also expected. The software developed should reach a Technology Readiness Level (TRL) of 6. The performer will work with the government to identify and participate in one or more technology demonstrations to Army stakeholders.

PHASE III DUAL USE APPLICATIONS: During Phase III, the software will be matured to a TRL 7. A series of demonstrations, simulations, or experiments intended to show responsiveness to priorities assigned to data and information from Mission Command systems, voice communications, face-to-face interaction, and cognitive processes is expected. The availability and bandwidth of network and communications, as well as the availability of Mission Command software systems and soldiers at physically separate locations, are factors that must be included. A robust data management / storage / routing solution is also required.

REFERENCES:
1. Army Doctrinal Reference Publication (ADRP) 6-0, Mission Command

2. Army Field Manual (FM) 6-0 COMMANDER AND STAFF ORGANIZATION AND OPERATIONS

3. Army Techniques Publication (ATP) 3-21.21 (FM 3-21.21) SBCT Infantry Battalion

4. https://www.c4isrnet.com/c2-comms/2018/01/19/the-army-wants-to-ensure-its-command-posts-arent-an-easy-target/

5. Government Accountability Office (GAO) ARMY MODERNIZATION Steps Needed to Ensure Army Futures Command Fully Applies Leading Practices

KEYWORDS: Value of Information, Data Strategies, Data Mediation, Command Post Integrated Infrastructure

A20-056 TITLE: Packaging Metal-Coated Fibers for Prolonged Storage and Efficient Dissemination

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop a low-cost manufacturing process to pack metal-coated fibers to high density and which will allow efficient dissemination. Fibers are theoretically the highest performing particle shape for obscuration, especially in the microwave region of the electromagnetic spectrum. They can also be the most difficult to efficiently pack and to aerosolize. The process to pack fiber will probably, but not necessarily, use an aligned format. Efficient dissemination implies a maximum of single fibers and a minimum of clumps. Phase I will focus on strategies to address issue of less than optimum packing density and dissemination quality, e.g. galvanic corrosion and/or filament to filament adhesion that reduces performance for nickel-coated fibers. Phase II will expand the effort by addressing cold welding in copper-coated fibers. It will also include the ability to demonstrate the usefulness of the concepts by using accelerated storage techniques and performing dissemination trials to show improvements

DESCRIPTION: Smoke and obscurants play a crucial role in protecting the Warfighter by decreasing the electromagnetic signature that is detectable by various sensors, seekers, trackers, optical enhancement devices and the human eye. Recent advances in materials science now enable the production of precisely engineered obscurants with nanometer level control over particle size and shape and coating thickness. Numerical modeling and many measured results on metal-coated fibers affirm that more than order of magnitude increases over current performance levels are possible if high aspect-ratio conductive fibers can be effectively disseminated as an un-agglomerated aerosol cloud.

Since this is a relatively new area of research for the Army, very little work has been performed so far in this area. One of the difficult issues is the corrosion that results from galvanic reactions in the packing process that degrades the fibers. Another is the particle-to-particle attractive forces that make efficient dissemination of single fibers difficult.

PHASE I: Describe techniques to minimize mechanisms of filament to filament adhesion, e.g. galvanic corrosion, cold welding, or other means of metallic coating degradation, of nickel-coated fibers during packaging and prolonged storage. Demonstrate with samples an ability to produce packed metal-coated fibers with a bulk density of at least 50% of maximum theoretical bulk density of the nickel-coated fibers, with no degradation, and preferably improvements, in dissemination efficiency.   Nickel-coated fibers are available commercially for this effort and should be cut to a length of one centimeter. (5) 100-gm samples shall be provided to ECBC for evaluation

PHASE I Option: Describe techniques to minimize cold welding in copper-coated fibers.

PHASE II: Demonstrate with samples an ability to produce packed copper-coated fibers with a bulk density of at least 50% of maximum theoretical bulk density of the copper-coated fibers with no degradation, and preferably improvements, in dissemination efficiency. Copper-coated graphite fibers are available commercially for this effort and should be cut to a length of one centimeter. (5) 100-gram samples shall be provided to ECBC for evaluation. Demonstrate the processes will improve performance for both nickel- coated and copper-coated fibers through the use of accelerated-aging storage techniques. Demonstrate that the process is scalable by providing 4 1-kg samples of each of the two improved bulk density packaged metal-coated fibers with no loss in performance from that achieved with the small samples. In addition, in Phase II, a design of a manufacturing process to commercialize the concept should be developed.

PHASE III DUAL USE APPLICATIONS: The techniques developed in this program can be integrated into current and future military obscurant applications. Improved grenades and other munitions are needed to reduce the current logistics burden of countermeasures to protect the soldier and associated equipment. This technology could have application in other Department of Defense interest areas including high explosives, fuel/air explosives and decontamination. Improved separation techniques can be beneficial for all powdered materials in the metallurgy, ceramic, pharmaceutical and fuel industries. Industrial applications could include electronics, fuel cells/batteries, furnaces and others.

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6. Hart M and Bruce CW, "Backscatter Measurements of Thin Nickel-Coated Graphite Fibers," in IEEE Transactions on Antennas and Propagation, vol. 48, no. 5, pp. 842-843, 2000.

7. Johnson S, Obscurant Applications, ISN Review, MIT, June 2012.

8. Burns A, “Means for Packaging and Dispensing Chaff,” US Patent 3,500,309, March 1970

KEYWORDS: metal-coated fibers, prolonged storage, microwave, packing, aerosolization, obscuration

A20-057 TITLE: Development of an Infrared Obscurant Produced In Situ from a Combat Vehicle

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop a means to produce an infrared obscurant in situ from a combat vehicle.

DESCRIPTION: The Army is considering reviving the Vehicle Engine Exhaust System (VEES), which vaporizes fuel (diesel, when VEES was first introduced in the 1980’s), by injecting it into the engine exhaust. The diesel recondensed immediately upon contact with ambient air, forming a dense white cloud. VEES did not work with JP8, and is also limited to primarily the VIS portion of the spectrum. Since that time, there has been a proliferation of sensors operating in the infrared. The objective of this topic is to develop an infrared obscurant that is produced in situ from the vehicle exhaust. It is suggested that the fuel be modified or have an additive which will react with the fuel upon extreme heating, or react upon exposure to air to produce the desired IR obscurant.

To address this requirement, the effort must identify the particles that will attenuate energy in the infrared portion of the electromagnetic spectrum. Generally speaking, higher performing particles are either flake or fiber shaped with high aspect ratio (approx. major dimension 3-5 um, minor dimension 10-50 nm) and high electrical conductive (on order of copper). Successful product will have an extinction coefficient of at least 1 m2/g covering the 3-5 um range and the 8-12 um range of the EM spectrum.

PHASE I: Outline then demonstrate the reaction chemistries necessary to produce an infrared obscurant using the on board vehicle exhaust of an existing combat vehicle. Demonstrate the infrared performance of the obscurant through modeling or chamber measurements. Effort may require a scaled system to demonstrate capability of producing IR obscurant through effluent stream. Continuous operation for at least 30 min without "gumming" or "fouling" of the exhaust system or otherwise adversely affecting engine performance is required.

PHASE II: Fabricate and install a working prototype on an M1 tank or M2 Bradley fighting vehicle. Demonstrate a feed-rate of at least one gallon per minute, while maintaining an aerosol cloud with an extinction coefficient of at least 1 m2/gm across the 3-5 and 8-12 um EM range. Continuous operation for at least 90 min without "gumming" or "fouling" of the exhaust system or otherwise adversely affecting engine performance is required.

PHASE III DUAL USE APPLICATIONS: Develop a production capability to produce thousands of gallons of performance mixture. If modifications to the exhaust are necessary, develop a low-cost protocol to retrofit the existing systems to accommodate the reaction parameters.

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KEYWORDS: infrared, obscuration, in situ, diesel fuel, extinction

A20-058 TITLE: Disseminating Obscurants at Mach I

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop a process for packaging and aerosolizing particulate obscurant materials from a high speed munition. The scenario is that the munition will be traveling at MACH I when the obscurant payload is quickly released to create an aerosol cloud at a specific location. Modeling could better define the required dissemination time and the resulting cloud geometry. Phase I will focus on modeling and defining concept parameters. Phase II will expand the effort to include fabricating hardware and testing to demonstrate the concept.

DESCRIPTION: Smoke and obscurants play a crucial role in protecting the Warfighter by decreasing the electromagnetic signature that is detectable by various sensors, seekers, trackers, optical enhancement devices and the human eye. The proliferation of threats to combat vehicles including ATGM’s and RPG’s, raises the stakes for the Warfighter. A low-cost, precision countermeasure to these threats will be critical in increasing the survivability of the Next Generation Combat Vehicle (NGCV).

Since this is a relatively new area of research for the Army, very little work has been performed so far. One of the difficult issues will be testing and evaluation of a fast moving munition; creative ideas are needed in the demonstration of the capability. Another issue may be a fast release of the obscurant to avoid a long, narrow cloud.

PHASE I: Develop a concept for packaging and disseminating a particulate obscurant material. Demonstrate with modeling what the resultant cloud would look like when released from a munition traveling at Mach 1. Assume an 80-mm diameter munition with a 1-kilogram payload of graphite flakes (Asbury Micro 850 or equivalent). Demonstrate with modeling how a cloud at least 5 meters in diameter and 10 meters long could be produced. If the concept will allow other obscurant materials, it will improve its utility.

PHASE II: Demonstrate the capability in the field. Provide 5 prototypes that will allow field evaluation of the resulting aerosol cloud. In addition, in Phase II, a design of a manufacturing process to commercialize the concept should be developed.

PHASE III DUAL USE APPLICATIONS: Integrate the design into a munition specified by the Army. Fast moving munitions would include rockets, missiles and grenades. This technology is probably specific to the Department of Defense, but there are other applications there.

With the emergence of the Army Chief of Staff's Modernization Priorities, this obscuration technology supports the NGCV. Other Army Modernization Priorities that could benefit from this technology effort include Long-Range Precision Fires, Future Vertical Lift Platforms, Air and Missile Defense Capabilities, and Soldier Lethality

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KEYWORDS: Mach 1, graphite flakes, dissemination, packing, aerosolization, obscuration

A20-059 TITLE: Mesoscale Model Capability Informed by Cemetitious Composite Microstructure

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: To develop computationally effective software for the prediction of concrete properties and their evolution in time based on constitutive materials.

DESCRIPTION: With increased frequency, military personnel in the field are required to build structures with concrete materials whose properties are not known and for which the available technical literature is insufficient to estimate these properties. This applies to a wide range of concrete mixes, from low-quality concrete manufactured from in-situ or indigenous raw material components to ultra-high-performance concrete designed for high-end applications such as the protection of sensitive and high value structures (e.g. embassies, command and control buildings, etc.). Hence, there is a need for computational tools that allow the prediction of the mechanical properties of concrete directly from the basic components used in the mix design through simulating the generation and formation of concrete. These tools need to be accurate enough to be used in practical design applications but, at the same time, might need to be simple enough to be operated by personnel in the field. By leveraging recent accomplishments and published research, the US Army seeks the further development of the foundation for such tools within the computational framework of finite element and meshfree methods [1], which have been validated in the simulation of concrete and concrete structures [2, 3, 4] subject to blast and penetration, as well as in the simulation of concrete subject to long term deterioration phenomena [5]. The desired product should be capable of receiving the mix design parameters for cements, cementious materials, and aggregates via a script or GUI based interface, and output model parameters for continuum level material models in meshfree and finite element codes. This effort will be limited to the concrete material at the meso-scale, and is not expected to include reinforcing bar, but may include fiber reinforcing.

PHASE I: Develop a framework for a microscale model informed directly by hydration simulation.Demonstrate this approach on a model system. Identify an approach to computational optimization to achieve desired performance characteristics to be demonstrated in Phase 2. Deliver a technical report including microscale model development, demonstration on model system, and conceptual approach for optimization tied to multi-scale modeling framework.

PHASE II: Develop an integrated approach of linked hydration, microscale, and multi-scale modeling. Develop an optimization routine to achieve desired performance characteristics. Demonstrate this approach on a variety of model material systems representing different types of concretes. Compare the predicted material behavior at all length scales and the continuum level response with experimental observations. Demonstrate linkages between a multi-scale enabled approach to directly inform continuum level constitutive model calibration for meshfree and finite element codes. Deliver updated software package with integrated microscale models and optimization algorithms. Deliver technical report showing use of these tools on variety of model concrete systems. Deliver training for ERDC computational mechanics team and software for integration into HPC platforms.

PHASE III DUAL USE APPLICATIONS: Develop a fully integrated software package for non-expert use with integrated optimization tools to achieve target/goal performance characteristics with microscale models and multi-scale framework running in background. Software should provide outputs that can directly calibrate continuum level material models for weapons effects codes. Deliver integrated software system, technical report of finding including demonstration of technology on real work problems in blast, penetration, and quasi-static loading under a variety of conditions (i.e., study boundary value problems with experimental validations), transition software tools to HPC environment, and provide training for ERDC users.

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KEYWORDS: cement hydration, concrete modeling, indigenous concrete, material by design, material optimization, multi-scale modeling, ultra-high performance concrete

A20-060 TITLE: Detection and Classification of Small Moving Objects Floating in/on Water Using Long Wave Infrared Imaging Polarimetry or Combination of Radio, Laser Detection and Ranging Radar Technologies

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop sensor technologies with object recognition capabilities that can identify and distinguish, count and geographically locate small objects (<3 inches to >3 feet) floating in riverine environments using long wave infrared imaging polarimetry or a combination of radio, laser detection and ranging radar technologies for above and below water detection.

DESCRIPTION: Technologies with object detection capabilities sensitive enough to identify fast moving objects floating on the surface of water (or just below the surface) can offer important capabilities to understand the environment, upstream activities, and add to competencies for future military readiness and the warfighter. In this way micro-object detection can be used to inform warfighter threat avoidance, maneuverability and mobility. To meet the operational challenges and emerging dangers of the future the armed forces must be able to detect threats quickly and precisely. Because floating river debris is varied, generally comprised of small objects, often fast-moving, and complicated by the refractive properties of light on water, it requires quick and exacting sensor recognition capabilities. Sensors with this type of fidelity have potential for use by soldiers in theater as part of their protection system gear, and in military vehicles and sea faring vessels to identify objects on land and floating on the surface of water that pose a threat.

Sensors with object detection capabilities are an emerging technology currently used to service a number of efforts including self-driving cars, autonomous maze solving robots, detection of large surfaces on the bottom of the ocean and for the commercial fisheries, the ability to identify fish. However, this capability has not yet been fully exploited for accurate small object detection. Developing the technology proposed here will introduce new methods for greater accuracy of small object identification in complex environments both on land and at sea.

The goal here is to innovate methods for small object detection in the complex and fast moving environments of riparian landscapes. This effort should consider long wave infrared imaging polarimetry or a combination of radio, laser detection and ranging radar technologies for optimal above- and below-water object detection.

The method should be able to distinguish small objects, identify debris quantities and types and geographically locate individual debris materials. The desired solution is a technology that can be used by the warfighter on land and at sea to advance current capabilities and increase security.

PHASE I: Develop a basic proof-of-concept capability, in a stand-alone prototype, with sensor capabilities to identify a limited number of small objects commonly found floating in riverine environments, and count and geographically locate individual items of debris. Development and testing of initial prototype can be done in a lab environment with a small pool of still water (at least 2 feet deep and several feet across).

PHASE II: The contractor will expand capabilities of the prototype developed in Phase 1. This prototype version should work in the field on small streams (several feet deep with surface areas of a few feet to yards across). Capabilities should include the ability to identify and distinguish between a greater number of objects, record numbers of each item sighted and geospatially locate each material.

PHASE III DUAL USE APPLICATIONS: The contractor will create a sensor product suitable for use on large rivers (yards across and several feet deep) and military vehicles and sea faring vessels with the expanded capabilities developed in Phase 2. Products will be applied to existing systems and contain a prototype for classification, training and safety certifications, and business case analysis for future acquisition activities.

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KEYWORDS: Sensors, Object-detection, machine learning, intelligence, moving water, fusion, GPS

A20-061 TITLE: AI Based Autonomous Agents that Possess Human-like Cognitive Skills in a Real-Time Strategy Game Environment

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop computer algorithm based autonomous artificial agents that operate in a virtual game environment and which possess human-like cognitive skills to learn complex human tasks (i.e., land navigation, strategy, course of action analysis, etc.), and function in varying scales from individual agents, small teams, to large groups that function in a coordinated fashion both cooperatively and in an adversarial manner with other agents.

DESCRIPTION: Current state-of-the-art artificial agents are performing human-like activities at or above professional level humans in adversarial real time strategy games such as Dota 2 and StarCraft II. These agents have successfully demonstrated a variety of human-like abilities such as learning, adapting, strategizing, and decision making in extremely complex adversarial games. However, current methods for training autonomous agents for 3D simulations involve utilizing game statistics, domain knowledge, and immense agent training time, which limit their applicability to more complex problem domains. Additionally, these approaches fall short in many areas when considering the ease in which humans perform even the most complex cognitive activities. Shortfalls in capabilities include (1) large computational costs associated with deep reinforcement learning reduce the feasibility of training large multi-agent systems, (2) the agents do not possess temporal memory or long term memory to keep, maintain,

or improve upon skills, (3) agents cannot perform complex long term planning instead relying on extensive exploration to learn a policy and (4) the lack of planning reduces the capability of the agents to effectively cooperate in multi-agent scenarios.
The following are the desired innovative and technical features to achieve the topic objective:
a)Function over long time horizons: up to 24 hours, in a large, high-dimensional, continuous observation/action space, with sparse feedback and delayed reward. Current state-of-the-art agents in Dota 2 perform over an average match length of 35 minutes. We are seeking agents that select optimum actions despite delayed rewards (action feedback) over long time horizons.
b)Cooperative planning: agents that are able to plan and coordinate policies with other agents to cooperatively complete a task.
c)Online learning: agents that are able to learn from immediate experiences without catastrophic forgetting of important learned information. This includes the ability to adjust to changing environment and task circumstances.
d)Memory: agents that possess temporal memory. Example: humans can navigate to desired location and easily retrace their return path back to the starting point without photographically memorizing all features along the way.

PHASE I: Provide a written innovative technical approach beyond state-of-the-art that demonstrates feasibility of an autonomous agent to learn performing complex tasks in OpenAI's Neural MMO: A Massively Multiagent Game Environment (https://openai.com/blog/neural-mmo/). Technical approaches must demonstrate feasibility of meeting one or more of the above stated technical features (a-d, above).

PHASE II: Develop algorithms which demonstrate autonomous agents that perform a variety of complex tasks and scale to large sets of teams to be identified in Phase I and with an ability to compete in adversarial games that possess all of the required technical features: agents that function over time horizons of at least twenty four hours, perform cooperative planning, online learning without catastrophic forgetting, and possess temporal memory. These agents must function in OpenAI's Neural MMO: A Massively Multiagent Game Environment (https://openai.com/blog/neural-mmo/). Agent algorithms must be capable of being trained on a desktop or server class computer with a minimum of a 16 core CPU at 99th percentile performance according to https://cpu.userbenchmark.com/ and a minimum of 8X GPUs with 99th percentile performance according to https://gpu.userbenchmark.com/. The agent algorithm must achieve a technical maturity of

PHASE III DUAL USE APPLICATIONS: Human-like agents that can perform human tasks at expert level or higher can be used for commercial factory automation, self-driving vehicles, and robot navigation. Government applications would include large scale virtual or constructive wargame simulations, cooperative drone swarms, and large-scale military logistics planning and support.

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KEYWORDS: Artificial Intelligence, Deep Learning, Reinforcement Learning, Real-time Strategy Games, Meta Learning, and Deep Neuroevolotion.

A20-062 TITLE: Atmospheric Water Harvesting Tool

TECHNOLOGY AREA(S): Human Systems

OBJECTIVE: Develop novel technology to efficiently harvest drinking water for individual warfighter application, where an expedient, lightweight, reliable, safe, and low or no power technique is critically needed.

DESCRIPTION: Clean water scarcity is a significant challenge to the Warfighter, particularly in arid and desert climates. Improved water self-sufficiency, which will supply safe potable water to a small squad without the logistical burden of re-supply, is highly desirable and is a priority for all Services. Supporting Service documentation demonstrates the need to improve access/procurement technologies for clean drinking water; atmospheric water harvesting technologies can fill this capability gap.3 There are 12,800 trillion liters of water available in earth’s atmosphere.4 According to the US Army Combined Arms Support Command Force Development Directorate’s Water Planning Guide, in both conventional theater tropical or arid environments the required amount of drinking water for sustainment is 3.3 gal / person / day (12.5L / person / day).4 Emerging materials and technologies in water harvesting such as metal-organic frameworks (MOF) can extract from this renewable resource in order to meet warfighter needs for clean, fresh drinking water.5 Strategies/technologies for water harvesting i.e., metal-organic frameworks, hydrogels, and other materials suitable for drinking water shall be identified, conceptualized and tested. A high fidelity breadboard model shall be evaluated in a simulated environment to validate the viability of the approach. It is desired that this small, portable individual atmospheric water-harvesting unit would support the individual warfighter, generating up to 14L of water / day to augment soldier hydration at the point of need. For example, the unit could use novel sorbent materials (such as MOFs, hydrogels) to capture water vapor at low relative humidity conditions (under 40% relative humidity (RH)) and then condense and collect the captured water, generating potable drinking water. If the unit is powered, it shall consume less than 0.5 kg of fuel daily and be capable of operating day or night with little to no noise emission and not generate an undesirable visible or thermal signature. Additionally, the proposed weight of the unit (<20lbs) is less than the weight of carrying 14L of water into the field (~30.8lbs). This would reduce weight and allow for multi-day missions without resupply. This capability would also protect warfighters from illness due to intentional or unintentional water contamination since the water would be self-generated from the atmosphere. This technology could also be scaled up to provide self-generated potable water for the squad level in the field.

The design shall be intrinsically safe (possess anti-microbial features, capable of being sanitized and/or disposable), provide hygienic functionality, convenience, and affordability (i.e. target production cost of $100 or less). The use of consumables or supplemental materials shall be avoided and the device shall also operate in environmental extremes (20F to 125F). The technology should provide a novel personal water harvesting capability that improves water production capabilities, increases self-sufficiency and reduces the requirement to transport water to the warfighter, ultimately enhancing maneuverability, security and readiness.

PHASE I: Develop a proof of concept capable of demonstrating the performance outlined above. Establish the feasibility and practicality of the proposed design, materially demonstrate and validate the concept through testing. A preliminary cost analysis be completed based on projected scale-up and manufacturability considerations. A final report shall be delivered that specifies how requirements will be met (including mitigation of risks associated with factors limiting system performance). The report will detail the conceptual design, performance modeling and associated drawings (Solidworks® format), scalability of the proposed technology with predicted performance, safety and human interface (MANPRINT) factors, and estimated production costs. The projected technical readiness level (TRL) shall achieve a TRL of 3 and provide a clear path to Phase II/III and follow-on commercialization.

PHASE II: Refine the technology developed during Phase I in accordance with the goals of the project. Fabricate and demonstrate an advanced prototype for the target warfighter application, verifying that the desired performance is met. Provide a report, associated drawings and control software/source code, if applicable, documenting the theory, design, component specifications, performance characterization, projected reliability/maintainability/cost and recommendations for technique/system implementation. Deliver a full scale prototype to support Army technical, operational, environmental and safety testing in the target application by the end of Phase II. An updated production cost analysis shall be completed and design for manufacture considerations shall also be projected to support advancement of TRL and associated Manufacturing Readiness Level (MRL). The operational characteristics of the water harvester shall be provided to validate the feasibility of the approach and support transition to military and commercial applications (Phase III).

PHASE III DUAL USE APPLICATIONS: The proposed technology innovation and associated manufacturing capability will overcome the present technology gap and be rapidly transitioned to both military and commercial applications, where a self-contained, high efficiency, and long life technology will lead to renewable personal water harvesting unit for individual warfighters or squad units, as appropriate. The Phase III is expected to advance the proposed innovation to a TRL of 7 or higher, supporting a system demonstration in a relevant environment in the hands of the Soldier. As a progression of the Phase I that serves to prove out the novel development proposed, the Phase II should result in a full scale prototype deliverable, which will serve to validate the performance, feasibility and overall benefit to be realized through the proposed development initiative. Ultimately, the technology will be transitioned to the Squad or individual Soldier, where high efficiency, long life, and low cost technology is needed to maximize the performance, lethality and security of the Soldier through optimum hydration and nutrition in all operating environments. The Phase III represents concurrent (unfunded) commercialization of the technology that is expected to provide economy of scale, logistic, and other benefits that can be attributed to the proposed development.

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KEYWORDS: Soldier sustainment, Personal water harvester, Drinking water source, Manufacturing Processes, Manufacturing quality

A20-063 TITLE: Brain-Inspired Few-Shot Object Recognition

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop a brain-inspired artificial neural network algorithm that performs accurate and robust object detection.

DESCRIPTION: Artificial Intelligence has yet to surpass the human brain in terms of training time: even the best algorithms require huge datasets that train carefully-tuned models over a long period of time. Current state-of-the-art artificial neural networks for image identification, called Convolutional Neural Networks (CNNs), are achieving at, or higher, than human level performance in recognizing 2D images from the open source ImageNet database (http://www.image-net.org/) of labeled images (plant, animals, etc.) which benchmarks performance. CNN performance in ImageNet data for standard color photos, greyscale, and photos based on textures (i.e.; elephant skin) are on par or slightly better than human performance. CNN performance degrades substantially with images of object silhouettes (black object with white background) and edges (image features represented with only lines), when objects under observation are small in scale relative to surrounding area, and when object viewpoint, rotation, size, and illumination vary. CNN training on ImageNet data requires on the order of 1000 examples per object class yet humans need to see a new object only once or twice and it becomes instantly recognized at a later time.
We are seeking brain-inspired artificial neural network algorithms that can meet the performance objectives of recognizing objects in images from less than 10 training examples with 90% confidence of object identification under a full range of image observation conditions to include varying scale, size, illumination (full sunlight to low light), occlusion (from zero to 90% in both height/width increments of 15%), and rotation (in increments of 30°). A virtual 3D environment to train and demonstrate viability of the proposed algorithm is desired such as the Unity open source game engine (https://store.unity.com/products/unity-personal?_ga=2.145300465.433590269.1559218374-1672088338.1559218374). It is desired that artificial neural network algorithm be developed with open source development code such as TensorFlow (https://www.tensorflow.org/) or Python (https://www.python.org/). It is desired to have a high resolution color video camera (https://www.blackmagicdesign.com/products/blackmagicmicrostudiocamera4k) with a minimum of 3840 x 2160 pixels be used to observe raw pixels from the 3D virtual environment to train and demonstrate feasibility and performance of the algorithm. Novel approaches to train for object recognition that realistically emulate the human vision system (e.g., stereopsis, foveation, etc.) are desired if a breakthrough in capability is feasible.

PHASE I: Demonstrate in the Unity game engine environment an innovative and beyond state-of-the-art approach that demonstrates a viable and feasible technical approach to meet the topic objectives.

PHASE II: Develop, demonstrate, and test object recognition algorithms that meet the topic objective. Object recognition algorithms will be tested incrementally against the Common Objects in Context (COCO), http://cocodataset.org/#home, and ImageNet, http://www.image-net.org/, image data sets to establish benchmark performance against state-of-the-art. Image data sets will be developed to be capable of being rendered to meet the topic objectives for challenging object recognition training observations (scale, illumination, etc.). Object recognition algorithms will be matured to a TRL 5 by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Robust object detection would be a boon for safer commercial autonomous self-driving vehicles, drones, and robots. Military applications would include target identification, combat friend or foe identification, and for live force-on-target training at combat training centers

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KEYWORDS: Object Recognition, Convolutional Neural Network, and Human Vision

A20-064 TITLE: Reduced Signature Powered Parafoils

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Develop and demonstrate innovative methods, materials, mechanisms and/or technologies to reduce the acoustic, visual, IR, and/or other radar signatures of traditional, commercial off the shelf powered parafoil systems for personnel and/or cargo.

DESCRIPTION: The U.S. Army Combat Capabilities Development Command, Soldier Center (CCDC-SC), Aerial Delivery Directorate (ADD) is looking to investigate innovative approaches for powered parafoil that have a reduced signature compared to traditional, commercial off the shelf systems (COTS). Paratrooper and aerial resupply operations are typically conducted from aircraft dropping either guided or unguided parachutes; meaning the range is determined by the aircraft’s altitude, parachute’s glide slope, and weather conditions. Adding a motor to the system can increase its range, thereby reducing the aircraft’s signature and, possibly, eliminate the need for airdropping the system. Increasing the range allows for further aircraft standoff, keeping aircraft away from the enemy. Without the need for an aircraft, powered parafoils enable ship to shore or ground to ground resupply. Once on the ground, a current parachute and JPADS systems are the responsibility of the Soldier but with the ability for a powered parafoil take off and autonomously return to launch; the responsibility of the system is lifted from the Soldier and powered parafoil can be refitted to be used again. Given the capability of a powered parafoil to autonomously and covertly deliver itself to a Soldier, the Soldier could leave an area without detection and without carrying all the equipment for flight throughout the mission. Powered parafoils can have a greater mass delivered to cost compared to a Unmanned Aerial System (UAS) but can often be detected by the noise from the motor and propeller and their slowly moving radar/IR signatures. CCDC-SC, ADD is interested in technologies that can reduce one or more aspects of the vehicle's signature, with particular interest in reducing the acoustic, visual, IR, or other radar signature. Specific manned and/or unmanned vehicles have not been identified, so technologies that have a more general application across a range of systems are of interest. Final system should be scalable for payloads from 25 lbs. to 500 lbs. and capable of traveling 500 km, in zero wind conditions. Reduction in acoustic, visual, IR, other radar should be shown compared to an unmodified COTS system at 100, 500, and 1000 feet, showing a minimal 20% reduction. Modifications should not increase the system procurement to more than 40% original cost.

PHASE I: Identify multiple solutions to reducing the signature of powered parafoils which would advance the current state of the art. Develop detailed analysis of predicted performance. If parafoil rigging materials (ropes, cords, suspension lines, slings, etc.) foreign to aerial delivery applications are used, conduct stress/strain, porosity and yield testing on swatches of material to quantify essential material properties. Phase I deliverables include a report detailing all procedures employed in the research, all results of tests conducted, all potential technologies reviewed, samples of materials or small scale prototypes, milestones to be accomplished in Phase II, a recommended path forward and cost estimate to a) reduce the signature of a COTS technology or b) design of a new technology to replace a COTS technology.

PHASE II: Design and construct prototype systems using the material and/or design identified in Phase I; prototypes should be capable of lifting at least 100 lbs. to ensure signature is comparable to final product. Demonstrate operation of the prototype systems in a relevant environment. This could entail releasing the system from either a fixed or rotary wing aircraft and/or ground take-off/landing to assess airworthiness in the airdrop environment and quantify usability and survivability of the solution. Prototype may have automated guidance, remote control or manned operator and repeat testing of the prototype systems to assess operational life of the system. Phase II deliverables include any prototype devices constructed, a technical data package detailing the material/methods/mechanism designs, a demonstration of the prototype system/device to include dynamic airdrops of the system, and a report detailing all Phase II work, a recommended path forward, and updated cost estimate to a) reduce the signature of a COTS technology or b) design of a new technology to replace a COTS technology for a range of quantities.

PHASE III DUAL USE APPLICATIONS: Powered parafoils can enable applications that today are not feasible. They require minimal infrastructure, have the ability to enter and depart locations that classic ground, fixed or rotary wing aircraft have difficulty reaching or be considered a high risk. They can move a considerable amount of mass, over greater distances, at a lower cost than an alternative UAS. With total loss of power, parafoil will return mass to the ground at a lower descent rate, compared to a multi-rotor UAS, enabling entrance into urban areas. Reducing the signature will allow for covert missions or exfiltration at minimal detections risks and great distances. Reduced signature will obscure the sources of resupply as the parafoil could only be detected at the last moments of flight. While powered parafoils are already used, quieter engines can be used for less unobtrusive nature studies. Given the capability of a powered parafoil to autonomously and covertly deliver itself, anyone could then be exfiltrated without detection. With drone delivery currently passing regulatory hurdles, this technology could minimize the impact of hefty deliveries into everyday life.

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KEYWORDS: Reduced Signature, Powered Parafoils, Parachute, IR, acoustics

A20-065 TITLE: Haptics-enhanced Augmented Reality Training System for Care Under Fire

TECHNOLOGY AREA(S): Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management

Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: The purpose of this SBIR is to develop an Augmented Reality (AR) training system that trains Care Under Fire concepts. Combat Medic and Combat Lifesaver trainees do not currently have the capability to train how to move from a "Soldier First" context and engage an enemy, to providing injury care, and potentially back to engaging the enemy, in a virtual world. While haptics capabilities have been integrated to a small scale with virtual reality training devices, they have not been integrated in an AR environment, which provides much more realism for some tasks requiring weighted objects (e.g., wounded soldier). The purpose of this effort is on the haptics capability, and not the development of a combat casualty care simulation.

DESCRIPTION: Current Care Under Fire training does not allow for effective transition from a Soldier First context to a caregiver context, and back again. Integrating haptics capabilities into an AR training system will allow trainees to participate in both contexts with much more realism than allowed by mock rifles. We are seeking a haptics-enabled AR system that provides virtual representations of some entities (e.g., enemy avatars), real-world entities where appropriate (e.g., weighted patient simulators), and augmented representations of other entities (e.g., bleeding wounds on patient simulators, devices in a real-world medic bag).

PHASE I: Phase I should include a detailed study of historical Care Under Fire situations and developing a flow of how to move a trainee through a "crawl-walk-run" training evolution. With this flow, the offeror should consider how and where to insert Virtual, Augmented, and if necessary Mixed Reality training systems. Considerations of where haptics technology should be inserted, and why, should be noted (e.g., clearing a weapons misfire, feeling for a devices inside a medic bag while visually scanning for enemies).

The end result of Phase I should thus focus on two areas. The first area explores the Care Under Fire phase of Tactical Combat Casualty Care, and explains the important training elements. A flow moving a trainee from a simple evolution (e.g., no enemy action), to a more complex evolution (e.g., initial enemy action requiring the trainee to engage the enemy prior to caring for the injured) to the most complex evolution (e.g., initial engagement coupled with a weapon misfire, caring for the injured, and follow-on enemy action causing the trainee to set aside patient care to engage the enemy). The second area will explore haptics capability and its relevancy to the Care Under Fire training scenarios, with a description of how haptics can and should be integrated with virtual and/or augmented reality.

At the end of Phase I, offerors must present an estimate of the per-unit cost at the end of the first year, and end of the second year, of Phase II, should they be slected.

A simple feasibility demonstration should occur late in Phase I. This may take place at the developer's facility.

Phase I should finalize with a working plan to mature these areas into a training system to be developed in Phase II. Included should be plans for how to obtain, procure, or reuse a virtual simulation – whether organic to the offeror, purchased from or subcontracted to another firm, or via government furnished information/property.

PHASE II: Phase II will result in a training system developed on the concepts explored in Phase I. Initial usability testing should be performed with relevant users (e.g., at a military training center). Based on enhancements from usability tests, a training effectiveness evaluation should be performed with military trainees (e.g., Army Medical Simulation Training Center, National Guard training site, equivalent Navy/Air Force/Marine Corps training site teaching Care Under Fire principles). Phase II should result in a working prototype training system and a final report that covers both training aspect considerations and technical considerations. At the end of both years of Phase II, offerors must present the government with updated estimates of per-unit cost. A deliverable of Phase II should be a technical data package listing all software and hardware, both commercial off-the-shelf and custom-developed, that comprise the final system. Licenses to allow for system usage for no less than one year after end of contract are also required in order to continue demonstration to potential transition partners. Finally, a users' guide and training manual should accompany the final delivery to allow for instructors to use the system.

PHASE III DUAL USE APPLICATIONS: The initial use for this technology will be to train military medical first responders who are trained as Warfighters first, Caregivers second. In much the same way, many local, state, and federal law enforcement officials (LEOs) are being trained to provide limited lifesaving skills (e.g., tourniquet application) during active shooter and similar events. A Phase III dual-use application would create a similar training system to support non-military LEOs in a tactical situation. As protocols differs from LEO and military, and even from one LEO entity to another, care should be taken to consider protocols during Phase III.

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KEYWORDS: Medical modeling and simulation, care under fire training, haptics, augmented reality

A20-066 TITLE: Vehicle Mounted Expandable Command Posts (VMECoP)

TECHNOLOGY AREA(S): Battlespace

OBJECTIVE: The mobility of tactical command centers and other key communication assets is a critical capability in future conflicts. To enable Soldier survivability, critical Command Post based assets will need to move freely and rapidly on the battlefield, increasing mission command capability. A VMECoP that can be expanded and torn down quickly would allow for short notice movement of the mission command capability, reduce vulnerabilities, and increase lethality. The expandable capability of this system is critical as non-expandable shelters provide limited square footage and reduce potential.

DESCRIPTION: U.S. Army's high-level objectives dictate that timely movement of mission command and tactical intelligence assets shall be prioritized. Forward mission command and tactical intelligence assets shall be mobile, achieving operational maneuverability in all environments and at a high operational tempo. Future Command Posts must have greater tactical mobility to support mission command in the current Mulit-Domain Battle. Specifically, the emplacement, erect/strike of the VMECoP must be completed in mere minutes.

Historically, the Army Standard Family International Standardization Organization (ASF ISO) expandable shelters have been utilized for a range of high value tactical functions, for example: Command/Control and Deployable Surgical Operating Theaters. These are transported to a site, off loaded with either 15K MHE or a special purpose vehicle. Once in position, the shelter is expanded, power is connected, and the desired mission performed. Tear down of the system would follow the reverse order of set up. Asset removal would again require a 15K MHE or special purpose vehicle. The process of moving an expandable shelter and its associated high value tactical system has historically been orchestrated with the coordination of 4 or more Warfighters, a 15K MHE or special purpose vehicle and careful coordination of all support equipment (power generation, power distribution, and environmental control units (ECUs)) which must be transported separately to support the capability.

The current ASF ISO Expandable Shelters conform to 8ft x 8ft x 20ft ISO shipping container envelope, as defined by ISO 668 Series 1 freight containers – Classification, dimensions and ratings. The current ASF ISO Expandable Shelters meet the structural requirements of ISO 1496-1 Series 1 freight containers – Specification and testing – Part

1: General cargo containers for general purposes. In the deployed configuration, the existing ASF ISO Expandable Shelter, 1 sided expandable provides 265 ft2 of interior space. Any proposed shelter would have to provide similar square footage. The common ISO interface of the existing shelters facilitates standardized material handling, transportation methods, and equipment integration, and would be required on any proposed design.

The proposed VMECoP solution shall meet the threshold requirements as shown in Table 1 below:

Table 1: Performance Metrics for Vehicle Mounted Expandable Command Posts - TABLE WILL BE UPLOADED WITH TOPIC

It is imperative that the proposed designs take into account both speed and Warfighter safety during deployment. Additionally, the stability of the expanded floor sections while in the deployed configuration is critical. If a powered assist is used to deploy the shelter, designs must consider the source to provide this power and its impact on the time required to achieve the basic deployment of the design. The current ASF ISO Expandable Shelters one side expandable should be considered as the baseline technology for this effort to improve upon.

The current Expandable ASF ISO Shelters can be shipped by road, rail, internal and external air transport, sea and moved via common MHE. Additionally the current Expandable AFS ISO Shelter can operate in conditions ranging -40F to 120F and survive exposure to temperatures from -70F to 160F. The one sided ASF Expandable Tactical Shelter provides a power/data entry panel and removable panels for a ducted ECU, but is not integrated with power generation assets nor ECU capability. Offers should consider proposing solutions incorporating power generation and ECUs systems as well. Innovation is encouraged when accounting for interfacing with, transporting and or integrating power generation and ECU equipment.

U.S. Army high-level objectives dictate that timely mission command and tactical intelligence shall be prioritized. Forward mission command and tactical intelligence assets shall be highly mobile, achieving operational maneuverability in all environments and at a high operational tempo. Command Posts must provide greater capabilities to support Warfighters in the current Multi-Domain Battlefield. Smaller, highly mobile, command posts are easier to conceal and move and, therefore, more survivable. A mobile, command post remains essential to command and control in future dispersed, decentralized, multi domain operations. It is also required to enable command from any location, assess the situation firsthand, make decisions rapidly, and influence people and operations to maintain or regain the initiative on a lethal battlefield.

As the objective is to increase Command Post capabilities, the proposed MMECoP design should exhibit the following characteristics:

- Shall meet or exceed the Threshold metrics established in Table 1.
- Shall be operationally deployable within an 8’ x 8’ x 20’ ISO 1C freight container envelope and requirements as defined by ISO 668.
- Shall meet CSC transportation requirements as defined by ISO 1496-1.
- Shall meet system weight objective values in Table 1.
- Shall have a pay load as stated in Table 1.
- Shall mitigate unsafe or hazardous conditions when shelter is deployed (set-up) while mounted on a vehicle.
- Shall exhibit mechanical stability of the expandable components when deployed.
- Shall not cause or shall mitigate unsafe of hazardous conditions when power generation and ECU equipment are in operation while the shelter is mounted on a vehicle.
- Shall minimize the logistical burden on the supply chain, and not require the transportation of unsafe or hazardous materials/chemicals.
- Shall interface with military power connectors. Current ASF ISO Expandable Shelters interface with 100A or 60A Class-L 208V 3-phase power connector (MIL-DTL-22992).
- Shall provide an interface for external data and communication systems on fixed end wall.
- Shall have an overall heat transfer coefficient less than or equal to 0.26 Btu/(h*ft2*°F) in the operational configuration. It is desired the overall heat transfer coefficient be less than or equal to 0.22 Btu/(h*ft2*°F) in the operational configuration.
- Shall interface with a logistically supported ECU: ducted 60K IECU and 60K FDECU.
- Designs solutions are not required to be an entirely rigid walled shelter system. Innovative approaches to fast deployment and strike are encouraged.

• Shall be deployed and struck at a minimum of 50 times without loss of functionality of component failure
• It is desired that the system perform fully in extreme environmental conditions from -60F to 120F
• Shall have an estimated production price of $150,000 or less.
• Shall be compatible for use with military vehicles. The following vehicles are listed as examples: M939 5 Ton Truck, Army Medium Tactical Vehicle Truck (MTV), and the Heavy Expanded Mobility Tactical Truck (HEMTT)
• Shall withstand a roof load of 40 psf.
• Desired: provide environmental control to the inhabitants of the shelter
• Desired: provide on board power generation
• Desired: capability to complex to other VMECoP or Army tent systems.

PHASE I: The Phase I awardee shall develop/prototype a VMECoP design addressing the aforementioned requirements.

The awardee shall report monthly on their progress, in the form of a technical report indicating accomplishments, technical drawings, project progress against proposed schedule (manage to budget), tables, graphics, and any other associated test data.

Deliverables:
• Six monthly reports, with each report containing the following:
  o Technical progress to date, against proposed requirements and schedule.
  o Technical achievement highlights, as well as problems or decision-points reached.
  o Draft of Interoperability analysis for VMECoP transport
  o Draft of analysis and visualization of the VMECoP expansion and striking sequence. The analysis of expansion and striking sequence should include a discussion of recommended safety features and potential safety hazards.
  o Draft of recommended testing to include at a minimum: dimensional, environmental, and transportation.
  o Expenditure to date, against proposed schedule.
  o Within first two reports, present market research of all existing and future expandable shelters and their applicability to a military deployment.
• Final Technical Report suitable for publishing on to the Defense Technical Information Center (unclassified) that describes the project, the work performed and recommendations.
• A Final Concept Package shall be submitted containing the following:
  o A system model. The system model should be a small scale model, physical or virtual, that would convey confidence in the system would meet deployment and set up times listed in the objective and description sections.
  o Analysis and visualization of the shelter's expansion and collapse while both vehicle mounted and emplaced on the ground. The analysis of expansion and striking sequence should include a discussion of recommended safety features and potential safety hazards.
  o Demonstration of the erect/strike capabilities of the system demonstrator model
  o Finite Element Model demonstrating structural integrity of proposed design and structural capability to withstand deployment/strike loads of 50 cycles.
  o Small samples of materials representing the floors, walls, and structural/mechanical components of the shelter shall be provided that would demonstrate confidence that the system would meet the required characteristics and properties listed.
  o Concept level technical drawings, showing the shelter expanded and collapsed.
  o High resolution graphics of the proposed concept.
  o A concept for interfacing with power generation, power distribution assets, and ECU equipment.
  o Interoperability analysis for transport, loading, unloading.
  o Analysis and visualization of the shelter's expansion and collapse. The analysis of expansion and striking sequence should include a discussion of recommended safety features and potential safety hazards.
  o The proposer shall construct a list of recommended testing to include at a minimum: dimensional, environmental, and transportation. Transportation testing should include appropriate tests for movement via rail, ground, internal and external air, and transport via common MHE. At a minimum this list of tests should include:
    • ISO compliance testing,
    • Convention for Safe Container (CSC)
    • Environmental Testing

- Road Transportation testing
- o A cost analysis of the systems life cycle, including the cost of maintenance items and consumables, as well as the initial capital cost of procuring the system – over 5 years.

PHASE II: Phase II is a significant R&D effort resulting in a fully functional, full scale VMECoP prototype. Additionally, the prototype developed shall at a minimum meet the threshold requirements listed in the Description section of this document. The Phase II effort will focus on prototype development, validation of function and demonstration.

Required Phase II tasks and deliverables will include:
- "Monthly" and "Final" reporting, as detailed in Phase I, to cover the 24 month Phase II "Period of Performance".
- Deliver technical drawings of VMECoP.
- Deliver editable 2-D CAD files or 3-D model of the VMECoP, Solidworks format desired
- Deliver high resolution graphics of the final prototype.
- Deliver user manual for the prototype.
- Modifications and improvements to FEA models developed in Phase I to represent the full scale, final design, including analysis of erect/strike loading.
- Devise maintenance plan, and indicate all supplies needed, including cost, quantity, and frequency of replacement thereof.
- Transportation testing reports, required transportation testing per agreed upon list produced as part of Phase I.
- Deliver a complete VMECoP prototype exhibiting the desirable performance characteristics listed in the description section above. Delivery should be to Base Camp Integration Lab, Fort Devens, MA or mutually agreed upon alternative venue.
  - o Demonstrate each of the performance characteristics of the VMECoP as listed in the description section above.
- Demonstrate interoperability with a vehicle.
  - o Vendor to provide a commercial flatbed vehicle for demonstration purposes.
  - o In addition to a commercial flatbed vehicle, the Government may provide a military vehicle for demonstration purposes, pending availability of such vehicle. The following vehicles are listed as examples: M939 5 Ton Truck, Army Medium Tactical Vehicle Truck (MTV), and the Heavy Expanded Mobility Tactical Truck (HEMTT).

- An updated cost analysis of the systems life cycle, including the cost of maintenance items and consumables, as well as the initial capital cost of procuring the system – over 5 years.
- A final report suitable for publishing onto the Defense Technical Information Center (unclassified) that describes the project and the work performed. An addendum shall also be provided which provides full detail and test results of the system developed, the system performance and the method by which the performance characteristics in the Description section were achieved.

PHASE III DUAL USE APPLICATIONS: The initial use of this technology is for highly mobile military tactical capabilities, but we foresee an extension of the technology to other governmental organizations and commercial industry. For example, the following areas have been identified as commercial markets requiring improvements in the mobility of tactical shelters:
- Mobile environmentally controlled space, required for:
  - o humanitarian medical efforts,
  - o disaster response,
  - o And commercial construction applications.

The potential for Dual Use applications of the Dynamic Expandable VMECop, would grow rapidly once power generation and HVAC assets are integrated into the structure itself.

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KEYWORDS: Command Post, Shelter, Expandable, ISO, Vehicle, Tactical, Mobile

A20-067 TITLE: Advanced Materials for Power Electronics

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: The Army is interested in improving its power electronics systems for aviation. Industry is currently taking advantage of breakthroughs in Silicon Carbide (SiC) and Galium Nitride (GaN) power electronic systems that can produce considerable efficiency gains. The Army would like to explore ways to utilize these systems on current rotorcraft platforms and Future Vertical Lift (FVL).

DESCRIPTION: Current legacy power electronic equipment are inefficient in comparison to modern equipment. By taking advantage of newer technologies, the Army hopes to reduce the size and weight of these systems while providing more capability to the warfighter.

The SBIR is intended to explore opportunities for the Army to utilize emerging technologies to improve electrical distribution. Systems such as the Regulated Transformer-Rectifier Unit (RTRU), which typically have an efficiency of 70~80% is a prime example of where gains can be made.

Classified proposals are not accepted under the DoD SBIR Program. In the event DoD Components identify topics that will involve classified work in Phase II, companies invited to submit a proposal must have or be able to obtain the proper facility and personnel clearances in order to perform Phase II work.

PHASE I: Under phase I, the electrical system in Army Rotorcraft should be researched and trades analyzed to determine what benefits could be realized by the Army. The Army would like to have an understanding of trade spaces and areas of improvement that can be realized for power electronics on aircraft.

The Army currently utilizes systems within the following specifications:
AC Generators: 40KVA-60KVA, 115VAC, 400Hz, at ~85% efficiency (min)
RTRU: 28VDC output @ 250-400A ~85% efficiency (min)

The Army desires to explore systems with the following specs:
AC Generators: 45-70KVA, 115-270VAC, 400Hz, at 95+% efficiency
RTRU: 28-270VDC @ +400A +95% efficiencies

Note: If a DC voltage bus is utilized the Army will also need a way to supply 28VDC to its legacy systems.

Current systems also have a MIL-STD-810G environmental requirement.

A report should be delivered to the Army with documenting the design decisions the Army could make when utilizing a more advanced system. If possible, a demo would be desired.

PHASE II: Under phase II, the Army would desire working prototypes with actual simulated aircraft electrical loads. A laboratory environment would need to be setup that would simulate the aircraft loads. Additionally, this phase should include qualification testing to ensure ability to comply with Army requirements. The Army would like testing conducted to show the optimal setup that would be required for facilitate Army rotorcraft power needs.

The final deliverable would be a report with testing and design data that would give the Army a path forward to utilize modern power electronics equipment.

PHASE III DUAL USE APPLICATIONS: Under phase III, the Army desires to pursue full qualification of the components and aircraft integration/testing on UH-60, AH-64, CH-47, and/or FVL. Additionally it is envisioned that this technology will have applicability to the commercial aircraft market.

The final deliverable for this effort would be a qualified modern, integrated power electronics.

REFERENCES:
1. MIL-STD-810G

2. MIL-STD-704

3. RTCA/DO160

4. MIL-STD-461

KEYWORDS: Generator, Regulated Transformer-Rectifier Unit (RTRU), Power Electronics, Power Distribution, Power

A20-068 TITLE: Additive Manufacturing (AM) for Aviation Shop Sets

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: Increase and Enhance Fleet Readiness of Army Aviation plus Reduction in non-mission capable (NMC) time.

DESCRIPTION: The Army Program Executive Office, Aviation; Product Director, Aviation Ground Support Equipment (AGSE) is interested in innovative technologies to include in the Aviation Shop Sets. The Aviation Shop

Sets provide approximately 3000 tools housed in ISO S/783G and S/784G one-sided expandable tactical shelters. These shelters also include cabinets, work tables and large metal working equipment to maintain Army aircraft and are deployed around the world. The Aviation Shop Sets also provide field maintenance support and test and measurement equipment that are not included in aviation maintenance personnel's individually assigned tool kits. Proposed AM systems are expected to significantly improve aircraft readiness levels through the ability to manufacture tools, support equipment, and aviation grade spare parts. This capability would enable units to continue with the mission when the procurement system is not responsive. This will also add the capability for on-site repair of existing tools, equipment, and aircraft reducing the reliance on a delayed procurement system especially in remote locations. The proposed system would have the capability to reproduce or repair most hand tools in the Aviation Shop Sets with similar or same material and quality. This would enable maintainers to always have the tool needed at the time needed resulting in improved readiness levels. The proposed AM system would also be a component of the Aviation Shop Set. Proposed AM systems should also be mindful of future requirements surrounding the Improved Turbine Engine and Future Vertical Lift (FVL) platforms. Developmental and Operational Testing of the proposed AM solution will be required to substantiate performance to determine if the system as a whole meets the Army's requirements and is capable of fielding a first unit within 24 months.

PHASE I: AGSE would like to examine the feasibility and extent of AM devices' capability to replicate, replace, and repair tooling and parts used to maintain Army Aviation assets. Identify potential uses and capability gaps that can improve or leverage Army Aviation readiness using AM technologies within Army aviation maintenance in both garrison and deployed environments. Identify and characterize the advantages and benefits of utilizing AM technologies to include areas such as, but not limited to: cost, technical, training, readiness, logistics, technology limitations, and weight. The AM capability studied will need to meet necessary size and weight criteria to enable packaging within the current footprint of the Aviation Shop Set. Additionally, the AM capability must duplicate the necessary strength, ruggedness, and application to complete the tasks of maintaining Army Aviation assets.

PHASE II: AGSE would like to leverage the feasibility determination accomplished in Phase I. Objectives of Phase II are to: A) Procure up to 3 AM devices for demonstration/testing, B) Demonstrate AM capability to produce multiple tools and/or parts required for Army aviation maintenance, C) Demonstrate the ability for the prototype AM device to fit within the Aviation Shop Set,   D) Demonstrate the ability for the AM device to duplicate tools or parts similar in physical characteristics such as strength, ruggedness, and application, E) Complete a Technology Readiness Assessment and provide a document detailing the artifacts and justification to satisfy TRL determination. The offeror will demonstrate a capability of completing the widest array of manufacture/repair of tooling necessary to render the Aviation Shop Sets and associated equipment fully mission capable.

PHASE III DUAL USE APPLICATIONS: AGSE will POM for funding necessary to procure and retrofit Aviation Shop Sets with at least one selected AM device. Entry into Milestone B of the Acquisition development life-cycle including the completion of all life-cycle targets including development of a training plan for TRADOC, necessary user testing, and sustainment strategies to support the enabling of this capability. AGSE will be charged with the complete life-cycle management of the Aviation Shop Set.

REFERENCES:
1. Direct Measurement of Energy in Additive Manufacturing (AM) Paper by Federico Sciammarella, Northern Illinois University, sciammarella@niu.edu.

2. Additive Manufacturing (AM) for Complex Maintenance Tooling and Training Systems Paper by Bryce Weber, NUWC Keyport, Bryce.a.weber1@navy.mil.

3D Metal Printing for the Factory Floor Paper by Tom McDonald, Optomec, INC. tmcdonald@optomec.com.

4. Additive Manufacturing Handbook: Product Development for the Defense Industry, 2017, edited by Adedeji B. Badiru, Vhance V, Valencia, David Liu, ISBN-13: 978-1-4822-6408-1.

5. Advances in 3D Printing and Additive Manufacturing Technologies, 2017, edited by David Ian Wimpenny, Pulak M. Pandey, L. Jyothish Kumar, ISBN 978-981-10-0811-5.

6. Additive Manufacturing Materials, Processes, Quantifications and Applications, 2018, edited by Jing Zhang, Yeon-Gil Jung ISBN: 978-0-12-812155-9.

7. Additive Manufacturing, 2019, edited by Rupinder Singh, J. Paulo Davim, ISBN-13: 978-1-1380-5060-0.

KEYWORDS: Additive Manufacturing, Rapid Fabrication, Aviation, Readiness, 3D Printer, 3D Scanner, Laser Engineered Net-Shaping, Selective Laser Sintering, Multi-Jet Modeling

A20-069 TITLE: Phased Array SATCOM System for Group 2 UAS (Tactical BLOS)

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and demonstrate a Phased Array SATCOM System for Group 2 UAS and Dismounts.

DESCRIPTION: The Army's FTUAS program is bringing rapid innovation and new capabilities to the US Army's combat brigades. The FTUAS program is reducing the size of drones at the same time as bringing increased capabilities. An increasingly difficult problem is the ability to stay connected to the network while conducting missions that last 8 hours or more. System agile satellite communications (the ability to use GEO, MEO, or LEO systems) will greatly enhance the military utility of the Army's FTUAS. The Phased Array technology must be cost effective in order to equip the FTUAS in quantity and must be compatible with the next generation tactical terminals. The system should be capable of supporting multi-megabit per second connections to different satellite system in different types of orbit. The system should have the ability to do make before break to ensure no dropouts when transitioning from one satellite to another. This capability when complete will support added resiliency for Army and Multi-Domain Battle (MDB) mission threads in a contested environment. Once complete, this capability could be scaled for use in other Army systems.

In addition to the DoD environment, this proposal has potential for commercialization. As we move towards an "Internet of Things" approach where IP addressing is frequently used and wireless technology is used to send system status or update information, this could provide a much needed, smaller form factor satellite connection. Another potential commercial application would be in the proliferating unmanned vehicle market in the commercial sector.

PHASE I: Identify the key component technologies required to support the performance and cost goals for the phased array system. Model the system to show how RF performance will be achieved within the Size Weight and Power (SWAP) constraints of FTUAS. The weight should be less than 8lbs and the power should be less than 200 watts. The size should be compatible with future FTUAS platforms. The analysis should show basic performance parameters associated with SATCOM links to include at a minimum frequency bands supported, EIRP and G/T. The initial analysis should demonstrate the cost to produce the system within the FTUAS SWAP constraints and the feasibility of meeting requirements in Mil-Std-188-164B.

PHASE II: Design and develop a system agile phased array satellite communications prototype unit to show the feasibility of providing SATCOM for FTUAS. Test and demonstrate key technologies to support an initial capability and identify areas requiring additional research and development to support the SWAP constrained capability. Demonstrate as many performance parameters as feasible and identify growth path to full performance with the

FTUAS swap. Identify key risk areas where performance, SWAP coupled with minimum performance of real time video over SATCOM is the primary concern.

PHASE III DUAL USE APPLICATIONS: Deliver working units to the FTUAS program for integration and test. Obtain Defense Information Systems Agency (DISA) certification to work on military satellite systems. Obtain commercial certification for use on commercial satellite networks. This will pave the way for use on commercial satellite communications systems.

REFERENCES:

1. DISA (https://www.disa.mil/)

2. MIL-STD-188-164b

3. MIL-STD-188-165b

4. FedBizOpps.Gov: Future Tactical Unmanned Aerial System (FTUAS), https://www.fbo.gov/index?s=opportunity&mode=form&tab=core&id=df9e464c23db523fa4658763460ab954

KEYWORDS: Satellite Communications (SATCOM), Unmanned Aircraft Systems (UAS), Geosynchronous Orbit, Medium Earth Orbit, Low Earth Orbit

A20-070 TITLE: Cross Domain Processing Solution (CDPS) for Group 2 UAS

TECHNOLOGY AREA(S): Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop and demonstrate a Cross Domain Processing Solution (CDPS) for Group 2 UAS and Dismounts.

DESCRIPTION: The Army’s FTUAS program is bringing rapid innovation and new capabilities to the US Army’s combat brigades. The FTUAS program is reducing the size of drones at the same time as bringing increased capabilities. The evolution of small form factor SIGINT, EWW, and mini EO/IR with lasing payloads will greatly enhance the military utility of the Army’s FTUAS. To provide an advanced exploitation and dissemination experience to both external uses and the FTUAS operations, onboard data processing at varying simultaneous security classification levels is required. The Cross Domain Processing Solution (CDPS) must offer power efficiency and compact size to fly on a Group 2 UAS. The solution shall manage processing of (2) or more domains simultaneously. The CDPS shall process and provide operators in the FTUAS ground control station with relevant data applicable to their security classification and mission needs. This solution also needs to implement a framework for date and time accuracy where GPS may not be available for extended durations. This capability, when complete, will support increased interoperability for Advanced Teaming mission threads.

In addition to the DoD environment, this proposal has potential for commercialization. The technology could be leveraged in mainstream IT to provide physical separation between sites and networks. Another potential commercial application would be in the delivery of data by commercial unmanned vehicles to multiple, distinct customers during flight.

PHASE I: Identify the key component technologies required to support the performance, size, and cost goals for the CDPS. Model the system to show what processing performance (CPU and graphics) will be achieved within the Size Weight and Power (SWAP) constraints of FTUAS. The weight should be less than 5lbs and the power should be less than 100 watts. The initial analysis should demonstrate the cost to produce the system within the FTUAS SWAP constraints and the path ahead for receiving certification from the NSA for multiple domain processing.

PHASE II: Design and develop a hardware prototype unit to show the feasibility of processing data and providing date, time information for FTUAS in the constrained SWAP environment. Test and demonstrate key technologies to support an initial capability and identify areas requiring additional research. Demonstrate as many performance parameters as feasible and identify growth path to full performance with the FTUAS swap. Identify key risk areas where performance due to SWAP is a concern. Validate plan for NSA certification.

PHASE III DUAL USE APPLICATIONS: Deliver working units to the FTUAS program for integration and test. Obtain NSA certification to operate on designated networks. Obtain commercial certification for distribution to multiple, distinct customers.

REFERENCES:
1. NIST Special Publications 800 Series

2. FedBizOpps.Gov: Future Tactical Unmanned Aerial System (FTUAS), https://www.fbo.gov/index?s=opportunity&mode=form&tab=core&id=df9e464c23db523fa4658763460ab954

3. Cross Domain Enterprise Service Site, https://public.cyber.mil/cdes/

KEYWORDS: CDS, Unmanned Aircraft Systems, GPS, EWW, EO/IR, SIGINT, NSA

A20-071 TITLE: Radio Network Sniffer and Baseband Signal Analysis Tool

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: OBJECTIVE: Design and develop a tool that provides Radio Frequency (RF) digital channel emulation, captures I/Q samples in real-time, processes and analyzes these baseband signals across all radios in the network to evaluate radio network performance. The tool will enable evaluation of performance metrics such as network connectivity, bandwidth efficiency, reaction time to changes, performance in intermittent conditions, scalability, susceptibility to interception and detection, etc. This capability will allow advance evaluation of GOTS and COTS waveforms necessary to understand their suitability in ever challenging tactical use cases spanning from increased capacity for data transport, to real-time control of unmanned objects and vehicles, and ability to operate in congested and contested environments, which is not currently possible through spectrum analyzers.

DESCRIPTION: DESCRIPTION: Evaluating large ad hoc network solutions in tactically relevant scenarios poses unique challenges that are not adequately addressed in the current state of the art wireless network evaluation. This is particularly true in the context of integrated, network-centric communications in a congested and contested radio frequency (RF) environment. The current state of the art channel emulators provide ability for the radios to communicate in realistic environment, which allows the system evaluators to measure the application layer performance in different channel conditions. This performance measurement ability is essential but it does not provide the necessary insight into the RF characteristics of the radios in different network scenarios. This level of advance baseband analysis capability across radio networks is not available through spectrum analyzers. Additionally, Army does not have a tool to compare different radio network solutions as far as RF level signaling is concerned. This lack of visibility could hide vulnerabilities of a radio system. For example, two radio solutions that have similar network performance may have drastically different RF footprint, which makes one solution more susceptible to RF interception and detection. The ability to capture and analyze RF data from a network of connected radios will help in understanding such behaviors.

A comprehensive analysis of a radio system requires analysis across all communication layers. The information available through network management entities is useful but rarely provide deep insight into the radio behavior. The ability to capture and analyze data across application, network and RF layers is necessary to provide a comprehensive assessment of radio performance. A tool that can measure RF behavior as well as network behavior will help the Army to better understand and evaluate various radio technologies. It will help detect any system vulnerability in early stages of adoption, and ultimately reduce the cost of developing new technologies relevant to the Army.

To fill this gap Army is soliciting the development of a radio network evaluation technology that provides visibility into the behavior of the radio network. The evaluation tool must provide Radio Frequency (RF) digital channel emulation, capturing of I/Q samples in real-time, and processing and analysis of baseband signals across all radios in the network to evaluate radio network performance. This tool should provide recording and playback of several minutes of Network and RF environment for advanced radio systems where the corresponding packets and RF emissions are tagged with the identity of the emitter. The recording must support at least 16 SISO radios as well as 4 4x4 MIMO radios. This tool must support channel bandwidth of at least 250 MHz. The tool must provide standard interface to external tools such as MATLAB and other like tools. This interface could be leveraged to consume more advanced channel effects generated by these external tools and for analysis and reporting. The network analysis tool must include MATLAB scripts for analysis and reporting.

PHASE I: Conduct a design study of the Radio Network Sniffer and Baseband Signal Analysis Tool. The design must cover Radio Frequency (RF) digital channel emulation, real-time capturing of I/Q samples, processing, analysis, and playback of baseband signals across all radios in the network. Design analysis must address accuracy, speed, and scalability of the approach. Demonstrate proof of concept technology for two radios.

PHASE II: Finalize the design of the Radio Network Sniffer and Baseband Signal Analysis Tool. Build and deliver evaluation tool that can support recording of Network and RF interactions between at least 16 SISO radios and 4 4x4 MIMO radios. This tool must support channel bandwidth of at least 250 MHz. The evaluation tool should include matlab interface and scripts to read and analyze the data. The ability to record RF channel with tagged meta-data should be demonstrated using tactical radios connected through an RF link emulator where the channel is drawn from the terrain data of a geographical area that will be defined by the Army. The evaluation tool should be able to emulate the RF recording at any point on the identified map. The tool should be delivered to Army for further testing and evaluation. Potential military and commercial applications will be identified and targeted for Phase III and commercialization.

PHASE III DUAL USE APPLICATIONS: PEO C3T / PM Tactical Radio / PM Tactical Networks will have high interest in the Radio Network Sniffer and Baseband Signal Analysis Tool as they will be looking to evaluate commercial radios and waveform technologies for Army's Integrated Tactical Network (ITN). The development of this tool will enable fast and effective way to evaluate and characterize new radio technologies. The tool will also benefit a wide variety of communications and sensor networks and vendors for both military and civilian applications.

REFERENCES:
1. ns-3: A discrete-event network simulator for Internet systems: https://www.nsnam.org/

2. The Extendable Mobile Ad-hoc Network Emulator (EMANE): NRL next-generation framework for real-time modeling of mobile network systems. https://www.nrl.navy.mil/itd/ncs/products/emane

3. New electronic simulation forum for wireless communication will host much of DARPA's Spectrum Collaboration Challenge. https://www.darpa.mil/news-events/2017-04-21

4. RFnest™: A network channel emulator that allows a full mesh of wireless nodes to experience realistic channels effects. https://www.i-a-i.com/product/rfnest/

5. Key Sight Technologies: N9040B UXA Signal Analyzer, Multi-touch, 2 Hz to 50 GHz. https://www.keysight.com/en/pdx-x202152-pn-N9040B

6. Advanced I/Q Signal Processing for Communication Systems: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.133.5905&rep=rep1&type=pdf

7. Tektronix: TTR500 Series Vector Network Analyzer (VNA): https://www.tek.com/vna/ttr500

8. JFW Industries: RF Matrix Switches: https://www.jfwindustries.com/product-category/test-systems/matrix-switches/

KEYWORDS: Channel emulation, RF Matrix, I/Q Signal Processing, Channel Effects, Spectrum Analyzer, MANET, RF footprint, Radio network evaluation, MIMO radios, Waveforms

A20-072 TITLE: Machine Learning Waveform Agnostic Electronic Warfare Countermeasures for Army Tactical Radios

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: The objective of this research will be to develop and demonstrate countermeasures to electronic warfare (EW) attacks on communication's systems thereby producing communications systems that have increased EW resilience.

DESCRIPTION: Historically, US Army tactical radios use hard-coded TRANSEC techniques to counter specific simple EW threats against very specific communications waveforms. With the advent of Software Defined Radios new electronic attack (EA) techniques are increasing in sophistication and being developed and deployed at a rate outpacing waveform development. Artificial Intelligence (AI), and especially Machine Learning techniques, have been demonstrated as applied research (TRL 3-5), that can learn performance of friendly communications waveforms over time, recognize anomalies in behavior, and adapt to overcome EW threats.
The US Air Force and Navy have found some success in employing AI against Radar threats. Largely land bases, the US Army is primarily concerned with communications threats, yet much of the same AI might apply for both RADAR and comms.

PHASE I: The Phase I effort should demonstrate, in a laboratory environment, the ability of the AI algorithms to, based on performance observed over time, learn to recognize when SINCGARS, MUOS, and/or TSM waveforms are experiencing an EW attack (brought on by skilled EA operators using sophisticated modern attack techniques) and respond within five minutes to adapt and counter the attack without a-priori information regarding the nature of the attack.

PHASE II: Following the precedent of previous Product Manager Electronic Warfare Integration (PdM EWI) Radio Interference Mitigation (RIM) efforts, the Phase II effort should demonstrate (TRL-6/7), within a relevant environment (e.g., Yuma, EPG, etc.) embodiment of this AI solution in a form factor with a clear path to a fieldable tactical solutions that runs independent to any particular radio acquisition effort.

PHASE III DUAL USE APPLICATIONS: Phase III should advance the technology maturity to embodiment of this AI solution in a form factor demonstrated an operational environment at operational vehicle speeds and at operational range separations with anticipated range of red EA systems. Commercial applications include robust resilient communications for private security industry, air traffic control, first responders counter terrorism EA against private sector targets. May also likely counter non-malevolent interference events in congested RF environments.

REFERENCES:
1. Waveform Agnostic Communications via Deep Learning, DeepSig, https://oshearesearch.com/, Tim OShea

2. DARPA Behavioral Learning for Adaptive Electronic Warfare (BLADE) Program, https://www.darpa.mil/program/behavioral-learning-for-adaptive-electronic-warfare

3. DARPA Adaptive Radar Countermeasures (ARC)

4. (DARPA) for the Network Universal Persistence (Network UP) project. https://www.militaryaerospace.com/computers/article/16726529/darpa-seeks-to-ensure-radio-communications-and-networking-reliability-in-jamming-and-interference

KEYWORDS: Electronic Warfare, EW, Resilient, Radio, Radio Frequency, Communications, Artificial Intelligence, AI, Waveform Agnostic, Antijam, AJ, Machine Learning, ML,

A20-073 TITLE: Every Camera a Biometric Checkpoint

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: The objective of this project is to develop/implement an artificial intelligence/machine learning (AI/ML) algorithm employed in video surveillance cameras to detect identities, track identities, and disseminate identities through facial recognition from live video surveillance cameras anywhere.

DESCRIPTION: The U.S. Army has a need to enhance security measures at Forward Operating Bases (FOBs) and other secured facilities by detecting threatening individuals, preventing infiltration by non-authorized personnel and rapidly authenticating authorized personnel. To meet this need PM DoD Biometrics is in need of advanced identity verification, biometric identification leveraging real-time video surveillance monitoring and exploitation technologies. The primary objective of the desired capability is to rapidly (in near real time) determine or verify a person's identity from live video surveillance by automatically detecting, tracking and submitting high-quality face images to a cloud-based enterprise face recognition and alerting system. The system will deliver this capability anywhere, anytime and using any digital video surveillance camera which has Internet/network connectivity. The US Army desires an AI/ML-based face detection, face tracking and face search submission edge-device(s) which is capable of monitoring live video surveillance feeds (from commodity video surveillance cameras to include embedded cameras on Android and iOS devices) coupled with an enterprise cloud-based watch list management and face recognition matching capability. This system is intended to standardize and centralize edge-device management/authorization, face matching, face match adjudication, authoritative watch list management, and alerting/notification mechanisms. The system must be scalable to biometrically enable a large array (10k+) of video surveillance cameras.

PHASE I: The objective is to develop an overall system design that includes specification of AI/ML based techniques employed, specification of architecture required to support concept of operation, sensor specifications required to achieve detect, track, match, and disseminate functions, recognition techniques employed by algorithm, and protocol for employment with current identity operations and intel platforms.

PHASE II: Develop and demonstrate a prototype system in a realistic environment. Conduct testing to prove feasibility over extended operating conditions.

PHASE III DUAL USE APPLICATIONS: Upon completion of research, software developed could be integrated into current biometric collection capabilities.

REFERENCES:
1. https://www.electronicshub.org/types-of-biometric-sensors/

2. https://www.cnet.com/how-to/facial-recognition-apple-amazon-google-and-the-race-for-your-face-facebook/

3. https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78

4. https://www.quora.com/How-do-machine-learning-and-facial-recognition-algorithms-work

KEYWORDS: Machine Learning, Artificial Intelligence, Facial Recognition

A20-074 TITLE: Profile-to-Profile Face Recognition Matching Capability

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: The objective of this project is to develop/implement machine learning algorithms to automate identification of persons-of interest using face recognition with frontal and off-angle images from publically available information.

DESCRIPTION: While there has been much focus on the use of Artificial Intelligence (AI) or Machine Learning (ML) based techniques to automate identification of persons-of-interest using face recognition using frontal and off-angle face images, there is a need to develop/augment a face recognition algorithm to be capable of matching faces at extreme angles, such as faces captured as full 90-degree profile images. Many operational use cases exist whereby DoD is only able to collect a profile face image (for example, images extracted from Captured Enemy Material and from publicly available information) and has the need to identify the unknown subject. The Project Manager (PM) is interested in algorithms that incorporate state-of-art AI and ML processes. Approaches should address use of neural network design and training processes; use of performance and model monitoring tools; and data analytics for validation and visualization. Preference is for solutions to be agnostic to future systems to allow rapid capability increase for fielded systems – in particular the US Army’s Video Identification, Collection and Exploitation (VICE) System.

PHASE I: The objective is to develop overall system design that includes specification of AI/ML based techniques employed, specification of architecture required to support concept of operation, sensor specifications required to achieve match by various distances, recognition techniques employed by algorithm, and protocol for employment with current identity operations and intel platforms.

PHASE II: Develop and demonstrate a prototype system in a realistic environment. Conduct testing to prove feasibility over extended operating conditions.

PHASE III DUAL USE APPLICATIONS: Upon completion of research, software developed could be integrated into the Near Real Time Identity Operations (NRTIO) or Next Generation Biometric Collection Capability (NXGBCC) systems architecture. Providing the match/no-match response through a cloud-based architecture supports the cueing of multiple sensors on and off the battlefield. Technology could also be used to support smart cities concept in support of local governments via friction payment authentication or law enforcement applications.

REFERENCES:

1. Alyea, L.A., Hoglund, D.E., Eds. Human Detection and Positive Identification: Methods and Technologies, SPIE. 1996.

2. https://www.cnet.com/how-to/facial-recognition-apple-amazon-google-and-the-race-for-your-face-facebook/

3. https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78

4. https://www.quora.com/How-do-machine-learning-and-facial-recognition-algorithms-work

KEYWORDS: Machine Learning, Artificial Intelligence, Facial Recognition

A20-075 TITLE: Touchless Fingerprint Identification Toolkit (TFIT)

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: A software development kit (SDK) for mobile devices (iOS and Android) able to collect, process and match fingerprints from subjects (up-close and standoff) using stock rear camera. The SDK should provide (1) offline and online collection, processing and matching; (2) synchronization over disadvantaged, low-bandwidth connection when connected; and (3) online and offline matching against legacy (500 ppi), next-generation high-resolution (1000+ ppi) and minutiae-based fingerprints; and (4) advanced presentation attack detection (PAD) mechanisms. The SDK should support a wide range of import and export formats for interoperability with legacy and next-generation multi-biometric systems including support for probabilistic 1-to-many matches for partial latent collected prints from exploited sites. The SDK should be benchmarked for all conversions high resolution-to-legacy, legacy-to-high resolution and minutiae formats using NIST SP 500-305 and subsequent non-Appendix F matching methods. Finally, the SDK will pioneer a universal, open-source biometric envelope standard format to promote maximum interoperability and avoid future vendor-lock.

DESCRIPTION: Current mobile devices (phones & tablets) support specialized graphics processors and high resolution imaging cameras at low cost, but lack sophisticated biometric processing capabilities that would allow for efficient collection, processing and matching of fingerprint images at the edge. Future devices will get even more powerful in their capabilities but will lack software capabilities to exploit fingerprint image data unless software development kits (SDKs) are developed for watchlist 1-to-many matching in disconnected mode; fingerprints collected during operations; at-a-distance fingerprint image collection; backward-compatibility to legacy formats (ink and touch-based collected prints); and partial print processing and matching from site exploitation latent prints.

PHASE I: An operational, version 1.0 SDK and interoperability study to characterize the compatibility of high-resolution images with existing legacy ink & touch-based fingerprint databases based on NIST SP500-305 benchmark metrics (including PAD levels). Such an SDK will be released open source with plugin vendor drivers for biometric processing and matching engines but support version 1.0 of the interoperable biometric envelop format standard.

PHASE II: An operational, version 2.0 SDK with support for collection, processing and 1-to-many matching of latent fingerprints (including partial prints). The version 2.0 SDK will improve interoperability between legacy and next-generation (1000+ ppi and minutiae) formats, introduce new APIs for pluggable engines and re-benchmark matching (both 1-to-1 and 1-to-many) according to NIST SP 500-305 testing procedures (or subsequent NIST update editions).

PHASE III DUAL USE APPLICATIONS: A robust globally recognized fingerprint collection, processing and matching “backbone” (or “bus”) released as open source with pluggable extensions provided by vendors that provides interoperability between legacy and next-generation (1000+ ppi and minutiae) formats.

REFERENCES:

1. SOCOM 2019 Biometric TBE - https://www.nationaldefensemagazine.org/articles/2019/6/28/socom-seeks-smartphone-app-for-fingerprint-data

2. NIST Contactless Fingerprint Cooperative Research And Development Agreement (CRADA) - https://www.nist.gov/itl/iad/image-group/crada-program-contactless-fingerprint-capture-device-measurement

3. Bill and Melinda Gates Foundation - https://www.biometricupdate.com/201410/bill-gates-talks-biometric-identification-banking-for-emerging-countries

4. Bunq Bank - https://www.bunq.com/personal

KEYWORDS: biometrics, fingerprint, contactless, mobile, smartphone, standoff,

A20-076 TITLE: Correlating Threat with Identity

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: The objective of this project is to automate the detection and classification of vehicles and weapons from live video sources and correlate these objects with specific individuals using face recognition.

DESCRIPTION: To meet the vehicle/weapon detection and search requirements, PM DoD Biometrics plans to develop and integrate machine learning based vehicle and weapon detection algorithms within an open, scalable and flexible high-performance computing platform which collects, processes, analyzes and searches (by face and keyword) large photo and video collections and repositories. US Army’s Video Identification, Collection and Exploitation (VICE) System supports the rapid integration and operationalization of new computer vision algorithms which shall can detect and annotate objects of interest, such as vehicles, weapons, and other objects of military interest. The combination of face recognition and vehicle/weapon detection will enable operators and analysts to correlate persons-of-interest with objects-of-interest in support of Intelligence and Force Protection operations.

PHASE I: The objective is to develop an overall system design that includes specification of AI/ML based techniques employed, specification of architecture required to support concept of operation, sensor specifications required to achieve the ability to match identities associated with behavioral biometrics, and protocol for employment with current identity operations and intel platforms.

PHASE II: Develop and demonstrate a prototype system in a realistic environment. Conduct testing to prove feasibility over extended operating conditions.

PHASE III DUAL USE APPLICATIONS: Upon completion of research, software developed could be integrated into current biometric collection capabilities.

REFERENCES:

1. https://www.wired.com/2013/01/biometrics/

2. https://mexiaone.com/solutions/watchlist-person-of-interest-alerts/https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78

3. https://www.quora.com/How-do-machine-learning-and-facial-recognition-algorithms-work

KEYWORDS: Machine Learning, Artificial Intelligence, Facial Recognition

A20-077 TITLE: Network Enclosure Architectural Concept Improvement

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Project Office Integrated Air & Missile Defense (IAMD) is the lead materiel developer of the Army's Integrated Air & Missile Defense (AIAMD) Integrated Battle Command System (IBCS). IBCS will fuse multiple Sensors into a Single Integrated Air Picture for Air & Missile Defense engagement planning and execution. One of the IAMD developed components is the Integrated Fire Control Network Relay (IFCN). A major component of the IFCN Relay is a Network Enclosure Assembly (NEA). The NEA houses many critical components to enable IAMD data. The NEA is plagued with multiple issues from size, weight, cooling capacity and access. The objective of this SBIR submission is to obtain innovative small business insights focused on Size, Weight, Power, and Cost (SWAP-C) improvements of the NEA architectural concept, improving the reliability and availability of internal components so that they work in the harsh environment and conditions experienced by the NEA, and improving maintainability of the NEA by providing Soldier access to perform operations and maintenance.

DESCRIPTION: The NEA, which is a proprietary item, possesses seven additional proprietary items as well as eight others of which one is ruggedized. Given the proprietary nature of the item and several of the components, the intent of this SBIR is to evaluate the NEA architectural concept as a whole by:
(1) Determine internal components that could be improved so that they operate in the harsh environment experienced by the NEA,
(2) Assess and reduce the cooling system requirements based on improvement of the NEA architectural concept.
(3) Enhancing maintenance and Soldier access to the NEA.

The components that comprise the NEA:
1. Integrated Fire Control Network Relay (IFCN) Mission Case (Proprietary) - Bare bone case with Environmental Control Unit (ECU), Quantity: 1
2. Environmental Control Unit (ECU) Controller Assembly (Proprietary) - ECU control logic, Quantity: 1
3. Power Distribution Unit (Proprietary) - Internal Power Distribution (DC Edge Attachment), Quantity: 1
4. Northrop Grumman (NG) Integrated Battle Command System (IBCS) High- Band Radio Frequency Unit (HRFU) control/status protector (Electromagnetic Interference (EMI) / Lightning protection) (Proprietary) - EMI/Lightning Protection, Quantity: 1
5. IBCS NG 100A 28 Volts Direct Current (VDC) Protector (Proprietary) - Circuit Breaker with EMI/Lightning Protection, Quantity: 1
6. Status & Coordinate Input Module (Proprietary) - Soldier input / display device to Initialization Global Positioning System Receiver Module (IGRM), Quantity: 1
7. Breaker Box, Electromagnetic Interference (EMI), 100 amp (A) (Proprietary) - Circuit Breaker with EMI/Lightning Protection, Quantity: 1
8. Initialization Global Positioning System (GPS) Receiver Module (IGRM) - The IGRM provides location information and 1 PPS signal to the HNR for initialization and continuous operation, Quantity: 1
9. PARVUS DURANET 18-Port Switch - Parvus Duranet 3000 Ethernet switch. The Parvus Duranet 3000 Ethernet switch routes classified data traffic between the Network Equipment and the PFPU, Quantity: 1

10. HAIPE, AltaSec KG250X, Ruggedized - HAIPE 3.0 encryption device (ViaSat AltaSec KG-250X). The KG-250X HAIPE 3.0 encryption device maintains the red / black communication boundary for all IFCN communication, Quantity: 1
11. Harris Baseband Processing Unit (BPU) - The BPU includes the control processor that hosts the HNW version 2 data link control layer, an OFDM burst modem that provides the HNW version 2 physical layer and an embedded mobile access switch router, Quantity: 1
12. Spectracom SecureSync Timing Unit Direct Current (DC) Power - The Spectracom SecureSync network timing unit provides critical system timing information, ensuring end-to-end synchronization with all IFCN nodes by means of a GPS-base NTP server, Quantity: 1
13. Telecommunication Systems (TCS) Tactical Router, MIL SPEC - Alt-Media Router, Quantity: 1
14. Media Converter Chassis - Fiber optic media converter chassis with Omnitron 119-0 media converters, Quantity: 1
15. NTN, Remote Global Positioning System (GPS) Antenna - GPS antenna, Quantity: 1

PHASE I: Investigate and research innovative technologies and architectures that can be incorporated into a new mission focused enclosure, component focused, which can improve reliability and availability, operate with less or without active cooling, and which can perform the same functions as the components listed in the NEA description. Once investigation and research of potential technology is complete, the offeror will, in an unclassified format, identify implementation options in a Phase I report.

Analysis information and prototypes developed during this phase must be supplied to the PEO Missiles and Space.

The Phase II effort will likely require secure access. The Phase I effort will not require access to classified information.

PHASE II: Using the technology and approach(es) identified in Phase I, design and package the improved components into mission focused prototype enclosures that are smaller, lighter, and more accessible. Analysis information and prototypes developed during this phase must be supplied to the PEO Missiles and Space.

Analysis information and prototypes developed during this phase must be supplied to the PEO Missiles and Space.

PHASE III DUAL USE APPLICATIONS: Transition the Phase II product into a deployable capability to enter into detailed technical and operational testing. Following testing, if successful, prepare sufficient data products to support potential procurement and fielding as part of the IAMD IBCS System as an integrated component.

REFERENCES:
1. Army Integrated Air and Missile Defense (IAMD), https://asc.army.mil/web/portfolio-item/ms-aiamd-2/

2. Army Integrated Air and Missile Defense (IAMD), https://www.msl.army.mil/Pages/IAMD/default.html

3. Office of Secretary of Defense (OSD) Director, Operational Test & Evaluation (DOTE) FY2016 IAMD Report, https://www.dote.osd.mil/pub/reports/FY2016/pdf/army/2016iamd.pdf

4. Detailed requirements will be provided upon successful acceptance of this proposal.

KEYWORDS: Army Integrated Air and Missile Defense (AIAMD), Integrated Air and Missile Defense (IAMD), Integrated Battle Command System (IBCS), Integrated Fire Control Network (IFCN), IFCN Relay, Network Enclosure Assembly (NEA)

A20-078 TITLE: Artificial Intelligence Application for Air and Missile Defense Combat Identification, Planning and Weapon Assignment

TECHNOLOGY AREA(S): Information Systems

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OBJECTIVE: Project Office Integrated Air & Missile Defense (IAMD) is the lead materiel developer of the Army's Integrated Air & Missile Defense (AIAMD) Integrated Battle Command System (IBCS). IBCS will fuse multiple Sensors into a Single Integrated Air Picture for Air & Missile Defense engagement planning and execution. The objective of this SBIR submission is to develop a system architecture and algorithmic framework engine that supports artificial intelligence (AI)-based algorithms used to perform diverse functions such as Defense Design, Identification and Classification of tracks, Predictive Track Vectors, Sensor and Weapon Management, and other potential IAMD functions.

DESCRIPTION: Advances in artificial intelligence (AI) and deep learning techniques, in conjunction with rapid growth in GPU hardware performance have opened up new possibilities for exploitation of AI to perform highly complex tasks with performance exceeding that of more traditional approaches. Potential applications within the Army Integrated Air and Missile Defense (IAMD) system include Identification and Classification of tracked objects, Defense Design, and Dynamic Planning and Tasking.
To support AI / Deep Learning-based applications, the Army requires a robust, scalable architecture, framework and algorithm engine that can be utilized by multiple AI applications in an easily maintainable and extensible manner. The architecture and framework should include a combination of hardware and software that has a straightforward path of integration with current IAMD systems. The AI Engine should support integration and execution of multiple, simultaneous AI applications, as well as the ability to ingest, store, and process significant amounts of data.
In addition to execution, the architecture, framework and engine should support training of the algorithms, which minimizes hardware and software costs as well as permits on-the-fly enhancements to the different applications.

PHASE I: Develop a concept and initial prototype for a system architecture, framework, and algorithm engine. Demonstrate that the framework and engine will support AI-based functions such as Identification and Classification of tracks or others. Establish feasibility through evaluation of the framework via a study and/or use of simulation-based analysis.

The Phase II effort will likely require secure access. The Phase I effort will not require access to classified information.

PHASE II: Design, develop and deliver a prototype architecture, framework, and AI engine that demonstrates the capability to perform multiple AI-based functions, and is integrable with the current IAMD hardware and architecture. Perform the demonstration at a government defined facility. Prepare a Phase III development plan to transition the technology for the Army IAMD.

PHASE III DUAL USE APPLICATIONS: Transition the Phase II product into a deployable capability to enter into detailed technical and operational testing.

REFERENCES:
1. Vasudevan, Vijay. "TensorFlow: A system for Large-Scale Machine Learning." Usenix Associate, USENIX OSDI 2016 Conference, 2 November 2016.

2. Vasudevan, Vijay. "TensorFlow: Large-Scale Machine Learning on Heterogeneous Distributed Systems." Usenix Association, 2016. http://download.tensorflow.org/paper/whitepaper2015.pdf

3. Schmidhuber, Jurgen. "Deep Learning in Neural Networks: An Overview." Neural Networks, Volume 61, January 2015, pp. 85-117. http://www.sciencedirect.com/science/article/pii/S0893608014002135

KEYWORDS: Artificial Intelligence, Deep Learning; Identification; Classification, Defense Design, and Dynamic Planning, automated resource assignment.

A20-079 TITLE: Improved Ground Based Fire Control Radar Interferometry Techniques

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Development fire control solutions for the C-RAM II PTS testbed radar and system development of prototype radar software to implement detection and tracking algorithms as well as ambiguity resolution algorithms, waveform improvements, processing capabilities.

DESCRIPTION: Radar systems providing high accuracy tracks are critical to the development of state-of-the-art solutions for the warfighter. These radar systems find utility as fire control radars associated with some interceptor and also as truth sensors for conducting flight tests with UAS, missiles, projectiles, interceptors, mortars, and more. The PEO Missiles and Space is interested in developing fire control solutions for the C-RAM II PTS testbed radar system. This effort requires the development of prototype radar software to implement detection and tracking algorithms as well as ambiguity resolution algorithms, waveform improvements, processing capabilities. There is also interest in enabling the radar to be integrated in a networked configuration to support command and control mission requirements. The aforementioned improvements also require that the radar can successfully be instrumented to collect data in contested Electronic Warfare and Cyber environments. Radar system and component level improvements and maintenance are expected in order to support demonstration events and prototype development.

It is the intent of this topic for the offeror to demonstrate the capability to create improved tracking techniques for the C-RAM II PTS testbed radar system. The proposals must result in software and/or hardware modifications to the system that enhance its performance and develop technologies that can be inserted to or assist fielded radar systems.

PHASE I: In Phase 1, the offeror shall research, develop and evaluate prototype algorithms for resolving angle ambiguities and improving the tracking performance of a C-RAM II PTS interferometric testbed radar. Additionally, as part of Phase 1, the offeror shall investigate and produce a concept for adding waveform agility to the testbed radar. The final product of Phase 1 shall be prototype algorithms for certain missions, algorithm documentation, and a report documenting the new waveform possibilities of the sensor. Algorithm prototypes are required during Phase I and must be supplied to PEO Missiles and Space.

PHASE II: In Phase II, the offeror shall use methods developed in Phase 1 to modify radar software for implementation of the algorithms presented in the algorithm documentation. The updated configuration shall be evaluated by the offeror via demonstration at a test range (location TBD) and against the targets for which the algorithms were developed. The purpose of this demonstration is to verify the improved radar performance. Additionally, the offeror shall develop a detailed software, firmware, and hardware design for adding transmit waveforms to the testbed radars signal generation capabilities. The modifications that are associated with adding waveforms to the library of the radar shall be described and established. The offeror shall calibrate the antennas of the testbed radar for optimal performance. These improvements to the waveform and antennas are aimed at improving the agility and tracking performance of the testbed. Furthermore, the offeror shall generate a concept and implementation path for a Hardware-In-the-Loop (HWIL) representation of the radar in order to conduct algorithm development testing and performance predictions. Finally, software development that enables the testbed to collect and process sensitive data is necessary and will require improvements to the source code and data recording process. The desired products of Phase II include: 1) software builds implementing algorithms and capability improvements, 2) Demonstration of the radar performance improvements, 3) Improved antenna array calibration, 4) A detailed prototype design concept for implementing additional waveforms capability, and 5) a prototype design to achieve an HWIL configuration. Analysis, documents, and prototypes are required during Phase II and must be supplied to PEO Missiles and Space.

PHASE III DUAL USE APPLICATIONS: For Phase III of this effort, the offeror shall expand upon the solutions of Phase II to develop an HWIL system for the radar and waveform transmit unit generating various waveforms. The purpose of the HWIL development is to create a prototype system for conducting radar performance predictions against different targets or interest using hardware and software components identical to those in the radar processor. The purpose of the waveform generation unit is to enable the development and testing of prototype search, acquisition, detection, and tracking algorithms on interferometric radar systems that result in improved radar capabilities. Prototypes are required during Phase III and must be supplied to PEO Missiles and Space.

Phase III applications: Particular military applications include generic radar sensor system applications for accurate tracking of specific targets of interest either as a truth sensor or fire control radar. Additionally, improved algorithms and testing capabilities enable pre-flight test predictions, improved radar accuracy performance, and engagement of more advanced targets. Transitions of opportunity include military grade radar systems utilizing interferometer techniques and phased array antenna apertures. The most likely path to transition the prototype algorithms and hardware is for a ground based radar program that will adapt the technology during their development and test cycle or for PEO Missiles & Space to utilize the testbed in an integrated air defense network as a testbed radar.

REFERENCES:
1. "Passive Direction Finding - A Phase Interferometry Direction Finding System for an Airborne Platform", Worcester Polytechnic Institute, October 10, 2012, Daniel Guerin, Shane Jackson, Jonathan Kelly, Submitted to: Project Advisors: Professor Edward A. Clancy, Professor George T. Heineman, Professor Germano Iannacchione, Project Supervisors: Lisa Basile, MIT Lincoln Laboratory, Kelly McPhail, MIT Lincoln Laboratory, Christopher Strus, MIT Lincoln Laboratory, https://pdfs.semanticscholar.org/66

2. "Comparison of Direction of Arrival (DOA) Estimation Techniques for Closely Spaced Targets", International Journal of Future Computer and Communication, Vol. 2, No. 6, December 2013, Nauman Anwar Baig and Mohammad Bilal Malik, http://www.ijfcc.org/papers/246-B243.pdf

3. Beamforming for Direction-of-Arrival (DOA) Estimation-A Survey, International Journal of Computer Applications (0975 – 8887), Volume 61– No.11, January 2013, V Krishnaveni, PhD. Associate Professor ECE Department PSG College of Technology, T Kesavamurthy, PhD. Assistant Professor (Sr.) ECE Department PSG College of Technology, Aparna.B PG Student ECE Department PSG College of Technology, https://pdfs.semanticscholar.org/55e2/3309292fd24c3e2839295b19e1b7a9d0540a.pdf

KEYWORDS: Interferometry, Phased Array Antennas, Algorithms, Waveforms, Signal Processing, Fire Control, Network

A20-080 TITLE: Continuous-Time Digital Signal Processing (DSP) Using Reconfigurable Devices

TECHNOLOGY AREA(S): Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Modern missile systems require tremendous amounts of signal and information processing using constrained resources in an extreme environment. Multi-spectral sensors, high-bandwidth communications, and supersonic flight control demand significant processing power, while space and weight constraints limit available power and heat dissipation. It is uncertain that conventional Digital Signal Processing (DSP) approaches can provide the increased performance required in next generation missile systems. To meet this need, alternatives to conventional, power-hungry digital processing approaches are desired. A promising novel approach is continuous-time digital signal processing (CTDSP), which achieves similar or improved performance while offering a significant decrease in power and heat dissipation requirements [1]. In particular, continuous-time algorithms that can be implemented on reconfigurable hardware including field programmable gate arrays (FPGAs) can enable the flexible design of future missile systems. Because the power reduction of this technique is application-specific, an exact benefit to Army systems cannot be quantified at this time; however, power savings of as much as a factor of 3 have been reported [2]. This effort is designed to impact the Long Range Precision Fires and Air and Missile Defense Army Modernization Priorities.

DESCRIPTION: Continuous-time digital signal processing (CTDSP) offers a promising alternative to conventional digital signal processing (DSP) for systems constrained by size, weight, power and cost [3]. The defining attribute is the use of continuous digital states instead of discretely clocked samples. Gate outputs switch as input signals change, in contrast to conventional DSP where gate outputs update with a fixed frequency clock. As such, CTDSP can be described as unclocked digital processing. The primary potential benefit of CTDSP is a reduction in power consumption and heat generation due to reduced switching for low-activity signals. As CTDSP matures, the standard modules and functions that underlie many of the most common signal processing algorithms must be redesigned to operate using unclocked logic. Operations including linear filters, mixers, correlators, and even simple mathematical functions require a new design approach. Many key algorithms have been successfully demonstrated, primarily filters using FPGAs [3] and application specific integrated circuits (ASICs) [4]. Importantly, the development of conventional digital systems has been greatly aided by the widespread use of reconfigurable devices such as FPGAs. The inclusion of reconfigurable devices not only accelerates initial development but also facilitates maintenance and upgrade of fielded systems. To exploit recent advances, the development of continuous-time digital signal processing algorithms beyond linear filter networks that work on reconfigurable digital devices is highly desirable. These algorithms may use amplitude quantization of analog input signals but enable continuous, unclocked processing of the digital signals. Targeted algorithms will enable the common signal processing operations required for communications, sensing, and control that are typical of modern missile systems. Challenges include continuous-time digitizing of analog signal input, algorithm design, resource optimization, amplitude quantization effects, bandwidth limitations, and error correction or tolerance. Preferred designs will be vendor agnostic and portable across reconfigurable devices, with minimal tuning that is device dependent. The intent of this solicitation is to develop a suite of CTDSP algorithms to enable low-cost, low-power, reconfigurable signal-processing devices to support a large variety of applications. As such, the solicitation is not limited to a particular application or performance specification.

PHASE I: Conduct a design study to identify important signal processing blocks for implementation using continuous-time digital circuits on a reconfigurable device. These important processing blocks should, at a minimum, implement lowpass, highpass, bandpass, and notch filters as well as modulation. Simulation and theoretical analysis will identify a preferred concept design for signal representation and modularization of operations. Consideration will be given to analog signal interface, resource requirements, quantization effects, and portability within reconfigurable architectures.

PHASE II: Finalize an optimized suite of continuous-time signal processing tools implementable on reconfigurable gate arrays to support various signal processing requirements typical in a missile system. Performance metrics will establish improved performance compared to conventional DSP approaches in terms of size, power, heat dissipation, cost, and reconfigurability. Potential military and commercial applications will be identified and targeted for Phase III exploitation and commercialization.

PHASE III DUAL USE APPLICATIONS: The development of continuous-time digital signal processing to meet signal processing requirements using reconfigurable gate arrays enables a significant leap-ahead technology for signal processing to support communications, remote sensing, and control. These technologies offer potential benefits across a wide swath of communications and sensor networks for both military and civilian applications.

REFERENCES:
1. Y. Tsividis, “Continuous-time digital signal processing,” Electronics Letters 39(21), 1551 (2003).

2. Y. Tsividis, "Event-Driven Data Acquisition and Digital Signal Processing—A Tutorial", IEEE Transactions on Circuits and Systems—II: Express Briefs, Vol. 57, No. 8 (2010).

3. T. Beyrouthy, L. Fesquet, “An event-driven FIR filter: Design and implementation,” 22nd IEEE International Symposium on Rapid System Prototyping, 59 (2011).

4. C. Vezyrtzis, W. Jiang, S. M. Nowick, Y. Tsividis, “A flexible, event-driven digital filter with frequency response independent of input sample rate,” IEEE Journal of Solid-State Circuits 49(10), 2292 (2014).

KEYWORDS: Digital Signal Processing (DSP), Continuous-Time Digital Signal Processing (CTDSP), Field Programmable Gate Arrays (FPGAs)

A20-081 TITLE: Visor Projected Display NVG Camera

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: Replace Generation III Night Vision Goggles with equivalent performance camera sensor to achieve wider field of view and integrate day and night HUD into visor projected helmet mounted display.

DESCRIPTION: Currently, the aviation heads up display (HUD) modifies the Generation III Night Vision Goggles to provide symbology overlay for aircraft instrumentation. This forces the Army to field two HUD displays, one for day use, another for night operation. The SBIR topic “Next Generation Aviation Helmet Mounted Display”, A18-089, is developing a low cost replacement for the current day display which offers a wider field of view to the pilots. This technology is incompatible with the fielded night vision goggles because the visor cannot be closed while wearing the NVGs. A digital night vision sensor is required for integration into the Visor Projected Helmet Mounted Display (VPHMD) such that a single display can be used in both day and night conditions. The night vision camera sensor must be equivalent to generation III NVG performance and operate on existing voltage and current available from the fielded HUD computer display power supply. The sensor shall not require cooling or active illumination to perform, and shall offer 60hz frame rate in high resolution. Weight is critical to head mounted avionics, so the total weight of the VPHMD cannot exceed the weight of the Generation III NVGs (590 grams) modified with the HUD display (additional 145 grams), and the moment arm of the replacement weight cannot exceed that of the existing fielded NVGs modified with the night HUD.

Camera companies around the world are working towards real time high definition ultra-low light sensors which may be capable of achieving equivalent operational performance to Generation III NVGs IAW MIL-PRF-A327945, paragraph 3.5.3.5, i.e., “The brightness gain (see 3.6.10) shall not be less than 5,500 fL per fL (footlamberts)”.

This solicitation intends to identify low level light sensor solutions that can be integrated with the VPHMD with the least amount of weight and power consumption, and verify the brightness gain equivalence to Generation III NVGs. This topic aligns with modernization priority for Soldier Lethality.

PHASE I: This effort shall identify an existing low level light sensor capable of being integrated into the VPHMD with minimal size, weight, and power consumption. A laboratory demonstration is required to demonstrate breadboard operation of the sensor and prove brightness gain equivalence to Generation III NVGs. A test report is required documenting the results of the laboratory demonstration and the brightness gain actually achieved by the sensor. The contractor shall write and deliver a plan for a Phase II integration of the sensor into the VPHMD. The integration plan shall project cost, size, weight, and power consumption of the sensor to be integrated into the VPHMD based on the breadboard build prototype.

PHASE II: The contractor shall partner with the day display vendor winner of SBIR topic “Next Generation Aviation Helmet Mounted Display”, A18-089 to deliver a sensor solution which provides night video input to the VPHMD. A total of not less than eight sensors with all interface hardware shall be built and delivered. An interface control document shall be provided to the Government and the VPHMD vendor detailing mechanical and electrical interface to the VPHMD. The VPHMD vendor shall have project management control of weight/space/power assignment of the sensor integration.

The contractor shall host a Preliminary Design Review and perform a Critical Design Review (CDR) at the Government's facility in month eleven. Critical Design Review (CDR) shall serve as the first milestone at the end of year one. Both design reviews shall make projections for weight/space/power requirements of the sensor. CDR shall present a cost projection for the sensor. Design reviews shall address VPHMD top level requirements for environmental compliance (rain, dust, electromagnetic interference, etc.), automatic shutoff when exposed to bright light and rapid recovery when light is no longer on sensor, durability, and interface to VPHMD. Delivery of sensors to the VPHMD vendor for integration shall serve as the 2nd year milestone.

The contractor shall provide technical support to the VPHMD vendor by phone and travel to the VPHMD vendor site for first integration build activity. The contractor shall design the sensor as a replaceable module within the VPMHD by a soldier in the field using a standard Army electrical toolbox. The contractor shall provide final measured sensor capability and weight/space/power information to the VPHMD vendor so that the product specification for the VPHMD can be updated. The contractor shall perform a bench demonstration of the first sensor built to verify space/weight/power, functions, and capability.

Deliverables will include briefing slides for the design review, meeting minutes for bi-weekly status telecons and design reviews, a test plan for sensor performance demonstration showing compliance to VPHMD integration requirements, test report documenting test accomplishments, data for updated VPHMD performance specification reflecting measured sensor performance, and a report detailing projected cost of the final sensor design as a function of quantity from a minimum of 50 and up to 1000 at a time. A preliminary technical data package for the sensor module shall be delivered.

PHASE III DUAL USE APPLICATIONS: Develop production processes for sensor prototypes built and delivered in Phase II. Update the VPHMD item specification to reflect final production process weight and performance impact based on production configuration sensor. Build thirty six (36) production representative sensors to supply to VPHMD vendor for final operational testing on multiple US Army helicopter configurations. Provide technical data package for sensor module. Sensor may migrate into ground soldier night vision equipment. Primary commercial application of sensor will be replacement of expensive commercial night vision systems used for hunting, cameras for photography, police and firefighting applications.

REFERENCES:

1. SPI Infrared: https://www.x20.org/cmos-night-vision-sensor-hfis-x26/

2. SiOnyx: https://www.sionyx.com/resources/blogs/sionyx-night-vision-is-the-technology-to-beat/

3. Canon: https://www.usa.canon.com/internet/portal/us/home/products/details/cameras/cinema-eos/me20f-sh

KEYWORDS: HUD, Helmet Mounted Display, Night Vision

A20-082 TITLE: Docking Pouch for Soldier Electronic Devices

TECHNOLOGY AREA(S): Human Systems

OBJECTIVE: Develop a pouch technology that serves as a docking station for personal electronic devices, connecting these devices into a body-worn electronics network.

DESCRIPTION: While home and office docking stations provide for quick pre-wired connection between a computer and local peripherals, those docking devices have not yet been adapted for wearable systems (Reference 1). Small batteries can charge individual devices, but must be paired directly to the device (Reference 2). Connectors for personal electronic devices are getting smaller, more robust, and are preparing for a booming market in wearable technology (References 3 and 4). The Army desires a pouch that can serve as a docking station for a personal electronic device and connect into a body-worn network. This pouch development effort will explore unique methods for combining electronics docking with textile systems.

When the personal electronics device is inserted, the pouch will guide the device to a connector and not allow incorrect insertion/connection. The pouch may require different configurations for the size of the device and the type of existing connector on the device. When mated, the device shall be connected to the power (5V minimum) and data network. Data transmission from the electronic device will use USB protocol compatible. Typical connectors on personal electronics will include variations of USB such as Type A/B/C, mini-USB, micro USB, and Lightning. Upon insertion of the device into the pouch, there shall be tactile feedback that the User senses to assure that a power connection is made.

The pouch connector shall vary as a function of the existing personal electronics devices. Examples of Personal Electronics Devices used in Army Aviation include (but are not limited to) Lightweight Wearable Environmental Control System (LWECS), 45 Watt battery, End User Device (EUD) (an Android cell-phone-sized device adopted from Nett Warrior by Air Warrior), and the Electronic Flight Bag (EFB) (a tablet-sized Android device).

The pouch shall provide protection from an aircraft environment to include sand and dust, Petroleum/Oil/Lubricants (POL), electrostatic accumulation, flash-fire, and rain. The pouch configuration may allow insertion of the device from the bottom so the connection is at the top of the pouch if it provides better protection from contamination. Other innovative approaches to avoiding sand and dust contamination are welcome. The pouch shall retain the personal electronics device and shall maintain connection between the pouch connector and the inserted device. The connection between the device and pouch shall not be broken during normal user motion to include walking, running, crawling, and jumping. The connection shall be rated to IP68 (International Protection Marking, IEC standard 60529).

While power and data requirements are driven by the particular device the pouch contains, the docking pouch will be used in an aircraft environment. Electromagnetic signal emission and susceptibility shall be compatible with Army rotary wing aircraft.

PHASE I: This effort shall be used to develop a strawman architecture and design for a docking pouch solution that integrates with a body-mounted power network. The offeror shall identify viable manufacturing technologies and techniques that can be used in the assembly and production of the docking pouch solution. Proposed solutions shall be robust for military applications. If weight savings can be achieved with an innovative attachment and carriage system for use with a tactical vest, the technology shall be presented in this phase. A trade study shall be presented which compares the potential technologies with relevant parameters, including performance measures, size, weight, reliability, cost, and manufacturability. From this trade study, the offeror shall provide a recommended path forward.

PHASE II: This effort shall be used to develop the docking pouch technical details and to produce a limited quantity of test articles. The offeror shall develop the details for the physical and electronic components, as well as the human performance features. The offerer shall develop an approach to verify that the objectives are achieved. Twelve sets of pouches (one battery, one EUD, one EFB, and one LWECS) shall be delivered. The offeror shall conduct a lab demonstration of the pouches and perform initial aircraft compatibility to include electromagnetic interference and electromagnetic compatibility tests. The offerer shall maintain communication with IPC-8941 Subcommittee developing Guidelines on Connections for E-Textiles (Reference 5). Communication from the subcommittee shall be used to ensure compliance with emerging standards. Lessons-learned from development shall be communicated back to the subcommittee for their consideration.

PHASE III DUAL USE APPLICATIONS: Military personnel will be able to quickly recharge mission equipment in their docking pouches, and well as automatically connect to wired and wireless aircrew information systems. Other potential benefits as a result of this effort include commercial applications such as safety and situational awareness gear for outdoor enthusiast market, mine safety, and off shore oil and gas consumer markets.

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KEYWORDS: e-textiles, electronic clothing, tactical vest pouches, smart fabrics, docking station, flame retardant fabric, connectors

A20-083 TITLE: Low-Latency, High-Bandwidth Expeditionary Mobile Data Networks for Supporting Future Live Training Simulation Capabilities

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop techniques and methodologies that reduce latency and increase scalability of mobile networks to support bandwidth requirements for future live training systems and simulations.

DESCRIPTION: Future live force-on-force training systems will require high-bandwidth, low-latency transfer of information to facilitate advanced simulation capabilities such as real-time direct & indirect fires, interaction with virtual entities (controlled by both live participants and constructive simulations), and streaming of virtual terrain data.

To limit the burden on participants and increase realism, live training systems are made as small as possible, limiting the on-board processing capabilities of these systems. For this reason, cloud-based computing is an attractive option for enabling the capabilities described above. However, cloud computing requires a high-bandwidth, low-latency network to ensure that data is exchanged between the cloud and the point of need quickly enough to accurately simulate real-world military operations.

The problem is further compounded by the expeditionary nature of Army live training, which often takes place in areas with little or no wireless data network infrastructure.

The Army is interested in exploring techniques and methodologies for enabling low-latency, high-bandwidth expeditionary mobile data networks to support future live training simulation capabilities.

PHASE I: Desired end product of Phase I is a whitepaper describing the design of the new network technologies along with quantified estimates on bandwidth and latency.

PHASE II: Desired end product of Phase II is a demonstration of new network technologies on a virtual or live network, along with metrics on bandwidth and latency. In addition, the offeror would provide a document describing the expected risks, costs, and performance of the networking technologies developed when deployed on a large (Combat Training Center-sized) network.

PHASE III DUAL USE APPLICATIONS: Desired end state of the Phase III would be a tech demo of new TRL 6 networking technologies in a live Army training network at a homestation training application.

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KEYWORDS: Data Networks, Cloud Computing, Simulation, Cross-Domain Training

A20-084 TITLE: Cyber Training Big Data Analytics and Visualizations

TECHNOLOGY AREA(S): Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop an innovative technical application of big data analytics and visualizations for cyberspace operations training environments and datasets that support virtualized compute, network, storage nodes, high fidelity synthetic internet/grey space traffic, specialized hardware-in-the-loop assets, and threat actor signatures/emulation. The capability would support the ability to collect, correlate, extract, visualize and assess Cyber Mission Forces (CMF) embedded within high fidelity training environments across defensive/offensive operations and from individual, collective and force level training continuum.

DESCRIPTION: As stated within the Command Vision for United States Cyber Command (USCC), the Department of Defense's cyber warriors conduct a full spectrum of daily operations in a contested, dynamically challenging cyberspace against near-peer competitors and adversaries. The outcomes of these operations are to ensure support for military operations, defend the nation against cyberattacks of serious consequence, and protect DoD information networks. As such in 2018, USCC, as a combatant command, announced 133 teams reaching full operational capability across USCC and Service Cyber Components for such missions.

As these teams have been rapidly built out, maintaining and enhancing readiness through realistic, high fidelity training is critical to projecting multi-domain military superiority across the full spectrum of conflict. As such, established to provide a standardized cyberspace operations training platform for the CMF, the Persistent Cyber Training Environment (PCTE) is spearheading the capability development of an on-demand, self-service enterprise training platform across cyber mission sets across individual-collective-force level training. As the CMF training platform, PCTE will enable CMF operators to plan-prepare-execute-assess on-demand training content, environments, tools, and datasets that can be readily re-used and shared across the DoD.

As CMF individuals and teams execute the training continuum lifecycle, PCTE will be utilized to plan, define, and deploy high fidelity training events consisting of virtualized instances of compute, network, and storage coupled with automated actors, realistic traffic profiles, key terrain, master scenario event list (MSEL) injects, cyber tools, intelligence artifacts, and assessment criterion to replicate real world conditions enabling cyber readiness. As such environments are defined and executed, a significant breadth and depth of digital activities transpire that are required to be collected, extracted, transformed, visualized and correlated to aggregate results, trends and playback/replay scenarios in order to obtain a more refined quantitative and qualitative understanding of achieving training objectives, standards, and conditions. Data sources within these environments include but are not limited to network traffic flow capture, node health state, in-range sensor instrumentation, operator activity, scenario injects/effects, collaboration methods, and observations against training objectives.

To date, many of these sources of datasets are individually and in stove-piped fashion captured that can potentially be collectively mined to more comprehensively understand performance, assessment, and collate after action reviews overtime with trends and predictions. Processing through machine language with artificial intelligence could potentially be applied to achieve an integrative data analytics and visualization capability tailored for cyber training.

Moreover, layered around the cyber event environment, the PCTE platform provides a suite of tools, applications, and repositories that are access by CMF operators whose data can be further accessed to understand over trends in popular tools, content, and assessment patterns across training profiles. The utilization of a big data platform and visualization applied to cyber training specific analytics and collective data interpretation would significantly add to understand individual, tea, and force level performance against training objectives and results across AAR playback, analysis, assessment, and trends/projections.

PHASE I: Phase 1 should perform a study to investigate concepts and approaches for leveraging, integrating, and applying big data analytics and visualization technologies for utilization within DoD CMF cyberspace operation training environments. The initial conceptual design should include means of storyboarding the problem set and walking through the plan-prepare-execute-assess process for cyber training events. Specific consideration across data sources, transformation, enrichment, storage, analytics, visualization and alerting should be addressed as well its application to cyber training across assessment, performance measurement, event monitoring/activity, and AAR/playback.

PHASE II: Phase 2 extends the deliverable concepts and approaches of big data analytics and visualization for cyber training environments and implements a proof-of-concept prototype that could be applied within the PCTE platform. Initial prototypes could be demonstrated within a standalone environment and gradually phased into the PCTE platform through agile scrum execution based on currently defined cyber training environment and scenarios. The prototype should consider specific aspects of Phase 1 investigation and demonstrate visualization dashboards, data feeds, aggregation, and correlation that provide deeper insight, results, and near-real time results and activity of CMF individuals and teams within cyber training environments and events across a variety of data sources. Additionally, trends and predictive analysis could also be demonstrated based on CMF operator use of specific content, injects, and other platform specific services, repositories, and tools to provide feedback on overall utilization metrics.

PHASE III DUAL USE APPLICATIONS: A big data analytics and visualization capability would have significant operational military applications and SBIR research transition prospects. As the DoD training platform, PCTE has the mission to provide tools and capabilities to measure, collect, warehouse, and provide data visualizations of on-demand training environments executed by CMF operators at individual, team, and force level continuum. Next, a number of corresponding cyber operational and even other DoD modeling and simulation (M&S) programs of record could leverage this effort for transition purposes. Commercial application for use within financial, cybersecurity, and gaming technologies could also be made.

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KEYWORDS: cyber, cyberspace, operations, big data, analytics, visualization, artificial intelligence, machine learning, extract, transform, load

A20-085 TITLE: Quantum Sciences Components for Space Applications

TECHNOLOGY AREA(S): Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop advanced quantum sciences communications components such as: high brightness entangled pair sources, photon counting detectors, quantum random number generators, optical components, subsystems, and systems for applications in the space environment (low Earth orbit to geosynchronous Earth orbit).

DESCRIPTION: Future Army communications systems will be implemented in a harsh adversarial environment whereas encryption hardware and algorithms will be required. Following the onset of future quantum computational systems modern day encryption and communication systems will be at risk. A potential solution to secure high bandwidth communications is quantum entanglement based optical communications channels. For these quantum channels to exist future satellite networks must contain such systems. Therefore, space environment hardened long lifecycle components for quantum communications must be developed.
The challenge is to develop advanced quantum entanglement components and experiments for communications networks that can survive in space. The specific technical challenges to be addressed include:
• violation of Bell’s inequality
• Data teleportation
• Quantum key distribution (QKD) and entanglement based protocols
• Quantum state tomography
While these components and experiments may be at low technology readiness levels (TRL) in Phase I it is expected that a pathway to TRL maturation will be achieved through Phase II with potential flight experiments in Phase III. A goal of this SBIR is to develop components and/or subsystems and systems that will enable a demonstration of entanglement based high bandwidth encrypted communications between space based satellites.

PHASE I: The phase I effort will result in analysis and design of the proposed components and experiments. The phase I effort shall include a final report with modeling, simulation, and/or experimental results supporting performance claims. The method for performing entanglement based communications will be documented.

PHASE II: The Phase I designs will be utilized to fabricate, test and evaluate a breadboard system. The designs will then be modified as necessary to produce a final prototype for flight qualification testing. Flight qualification testing can be proposed as a Phase II option. The final prototypes will be demonstrated to highlight the specific capabilities and performance in meeting the technical challenges. A complete demonstration system (of the breadboard and/or prototype system(s)) must also be provided by the offeror. At the end of the Phase II flight qualification option it is expected that the prototype will be at TRL 6.

PHASE III DUAL USE APPLICATIONS: Civil, commercial and military applications include high bandwidth secure site-to-site communications channels. The Phase III effort would be to design and build a flight experiment payload to demonstrate the particular proposed performance characteristics on an orbiting platform (i.e., small satellite, ISS platform, other). Military funding for this Phase III effort would be executed by the US Army Space and Missile Defense Technical Center as part of its Quantum Entanglement and Space Technology research.

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KEYWORDS: high brightness entangled pair sources, photon counting detectors, quantum random number generators, optical components

A20-086 TITLE: Small Satellite Components for Space Applications

TECHNOLOGY AREA(S): Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop small satellite technology components and subsystems for use in Low Earth Orbit (LEO).

DESCRIPTION: The appeal of small satellites as a low-cost, rapid-development approach to achieving a new on-orbit capability has gained momentum over the last several years. Future Army applications require constellations of multiple small satellites with various payloads and capabilities. The goal of this SBIR is to develop new and innovative components, subsystems, and systems for next generation small satellites.
The challenge is to develop components that can be packaged in a small satellite (12U or smaller) and operate in the harsh environment of space for extended lifecycles without sacrificing performance. The specific technical challenges to be addressed include:
• Low power, high data throughput Field Programmable Gate Array (FPGA) flight computers
• Low power digital camera systems
• Non-volatile solid state memory
• Guidance, Navigation, and Control systems, subsystems, and components
• Software Defined Radio
• Other Communications Components (i.e., antennas, amplifiers, optical, other)
While these components and experiments may be at low technology readiness levels (TRL) in Phase I it is expected that a pathway to TRL maturation will be achieved through Phase II with potential flight experiments in Phase III. A goal of this SBIR is to develop components and/or subsystems and systems that will enable a demonstration of the technical challenge(s) addressed by the proposed in a spaceflight experiment.

PHASE I: The phase I effort will result in analysis and design of the proposed components and experiments. The phase I effort shall include a final report with modeling, simulation, and/or experimental results supporting performance claims. The method for performing the technical challenges will be documented.

PHASE II: The Phase I designs will be utilized to fabricate, test and evaluate a breadboard system. The designs will then be modified as necessary to produce a final prototype for flight qualification testing. Flight qualification testing can be proposed as a Phase II option. The final prototypes will be demonstrated to highlight the specific capabilities and performance in meeting the technical challenges. A complete demonstration system (of the breadboard and/or prototype system(s)) must also be provided by the offeror. At the end of the Phase II flight qualification option it is expected that the prototype will be at TRL 6.

PHASE III DUAL USE APPLICATIONS: Civil, commercial and military applications include small satellite constellations. The Phase III effort would be to design and build a flight experiment payload to demonstrate the particular proposed performance characteristics on an orbiting platform (i.e., small satellite, ISS platform, other). Military funding for this Phase III effort would be executed by the US Army Space and Missile Defense Technical Center as part of its Quantum Entanglement and Space Technology research.

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KEYWORDS: Small satellite, Low power, high data throughput Field Programmable Gate Array (FPGA) flight computers, Low power digital camera systems, Non-volatile solid state memory, Guidance, Navigation, and Control systems, subsystems, and components, Software Defined Radio, Other Communications Components (i.e., antennas, amplifiers, optical, other)

A20-087 TITLE: Compact, Hemispherical Coverage Early Warning Detection and Track Sensor for Multi-Mission Applications

TECHNOLOGY AREA(S): Electronics

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OBJECTIVE: To develop a low-cost, compact early warning detection and tracking system for target tracking in support of mobile Army tactical platforms.

DESCRIPTION: Many military weapon systems rely on radar technology that is on a different platform as an early warning detection and tracking system. Difficulties with this method arise in the radar handover latency being too long relative to the incoming threat trajectory, and target location errors in having the cueing radar on a different platform. A more favorable approach is to have a small, lightweight early warning threat detection system onboard the tactical platform housing the defensive weapon system. Low-cost compact radar technology has seen improvements in recent years, however complete hemispherical coverage is still problematic without requiring a large gimbal or multiple panels. Optical sensor options have been considered, but research, development, and experimentation are still required before this type technology would be transitioned to a weapon system. Optical

sensor concepts for this type application may include a specialty hemispherical shaped lens that is capable of collecting am image from a full hemisphere and reshaping it onto a focal plane array.
The early warning detection sensor must be a subsystem on a platform with a defensive type weapon system such as a high energy laser, and therefore must have a small footprint. The entire volume of the system shall be less than Threshold: 5 cubic feet and Objective: 3 cubic feet. The system must be capable of detecting rockets, artillery, and mortars (RAM); group 1-3 Unmanned Ariel Systems (UASs), cruise missiles, rocket propelled grenades (RPGs), and Man-portable air-defense systems (MANPADs).
If successful, low-cost reduced SWaP early warning detection systems would significantly benefit many military and commercial applications such as High Energy Laser weapon platforms, small-satellite tracking applications, and the commercial aviation industry.
Requirements:
- FOV (Search Volume) - T: 180°; O: full hemispherical
- Track rate – T: 10 Hz; O: 50 Hz
- Angular Accuracy – T: 5 milliradian; O: 0.5 milliradian
- Volume (including electronics)– T: 8 cubic feet; O: 3 cubic feet
- Power Consumption – T: 1kW; O: 500W
- Time of day operation – T: day; O: day and night
- Targets and detection ranges:
    - -RAM – T: 5 km; O:10 km
    - -UASs – T: Group 1 at 3 km, Group 3 at 18 km; O: Group 2 at 10 km, Group 3 at 30 km
    - -Cruise Missile – T: 8 km; O: 18 km
    - -RPGs – T: 2 km; O: 5 km
    - -MANPADs – T: 2 km; O: 5 km

PHASE I: The phase I effort will result in the analysis and design the early warning detection system. Successful completion of the Phase I effort shall be a concept design that provides a high confidence in meeting the system requirements. Modeling and simulation, and / or laboratory experimentation shall be used to show efficacy of the concept design.

PHASE II: The Phase I designs will be utilized to fabricate, test and evaluate a breadboard system. The designs will then be modified as necessary to produce a final prototype. The final prototype will be demonstrated to highlight acquisition and tracking performance parameters.

PHASE III DUAL USE APPLICATIONS: Civil, commercial and military applications include short-range counter-RAM and UAV target tracking, remote sensing, small-satellite tracking, satellite communication, and other communication efforts. High energy laser weapons offer benefits of graduated lethality, rapid deployment to counter time-sensitive targets, and the ability to deliver significant force either at great distance or to nearby threats with high accuracy for minimal collateral damage. Future laser weapon applications will range from very high power devices used for air defense (to detect, track, and destroy incoming rockets, artillery, and mortars) to modest power devices used for counter-ISR. The Phase III effort would be to design and build a sensor that could be integrated into an Army's High Energy Laser Weapon System for real time use as part of the fire control system. Military funding for this Phase III effort would be executed by the US Army Space and Missile Defense Technical Center as part of its Directed Energy research.

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KEYWORDS: Phased Array radar; Interferometric radar; Flat Panel; all-sky sensor; infrared sensors,

A20-088 TITLE: High Power Coherent Beam Combined Laser for Army Platforms

TECHNOLOGY AREA(S): Weapons

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OBJECTIVE: To develop a high-power laser system with high beam quality utilizing coherent beam combination methods.

DESCRIPTION: Current HEL Weapon System demonstrators are primarily using spectrally beam combined fiber laser technology. Laser system output powers are pushing towards the 100 kilowatt threshold and all of that laser power must be combined via a physical beam-combining element. Beam combining elements, as well as the optical beam control systems, are rapidly approaching the physical limit of how much power they can handle before damage occurs. Similarly, as the Army explores options of integrating laser systems onto smaller, more compact platforms, the overall footprint of the laser source must decrease. A potential approach to overcoming these two limitations is to switch to a coherently combined laser system. Tiled aperture designs and monolithic filled-aperture designs each present intriguing advantages; one completely eliminates the need for individual optical elements to handle tens of kilowatts of power, while the other avoids the fill-factor losses associated with tiled arrays. Current platforms integrating lasers are finding that the predominant SWaP driver is the thermal management system of the laser. Obtaining electrical to optical efficiencies over 65% would enable integration onto previously unfeasible platforms but current fiber-based systems fundamentally will struggle to reach this objective. Resent results suggest that a laser system consisting of multitude of diodes with coherent combination between individual channels could be scaled up to the kilowatt-class level while maintaining efficiencies and SWaP superior to fiber-based lasers. These systems still have hurdles to overcome in beam quality and consistent mass manufacturing. This solicitation looks for a solution to achieve all parameters in one prototype:

- Continuous Wave Power Output: Threshold: 15 kW; Objective: 60 kW
- Electrical to Optical Efficiency: Threshold: 45%; Objective: 65%
- Beam Quality (M2): Threshold: 1.5; Objective: 1.1
- Wavelength: Wavelengths that transmit through the atmosphere

PHASE I: The phase I effort shall include analysis and design of the proposed laser architecture concept. The analysis shall provide confidence that the proposed concept design will be successful in meeting the specifications. Power, efficiency, and beam quality expectations out of the laser shall be addressed in the Phase I effort.

PHASE II: During phase II, the phase I designs will be utilized to fabricate, test and evaluate a laser system prototype. The power scaling potential, efficiency, and beam quality specifications shall be demonstrated during the phase II effort.

PHASE III DUAL USE APPLICATIONS: During phase III, the contractor will develop a 10s of kilowatt class coherently beam combined laser system and work with the government to integrate the technology into a laser weapon system. This coherently combined laser will be tested in one of the Army's high energy laser demonstrators or testbeds.

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KEYWORDS: coherently combined lasers, high energy lasers, high power fiber lasers, high power diode lasers

A20-089 TITLE: Tactical Beaconless Atmospheric Turbulence Measurements

TECHNOLOGY AREA(S): Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop a tactical beaconless atmospheric turbulence measurement system capable of measuring range resolved Cn2 over path lengths of 0.5 to 10 km with 10m range resolution.

The challenge is to create a tactical grade beaconless atmospheric turbulence measurement system capable of field deployment and measuring range resolved atmospheric turbulence Cn2 values over ranges of 0.5 to 10 km with a range resolution of 10m.

DESCRIPTION: As modern laser weapon systems begin to move into the field, measuring atmospheric turbulence for predicting the laser system effectiveness will be of great concern. Current methods of measuring turbulence include scintillometers, Shack Hartman Wavefront Sensors, and differential image motion monitor systems which require a beacon be placed down range and directed back toward a detector. Other methods use passive targets placed down range along with imaging systems to determine the level of turbulence. Placing a beacon or known available passive target downrange is not a feasible option for fielded systems, thus a single ended approach is needed.

The challenge is to create a tactical grade beaconless atmospheric turbulence measurement system capable of field deployment and measuring range resolved atmospheric turbulence Cn2 values over ranges of 0.5 to 10 km with a range resolution of 10m. The system should be ruggedized to withstand inclement weather in varied environments and should be capable of quantifying Cn2 in the range of 1x10^ - 16 < Cn2 < 1x10^ - 12. Although Cn2 can be derived from direct measurements of scintillation, wavefront phase aberration, localized wavefront tilt, or lidar backscatter, this topic is not limited to those types of approaches. An approach that uses local meteorological data along with real time atmospheric modeling and produces accurate results is also a viable solution.?

-Environment: Threshold: 24/7 Outdoor operation, Temperature 0-50C; Objective: 24/7 Outdoor operation, Temperature -15-60C
-Measurement Dynamic Range: Threshold: 1x10^ - 15 < Cn2 < 1x10^ - 12; Objective: 1x10^ - 16, Cn2 < 1x10^ - 12
-Measurement Range: Threshold: 1km < Rmax < 3km; Objective: 0.5km < Rmax < 10 km
-Range Resolution: Threshold: 100m; Objective: 10m
-Form Factor/Size/Weight: Threshold/Objective: Single Ended (no beacon or known available passive target) Tripod Mountable

PHASE I: The phase 1 effort will result in a trade study and final design of a new beaconless atmospheric turbulence measurement system capable of meeting measurement requirements.

PHASE II: The Phase I designs will be utilized to fabricate, test and evaluate a prototype system. The designs will then be modified as necessary to produce a final prototype. The final prototype will be demonstrated to highlight the effectiveness of measurements.

PHASE III DUAL USE APPLICATIONS: High energy DoD laser weapons offer benefits of graduated lethality, rapid deployment to counter time-sensitive targets, and the ability to deliver significant force either at great distance or to nearby threats with high accuracy for minimal collateral damage. Knowledge of the atmospheric turbulence along the shot path is a key limiting factor for lethality and as such it is a critical input for the fire control system. The Phase III effort shall be to design and build a sensor that could be integrated into an Army's High Energy Laser Weapon System for real time use as part of the fire control system. Military funding for this Phase III effort would be executed by the US Army Space and Missile Defense Technical Center as part of its Directed Energy research.

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KEYWORDS: High energy lasers, Atmospheric turbulence measurement, Atmospheric turbulence profiling

A20-090 TITLE: High Energy Laser Beam Absorption Diagnostics and Thermal Blooming Prediction System

TECHNOLOGY AREA(S): Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop an atmospheric absorption spectroscopy measurement system capable of measuring the absorption properties of atmospheric gases and particles in the 1000-1100 nanometer near infrared wavelength band, and predict the occurrence and degree of thermal blooming due to high energy laser beam propagation.

DESCRIPTION: The objective of this effort is to create a portable measurement system to characterize the spectral absorption in numerous deployable environments over the wavelengths of 1030 – 1080nm, and make predictions on thermal blooming effects. These measurements will be utilized to characterize the specific mechanisms that give rise to thermal blooming as well as to determine the maximum amount of laser energy that can be utilized for a given engagement before thermal blooming effects create diminishing returns on increased laser power. Since the instrumentation will be used in the field, it must be designed such that it is immune to the effects of turbulence which can be severe over long near ground paths. The measurement path length must be optimized to balance the need for adequate atmospheric sampling, measurement accuracy, and immunity to turbulence. The measurement system should be validated through modeling and laboratory experimentation before it is taken out of a controlled lab environment to support field tests. Below is a set of threshold and objective requirement for the final field test instrument.

Wavelength Range (nm): T: 1030-1070; O: 1000-1100
Spectral Resolution (nm): T: 0.1; O: 0.01
Absorption accuracy (%): T: 5; O: 1
Environment: T: 24/7 Outdoor operation, Temperature 0-50C; O: 24/7 Outdoor operation, Temperature -15-60C
Atmospheric Turbulence (worst case): T: Cn2 < 1x10^-13; O: Cn2 < 1x10^-12
Eye safety: Eye safe operation (no PPE required)
Size/Weight/Ruggedized: T: Field Test Transportable; O: Tripod Mountable

PHASE I: The phase I effort will focus on the design of measurement system and analysis of the thermal blooming prediction model theory. This effort should result in a preliminary design that has been analyzed using modeling and simulation to establish high confidence that the instrument will be capable of meeting the requirements in the field test environment described above, and the theoretical process for determining thermal blooming based on measurements from the system.

PHASE II: The Phase I designs will be utilized to fabricate, test and evaluate a breadboard system. The designs will then be modified as necessary to produce a final prototype. The final prototype will be demonstrated in a field test or controlled environmental chamber to validate its thermal blooming prediction accuracy.

PHASE III DUAL USE APPLICATIONS: High energy DoD laser weapons offer benefits of graduated lethality, rapid deployment to counter time-sensitive targets, and the ability to deliver significant force either at great distance or to nearby threats with high accuracy for minimal collateral damage. Future laser weapon applications will include very high power devices used for air defense to detect, track, and destroy incoming rockets, artillery, and mortars and it is expected that thermal blooming will be a significant limiting factor. The utilized laser power will need to be managed to keep it just below the level that would produce thermal blooming. The Phase III effort would be to design and build a sensor that could be integrated into an Army's High Energy Laser Weapon System for real time use as part of the fire control system. Military funding for this Phase III effort would be executed by the US Army Space and Missile Defense Technical Center as part of its Directed Energy research.

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KEYWORDS: High Energy Lasers, thermal blooming, Absorption spectroscopy, Spectral transmission, Spectrometer, Spectrophotometer

A20-091 TITLE: Tactical Ultrashort Pulsed Laser for Army Platforms

TECHNOLOGY AREA(S): Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: To develop an ultrashort pulse laser (USPL) system with sufficient SWaP and ruggedization for use on Army relevant platforms.

DESCRIPTION: Current high energy laser (HEL) weapon systems primarily consist of continuous wave (CW) laser sources with output powers in the kilowatts. These kilowatt-class CW laser systems predominantly engage targets via absorption of light; either causing the target to burn and melt or overwhelming optical sensors with high intensities. Thanks to the emergence of diode and fiber laser technology, these laser systems have grown increasingly ruggedized to the point they have been integrated onto platforms ranging from ground to sea. The Army is preparing the warfighter for a future battlefield with rapidly modernizing militaries while new threats and gaps are emerging. CW lasers provide solutions to many of these problems but due to their fundamental different natures, lasers with pulse widths in the range of femtoseconds provide unique tactical capabilities due to their rapid discharge of enormous power. This call aims to develop an USPL that is ruggedized enough to begin testing in relevant Army environments. While most CW lasers simply melt targets, USPL systems are able to neutralize threats via three distinct mechanisms: ablation of material from the target, the blinding of sensors through broadband supercontinuum generation in the air, and the generation of a localized electronic interference used to overload a threat’s internal electronics. Even the propagation of light from a USPL system holds unique advantages. The sheer amount of intensity in a terawatt pulse laser is able to cause a non-linear effect in air resulting in a self-focusing filament. These filaments propagate without diffraction, providing a potential solution to the negative impact turbulence has on beam quality when propagating a conventional CW laser system. Differences in lethality as well as propagation mechanisms makes USPL technology one of particular interest for numerous mission sets. Over the last two decades, femtosecond lasers have gone from requiring dedicated buildings at national laboratories to sitting on academic optics tables across the country. These USPL advancements, while promising, still have many hurdles to overcome in SWaP, relevant operating environments, and consistent mass manufacturing. This solicitation looks for a solution to achieve the parameters listed below in one prototype:

- Wavelength: Wavelengths that transmit through the atmosphere
- Average Power Output: Threshold: 20 W; Objective: 50 W
- Pulse Peak Power: Threshold: 1 TW; Objective: 5 TW
- Pulse Width: Threshold: 200 fs; Objective: 30 fs
- Repetition Rate: Threshold: 20Hz; Objective: 50Hz
- Beam Quality (M2): Threshold: 2.0, Objective 1.5

PHASE I: The phase I effort shall include analysis and design of the proposed laser architecture concept. The analysis shall provide confidence that the proposed concept design will be successful in meeting the specifications. The expectations for the above specifications out of the laser shall be addressed in the Phase I effort.

PHASE II: During phase II, the phase I designs will be utilized to fabricate, test and evaluate the laser system prototype. The above specifications of interest shall be demonstrated and measured during the phase II effort, or a detailed design for a prototype that will realize all parameters shall be delivered.

PHASE III DUAL USE APPLICATIONS: During phase III, the contractor will work with the government to complete a USPL system that meets all requirements and integrate the technology into a laser system. This laser system will be tested in one of the Army's high energy laser demonstrators or testbeds.

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KEYWORDS: ultrashort pulse lasers, USPL, high energy lasers, femtosecond lasers, pulsed laser sytsem

A20-092 TITLE: Intelligent Lithium-ion 6T MIL-PRF-32565 Compliant Battery Maintenance & Charging System

TECHNOLOGY AREA(S): Ground/Sea Vehicles

OBJECTIVE: An advanced, intelligent Lithium-ion 6T MIL-PRF-32565 Compliant Battery Maintenance & Charging System.

DESCRIPTION: The 28-V Lithium-ion 6T drop-in replacement battery (Li-ion 6T) is a critical technology to enhance energy storage to improve warfighting performance across the Army, Marines, and Navy. The Li-ion 6T is a drop-in replacement for legacy Lead-Acid 6T batteries for starting, lighting, and ignition (SLI) and silent-watch applications, and provides the same form, fit, and expanded function, including increased silent watch time, significantly extended cycle life, and faster recharge time. Currently fielded Lead-Acid 6TAGM battery chargers and maintenance equipment have limited or no compatibility with Li-ion 6T batteries, in part due to differences in battery chemistry and voltage levels (12V vs. 24V). Additionally, fielded charger solutions for Lead-Acid typically lack sophistication in charging method, usually only providing different preset charging voltage levels, and do not provide enhanced prognostics/diagnostics or CAN communication required for interfacing with modern, smart batteries. Accordingly, an intelligent Li-ion 6T MIL-PRF-32565 Compliant Battery Maintenance & Charging System (hereafter referred to just as "charger") is required to improve the field supportability, charging, and maintenance of Li-ion 6T batteries as well as to enable enhanced capabilities such as optimized charging per battery vendor/type, optimized charging for a given vehicle/mission, discharging to a preset SOC for storage & transport, advanced prognostics/diagnostics, detection of faults & manufacturing defects, bi-directional battery-to-charger CAN communication, equalization, and updating battery firmware over CAN bus (MIL-PRF-32565 Sections 3.6.4.8, A.5.3). Technology developed should be compatible with all MIL-PRF-32565 compliant Li-ion 6T products and generally applicable to low-voltage commercial Li-ion battery packs. The technology shall also aide the user in selection of optimal sets of Li-ion 6T batteries for a given vehicle platform and mission as well as identify deficit batteries or batteries in need of replacement. The technology shall be capable of optimally charging Li-ion 6T batteries individually as well as in full vehicle sets of up to six Li-ion 6Ts. The charger shall be MIL-STD-1275 compliant, shall support charging/discharging of both Type I and Type II batteries, and shall allow for bi-directional transfer of power between batteries for high efficiency and reducing losses. The charger shall be military ruggedized, designed for operation over the entire military temperature range, and include a human interface (graphical) that considers human factors. The charger shall be capable of providing external power to the battery's BMS through the battery power terminals (3.6.2). In support of prognostics, the charger shall additionally verify functionality of battery safety protections (3.6.3.3) as well as the resolution/error of the performance characteristics of MIL-PRF-32565 Table IV. The Phase II chargers shall additionally be capable of receiving and transmitting all messages and signals required to communicate with the battery in Appendix A of MIL-PRF-32565 and shall meet the requirements of SAE J1939 and ISO 11898, while providing variable baud rates and termination resistances where necessary. The charger shall interface with the MIL-DTL-38999 receptacle on the Li-ion 6T battery.

PHASE I: Identify and determine the engineering, technology, and hardware and software needed to develop this concept. Additionally, sophisticated novel charging/discharging techniques & methods should also be developed in this Phase to be employed in Phase II to achieve standard and rapid charging (4.4.9, 4.4.9.2) while producing the most benign impact to cycle life and supporting a range of turnaround times as the mission requires. These techniques & methods should make use of relevant parameters transmitted by the smart battery and should be adapted as necessary to optimize charge, discharge, and equalization for a given battery vendor, type, and chemistry. Bench top testing of a Phase I embedded hardware and software charger prototype for one Li-ion 6T battery is expected. Drawings showing realistic designs based on engineering studies are expected deliverables. Additionally, modeling and simulation (M&S) tools needed to drive the technology is expected. A bill of materials and volume part costs for the Phase I designs should also be developed. Designs in this phase also need to address the challenges and requirements identified in the above description as well as the charger requirements of Phase II.

PHASE II: Develop and integrate prototype hardware and software into intelligent Li-ion 6T MIL-PRF-32565 Compliant Battery Maintenance & Charging Systems (Phase II chargers) using the designs and technologies developed in Phase I. The technology shall be designed such that it is generally applicable to all MIL-PRF-compliant Li-ion 6T batteries (and low-voltage Li-ion batteries generally), but must be tested and demonstrated on at least two different Li-ion 6T battery variants. The chargers shall accommodate a variety of input source voltages (ex: 120/208/240VAC single/three phase, 20-60 VDC), including connection to a Tactical Quiet Generator (TQG). Deliverables shall include electrical drawings and technical specifications, software, M&S and test results, and at least two Phase II chargers, each capable of charging at least six batteries. The Phase II chargers shall include the ability to (1) read and use manufacturer specific parameters for charge/discharge optimization; (2) set battery baud rates (A.3.3.5); (3) capture and log long-term fault data (3.6.8) and short-term fault data (3.6.9) for reporting and improving the chargers' Li-ion 6T prognostics/diagnostics; (4) check the hardware and software version of the battery (3.6.5.3.4); (5) execute built-in test; (6) read and reset DTC trouble code faults and failures (3.6.5.3.3); (7) perform configuration overwrite (A.5.5); (8) set the transportability command, SOC reserve limit, application overcurrent limits, and application overcurrent periods (A.5.7.1-3); and (9) read in the maximum charge current and bus voltage request signals for optimization of charging functions (3.6.5.1.5, 3.6.5.1.7). The charger shall be capable of control of battery state transitions through CAN commands and charger output connections, including Operation, Standby, Maintenance, Protected, and Dormant State (3.6.6). The charger shall be capable of powering and controlling via CAN (enabling/disabling) the battery's internal automatic heater function to allow heating of the battery to the temperature required for optimum charging for a given set of charge conditions (3.3.5.2.3). The charger shall be capable of altering the state of the battery contactor via CAN bus (3.6.3.5). The charger shall be capable of mimicking the master power switch (On and Off states) and reset pin as well as acting as a virtual master power switch (A.3.3.3.1, A.3.3.7). The charger shall be capable of placing the battery into battle override mode (3.3.6) to allow for repair of faults that can be safely corrected through charge/discharge operations. A bill of materials and volume part costs for the Phase II design should also be developed.

PHASE III DUAL USE APPLICATIONS: This phase will begin installation and integration of the solutions developed in Phase II into military grade Li-ion 6T chargers as well as commercial low-voltage Li-ion chargers.

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KEYWORDS: Lithium-ion, 6T, charger, CAN Bus, batteries, power, energy, maintenance

A20-093 TITLE: Multifunctional Metamaterials for Novel Interaction with the Environment

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: Develop multifunctional metamaterials (MFM) which exploit the electromagnetic (EM) spectrum or energy for novel environmental interactions. Novel environmental interactions include (but are not limited to) EM wave guidance, absorption, negative permittivity, negative permeability, and EM stimulated mechanical resonance or oscillation.

DESCRIPTION: Multifunctional Metamaterials (MFM) can harness, direct and control the propagation and transmission of certain aspects of the EM spectrum. There is a need for novel materials that can manipulate the paths traversed by visible light and other frequencies of the EM spectrum, including infrared (IR) and microwaves, alter their reflection and refraction, and enhance material properties for combat applications. MFMs are defined as artificially structured organic, metallic, ceramic, or composites of many materials which interact with the EM spectrum and exhibit behaviors that do not readily occur in nature. The proposers should demonstrate MFMs that control EM radiation by absorbing or guiding an incident wave around an object, without being affected and/or reflected by the object. Metamaterials should be engineered with arbitrarily assigned positive or negative values of permittivity and permeability, which can also be independently varied at will. The proposers should demonstrate the capability to build metamaterial based devices, adaptable to a broad spectrum of radiated light. The proposers should demonstrate materials and techniques that produce strong scattering suppression in all directions and over a broad bandwidth of operation.

PHASE I: Phase I should demonstrate the innovation, the scientific and technical merit, the feasibility, and commercial merit of selected concepts. The proposers should identify and explore novel multifunctional metamaterials with one or many of the attributes such as negative reflective and refractive index across the electromagnetic spectrum, wave absorption, wave guidance, which enhance vehicle protection and performance. Metrics of interest for Phase 1 include percentage of EM energy absorbed, reflected, refracted at visible light frequencies and other frequencies of the EM spectrum, including infrared (IR) and microwaves; and measureable changes in MFM physical properties when under EM radiation and when not. Prototype samples, modeling and simulation (M&S), or other rigorous and scientifically sound methods should be used to demonstrate MFM performance along the stated metrics of interest. Prototype samples, models and data are an expected deliverable and include mathematical formulae and/or scientific M&S results.

PHASE II: Phase II should culminate in well-defined deliverable prototype(s) (technologies or materials) which meet the requirements of the original solicitation topic. Prototype(s) should manipulate the paths traversed by light and other EM frequencies, alter their reflection and refraction, and/or create effects which enhance material properties for combat applications.
Deliverables should include technical drawings and specifications, mathematical formulas, M&S and test results, and prototype(s) of MFMs. The measurable metrics of the metamaterials' performance should include the changes in refraction, reflection index and scattering. The first prototype should be delivered at the end of the first year of Phase II SBIR. The second prototype should achieve a significant performance improvement of the first year's prototype. The second prototype should be delivered at the end of the second year of Phase II SBIR and also include recommendations for large-scale manufacturing. Improved life cycle and performance models from Phase I are also expected deliverables. Testing of the Phase II designs should include benchtop testing of Phase II prototypes. Testing of the Phase II designs should also include system level testing of prototypes at Ground Vehicle Systems Center (CVSC) of Combat Capabilities Development Command (CCDC). Phase 2 performance metrics of interest include, but are not limited to a prototype MFM sample with the claimed environmental interactions from Phase 1 (% EM refractivity, % EM reflectivity, % EM absorption, etc.), MFM-mass cost at scale (i.e $/kg or $/ton), areal cost at scale (i.e. $/sqft or $/m2).

PHASE III DUAL USE APPLICATIONS: Proposers could partner with the industry to build and implement novel materials and manufacturing techniques which make vehicles more or less visible on the road. These are all commercially viable benefits of this topic. Possible applications include: road safety, law enforcement, intelligence, rescue and training aids. This is a dual-use technology applicable for government and private industry use.

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KEYWORDS: metamaterials, transformation optics, negative permeability, negative permittivity, negative refraction index, scattering, invisibility, inertial mass reduction, mechanical resonance or oscillation

A20-094 TITLE: Autonomous Trailer Hitch Couple/Decouple

TECHNOLOGY AREA(S): Ground/Sea Vehicles

OBJECTIVE: Develop an automated trailer coupling/decoupling system that can be integrated on to both current autonomous systems such as Expedited Leader Follower and Autonomous Ground Resupply, as well as Next Generation Autonomous Systems.

DESCRIPTION: Trailers provide the capability to increase throughput by transporting mission essential equipment and supplies including weapons systems, equipment, tactical power, water and ammunition. Connecting to trailers is an aggravating task, made more difficult by tough terrain and weather conditions. Developing/implementing an autonomous hitch can make a dangerous, time-consuming and manpower intensive task a one-person operation that can be done in a much shorter time period. This SBIR is looking for innovative ways to automate trailer coupling/decoupling. Ideally the system will be a simple installation onto the existing Military convoy vehicle fleet currently being utilized in various soldier tested autonomous convoy vehicle technology/capability demonstrations. Low-cost, high reliability sensors are critical for reliable autonomous hitch performance especially given the mission profiles experienced during autonomous convoy vehicle operations over rough terrain and high speeds.

This SBIR is linked to Ground Vehicle Robotics (GVR) Expedited Leader Follower (ExLF) and Autonomous Ground Resupply (AGR) Science and Technology Objective (STO) programs, providing additional autonomous vehicle capability to enhance vehicle autonomy operations to support automated convoy vehicle performance. ExLF and AGR are currently adding the capability to integrate trailers in forward and reverse directions as part of a semi-autonomous convoy. Adding the capability to autonomously couple and decouple a trailer will work to automate a dangerous, time consuming and manpower intensive task. The topic will implement innovative solutions to allow for a PLS vehicle to autonomously connect the pintle hitch and power/air/data lines of a M1076 trailer to fully automate trailer coupling/decoupling. There is an opportunity to demonstrate this capability as part of AGR Increment 3 Soldier experiment in FY21; ultimately transitioning the capability to inform the Leader Follower Program of Record.

PHASE I: Determine the feasibility of an optimal autonomous trailer hitch sensor suite that can engage/disengage with an autonomous vehicle. Develop simplied soldier controls for activating/monitoring autonomous trailer hitch process/operations. Develop system that requires minimal base vehicle modification/installation. Conduct autonomous trailer hitch simulations with integrated virtual sensors to refine autonomous trailer hitch design/operation. Design hitch capable of 3-axis articulation to allow for non-exact vehicle/trailer alignment. Develop hitch capable of interfacing/supporting FMTV/PLS vehicles and able to support Gross Trailer Weight Rating of 3000lbs and Tongue Weight Rating of 3,000lbs. Generate a technical report documenting above analysis/evaluation/integration of autonomous trailer hitch capability.

PHASE II: Create a prototype of autonomous trailer hitch system and evaluate in relevant scenarios/applications on representative base vehicles. Integrate optimal autonomous trailer hitch sensors identified/evaluated in Phase I on a representative base vehicle. Conduct autonomous trailer hitch testing throughout a variety of vehicle configurations/conditions and reevaluate/confirm previously selected optimal sensors. Optimize autonomous trailer hitch system with regards to performance, cost, reliability, ease of integration, etc. Incorporate a pintle that is moveable both laterally and longitudinally to permit a single operator to hook-up to a M1076 PLS trailer. Hook-up shall be with the trailer tongue offset laterally up to 12 to 18 inches from the centerline of the truck and 12 to 18 inches aft of the towing position. The pintle shall be capable of towing all lunette style trailers in common use with 2-1/2, 5, and 10 ton vehicles.

PHASE III DUAL USE APPLICATIONS: Transition autonomous trailer hitch system onto current/future targeted Military autonomous systems, including Expedient Leader-Follower/AGR, etc. Transition system into commercial market segments that would benefit or are currently utilizing trailers during normal operations, such as recreational vehicles, tractors, semi-trailers, etc.

REFERENCES:
1. http://www.teleswivel.com/

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3. http://www.freepatentsonline.com/y2016/0243908.html

4. http://www.freepatentsonline.com/y2018/0222264.html

5. https://patents.google.com/patent/WO2017220257A1/en

6. http://folk.ntnu.no/skoge/prost/proceedings/ifac2014/media/files/0437.pdf

7. https://press.zf.com/press/en/media/media_695.html

KEYWORDS: Autonomous, ground, resupply, expedited, leader, follower, trailer, hitch, vehicle, robotics, convoy, coupling

A20-095 TITLE: Design and Development of Hardened Autonomy Sensors (Lidar and Radar)

TECHNOLOGY AREA(S): Ground/Sea Vehicles

OBJECTIVE: Provide affordable and reliable high resolution Lidar and/or Radar systems which are hardened to withstand military environments for improved autonomous capabilities.

DESCRIPTION: Autonomous automated vehicles are the next evolution in transportation. Automated vehicles are equipped with multiple sensors (Lidar, radar, camera, etc.) enabling local awareness of their surroundings. A fully automated vehicle will unconditionally rely on its sensors readings to make short-term safety-related and long-term planning driving decisions.

Sensors have to be robust and function under all roadway and environmental conditions. Autonomous vehicles can only work properly with accurate and reliable sensors. They are equipped with a multitude of sensors, using different physical properties (light, ultrasound, radio frequency, etc.), Global Navigation Satellite System and accurate road maps. Lidar and radars are primary sensors used for vehicle automation.

The Army utilizes commercial-off-the-shelf sensors in programs including Expedited Leader Follower, Robotic Combat Vehicle, Autonomous Ground Resupply, and Combat Vehicle Robotics. However, as autonomy is added to tactical and combat platforms, there is a need to harden the sensors to not only withstand military environments such as weather, heavy dust, military shock and vibration, but also gunfire shock. Exposure to a gunfire shock environment has the potential for producing adverse effects on the sensors; potentially reducing or eliminating the platform’s autonomous capabilities after just one blast. This SBIR topic would implement design and analysis of hardening Lidar and/or radar under military conditions (hot/cold/humid/shock and vibration/abrasive dust) and conduct laboratory and/or live fire testing.

The following specifications for hardening requirements:
-Water and Dust Sealing: IP69 (the 9 designation is a recent addition to IEC 60529
-Electromagnetic Environmental Effects, per MIL-STD-461 CS101 and RS103.
-Environmental requirements: Operate per MIL-STD-810G, Part Three, Climatic Design Types Cold to Hot, except for a minimum low temperature of -40F.
-Impulse shock and blast over pressure will be provided.

Additional requirements:
Input power per MIL-STD-1275E
Provide a means to clean any external interfaces critical to operation after contaminated with dust, water, or mud.

The Impulse shock and blast over pressure requirements are not derived from a standard; they are based on measured data.

The maximum charge we will use on XM1299A1 will be provided.

PHASE I: Design a proof of concept prototype for an affordable, compact Lidar and/or Radar sensors that meets the specifications outlined in the description. Beyond the desired specs of Lidar and/or Radar sensors operating under military conditions (hot/cold/humid/shock and vibration/abrasive dust), these sensors need to function in a gunfire shock environment. This will provide greater functionality for autonomous system developers and designers. Delivered at the end of this phase will be a white paper outlining the proof of concept design and its feasibility.

PHASE II: The concept prototype will have its design refined and then be developed and built for component level testing. Demonstration and technology evaluation will take place in a relevant laboratory environment or on a military ground vehicle system. Delivered at the end of the phase will be at least 3 units for government feasibility and integration testing.

PHASE III DUAL USE APPLICATIONS: Mechanical packaging and integration of the solution into a vehicle will be achieved (TRL6) and technology transition will occur so the Lidar and/or Radar can be used on military autonomous ground vehicle applications. The Autonomous Ground Resupply Science and Technology Objective (AGR STO) would be a potential entry point for this sensor’s application. The hardening of the sensors will also be an attractive feature for the automotive industry as it will provide new avenues towards how they approach autonomous behavior and the harden sensors will provide more reliability.

REFERENCES:

1. http://velodynelidar.com/docs/datasheet/97-0038_Rev%20G_%20HDL-32E_Datasheet_Web.pdf

2. http://everyspec.com

3. https://www.atec.army.mil/publications/Mil-Std-810G/Mil-Std-810G.pdf

4. http://everyspec.com/MIL-STD/MIL-STD-1100-1299/download.php?spec=MIL-STD-1275E.045886.pdf

KEYWORDS: Autonomous, Autonomy Sensors, LIDAR, Radar, Combat Vehicle Robotics

A20-096 TITLE: Sensor suite for Ground Vehicle Survivability

TECHNOLOGY AREA(S): Ground/Sea Vehicles

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

OBJECTIVE: Develop a Hostile Fire Detection (HFD) and Active Protection System (APS) cueing and tracking sensor suite. Sensors of interest are stationary, non-imaging, multi-aperture combinations for ground vehicle threats.

DESCRIPTION: US Army effectiveness studies demonstrate HFD systems improve vehicle and crew survivability by creating crew situational awareness and cueing defensive systems. HFD systems can detect both Small Arms Fire (SAF) and larger threats like rocket propelled munitions and missiles. HFD systems with real time resolution can provide Army Fighting Vehicles (AFV’s) detection, classification, and threat tracking.

High-performance sensors effective against both SAF and larger threats are not fielded on ground vehicle platforms due to their high cost, processing overhead, and integration burden. When employed in research and development APS, HFD/APS cueing systems utilize cameras with cooled Focal Plane Array (FPA) technology for weapons flash detection and projectile tracking. While this approach can be effective, the systems tend to be impractical due to high cost and SWaP-C constraints. In addition, high integration and maintenance burdens limit the potential to field this type of technology on combat and tactical vehicles. Radar systems are not passive devices and can be degraded by clutter in the ground vehicle environment. For SAF detection and localization, lower cost acoustic sensors have been employed but are not effective against larger munitions.

Single modality sensor systems have proved to be prone to environmental clutter, noise, and vibration. Users experience high false alarms under typical operating conditions. Methods involving the use of high sample rate (>10KHz), multi-aperture, uncooled IR detectors have shown to be effective in producing accurate detection, classification and angular location capabilities, but can be prone to environmental clutter, noise and vibration. Multi-aperture sensors potentially offer advantages including low cost, low SWaP-C and complexity, very wide instantaneous field of view, low optical distortion, and a minimal solar exclusion angle. Studies integrating such high-sample rate multi-aperture EO systems with an acoustic modality show significantly reduced SAF False Alarm Rates (FAR) even under high noise/clutter conditions. However, introducing movement to sensors increases clutter to a degree that the fusion engine can be overwhelmed and fail to accurately pair events.

This program seeks to produce a low SWaP-C integrated multi-spectral, multi-aperture, multimodal EO, radar, and acoustic sensor product for ground vehicle survivability. It may be used for sense and warn (HFD) as well as cueing/tracking applications (APS), stationary and on-the-move. It must perform with a high probability of detection and negligible false alarm rate under a variety of challenging conditions and operations. It must also be capable of outputting accurate azimuth (bearing), elevation, and range to target, the target classification, and tracking of the target.

The system must be compliant with the MAPS Architecture Framework (MAF).

This topic will address a threat list to include: SAF (e.g. 5.56, 7.62, .50 Caliber), cannons (e.g. turreted, mortar), Rocket Propelled Grenades (RPGs), Recoilless Rifles, and Anti-Tank Guided Missiles (ATGMs).

PHASE I: Investigate and identify materials, packaging, design methodologies and critical design parameters for an HFD/APS cueing and tracking sensor system consisting of a high speed, multi-aperture, multi-spectral sensors for use in on-the-move environments. Analyze and model the far field performance of the proposed sensor where far field is proposed by the contractor and should represent a militarily useful distance. Build and test breadboards to prove high risk design element feasibility. Begin design of a prototype system that achieves the requirements and capabilities. Deliverables include final report detailing design process, Preliminary Design Review, documentation, and supporting data.

PHASE II: Finalize the initial design from Phase I. Build a proof-of-concept prototype system that will be used for hardware-in-the-loop testing and evaluation. Prototype must be MAF compliant. Perform initial testing and system characterization including testing of the design limits based on the modeling and analysis in Phase I. Identify areas to explore for a finalized system design and technical/programmatic risks. Deliverables include Critical Design Review and documentation, prototype hardware that will be used in government lab and field data collections.

PHASE III DUAL USE APPLICATIONS: Fabricate and deliver final test article. Support live fire testing, analysis and system upgrades as required. Further mature the technology, preparing for technology insertion into existing programs of record with the transition partner, PdM Vehicle Protection Systems. Deliverables include finalized prototype design documentation, manuals and hardware, including software. A potential commercial application of this project is for autonomous driving vehicles. Mass market autonomous vehicles require multiple, overlapping sensors with many of the same restrictions as military vehicles: clutter, safety, and cost.

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2. Gil A. Tidhar, Ori B. Aphek, and Eliyahu Cohen "OTHELLO: a novel SWIR dual-band detection system and its applications", Proc. SPIE 8704, Infrared Technology and Applications XXXIX, 87040E (11 June 2013); doi: 10.1117/12.2019202; https://doi.org/10.1117/12.2019202

3. Davis, Jami et al “Challenges of Ground-Based Hostile Fire Detection and Location”, US Army RDECOM CERDEC NVESD Technical Report, 8 September 2014; DTIC Accession Number: SENSIAC-2083014; https://www.dtic.mil/DTICOnline/downloadPdf.search?collectionId=tems&docId=SENSIAC-2083014

4. Pauli, Myron et al, “Fusion of Passive Flash Detection with Cued Active Pulsed-Doppler Tracking for Bullets, Rocket Propelled Grenades, and Missiles, NRL, US Army CERDEC I2WD, DOT&E Center for Countermeasures (WSMR), Lucid Dimensions, and Meggitt Defense Systems; 27 February 2012; Accession Number: SENSIAC-1991771; https://www.dtic.mil/DTICOnline/downloadPdf.search?collectionId=tems&docId=SENSIAC-1991771

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KEYWORDS: Survivability, ground vehicle survivability, Active Protection System sensors, Hostile Fire Detection, multi-function sensors, multi-spectral sensors

A20-097 TITLE: Engineered Synthetic Replacement for Army Heavy Transport Trailer Wooden Decking and Flooring.

TECHNOLOGY AREA(S): Ground/Sea Vehicles

OBJECTIVE: A robust physical configuration and manufacturing source for engineered synthetic floor boards (aka. decking) for Army Heavy Trailers, as well as any trailer that uses wood planking for deck-boards.

DESCRIPTION: Currently, Army heavy trailers primarily use the critically endangered rain-forest wood apitong. Problem to be solved is the frequent and costly redecking of Army heavy trailers.

Decking is an often overlooked integrated structural element of Tactical Trailers. Worldwide, approximately 16,500 DoD military trailers (in both production & sustainment) are decked nearly exclusively in $65M of Apitong, which is an increasingly rare and critically endangered East-Asian tropical rainforest hardwood (i.e. price is rising). Apitong is the only known endangered species actively harvested from nature for DoD use. Apitong has a field service life of only 8 years due to its susceptibility to rot and insect attack, requiring replacement up to 5 times over a 40 year lifecycle, resulting in wasteful utilization of a foreign endangered resource, downtime in addition to ‘random’ board replacement as damage occurs in addition to soldier labor time and incidentals such as corrosion repair and spot painting. An estimated lifecycle cost of $15K to $25K per trailer (in today's dollars @ $5K each in material and labor to re-deck every 8 to 10 years, leading to a life-cycle potential cost-avoidance for all trailers of >$400 million).

Performance Requirements:
- Sustained load-bearing of payload (5400 lb/ft2 est. for contact patch 7,500 lb / 200 in sq.) on 24” spaced crossmembers (3” top flange) without permanent deformation. Inherent stiffness shall not allow sag (deflection) under load of more than 1/4“ between crossmembers. Ref Drawing 12624740 M871A3 Semitrailer Floor Boards.
- Equal or greater mechanical properties vs Apitong/Keruing. Ref. A-A-52520.
- Resistant to standard automotive fluids including JP-8 and similar diesels, MoGas, motor oil, trans, brake and hydraulic fluid, gear lube, battery acid and caustics. Resist weathering – solar: UV and ozone, thermal -40 to +130F. Ref MIL-STD-810.
- Anti-mold & fungal growth inhibitors such as MicroBan ® or BioBlock ® shall be incorporated. Insect immune – example worst case Formosan termite infestation.
- Fastener req’ts and corrosion cause/isolation req’ts shall be selected for service life longevity.
- Saw and drill using standard wood working tools.
- Able to drive nails into and remove with minimal damage, holes reparable with caulk. Alternative std. fasteners may be acceptable.
- Maintenance-free except for repair of incidental damage.
- Fire-resistant, self-ext. ‘UL94-HB’/MIL-PRF-32518.
- Desired service life: 25 years or longer, with minimal maintenance (life of trailer).

- Color shall be a deep brown to a weathered gray.
- Successful product will supersede all wood decking across all trailers fleet-wide, and exhibit a service life-longevity of up to the life of the trailer; potentially having a cost avoidance of millions of dollars.

PHASE I: Evaluate multi-disciplinary 'states-of-the-art' and develop a detailed plan for composite, metal, polymeric or hybrid material trailer flooring board prototype for fabrication and testing in a relevant environment. Prior (market) research (TACOM Study – 2000) found no suitable commercially available products – use this study for a baseline. Use modeling to determine loads to be borne –MRAP Buffalo, M-113 as payloads. Buffalo front wheel is heaviest-case: 7,500 lbs over 200 in2 = 5400 lb/ft2. Determine design feasibility of concept. Explore other load situations such as impact and rock/gravel rollover.

PHASE II: Design a demonstrator configuration for the M-871A3 22.5 ton trailer, fabricate representative samples of candidate materiel configurations and conduct testing. Testing shall include at a minimum: static load, fatigue loading, accelerated weathering, surface coefficient of friction, simulate damage tolerance to include nailing of cribbing, hammer strikes, rock/gravel roll-overs, fluid immunity (MoGas, diesel, other vehicular fluids and caustics) and fire resistance. Best performer(s) shall be selected for demonstration project: Deliverable will be approx. 1000 linear feet, to redeck six M870A3 heavy trailers for testing.

PHASE III DUAL USE APPLICATIONS: Commercialization shall entail full rate production of the selected configuration. Potential Phase III military applications include M871A3 trailer (Ref. TACOM Drawing 126247025 22.5 ton); also include M872A3 & A4 34 ton and M172 22 ton. Commercial equivalent trailers of any uncovered size from tandem axle 10 ton for a backhoe to a 50 ton multi-axle lowboys for the oversize excavators and off-road dump trucks. Covered semi-trailers are also included, with reduced flooring thickness.

REFERENCES:
1. DTIC Publication "Trailer Decking Technology Study" Trailer Research and Development Contract No. DAAE07-99-C-S016, November 30, 2000

2. TACOM Drawing 12624740 M871A3 Semitrailer Floor Boards

3. CID A-A-52520 Hardwood: Floorboards and Platforms: For Military Vehicles (Metric)

4. MIL-STD-810 Military Test Methods: Environmental Engineering Considerations

5. MIL-PRF-32518 Interior Vehicle Human Factors Including Smoke and Toxicity

KEYWORDS: Composite, Wood, Decking, Flooring, Trailer

A20-098 TITLE: Energy Attenuation Bench Seat System

TECHNOLOGY AREA(S): Ground/Sea Vehicles

OBJECTIVE: The Energy Attenuation Bench Seat System will protect and accommodate multiple sized Soldiers from a variety of typically injurious scenarios like Vehicle Borne Improvised Explosive Devices (VBIED), underbody blast, top/bottom attacks, crash, and rollover events. By consolidating seating to benches and reducing the overall footprint of the seat, vehicle length could be reduced achieving a significant overall weight savings.

DESCRIPTION: Ground vehicle energy attenuating seat systems are traditionally designed to accommodate and protect a single Soldier with a prescribed distance between seats. Limited existing Military bench seating does not provide energy attenuation, desired accommodation, or an adequate level of Soldier endurance and performance. A new bench seating system shall be internally mounted in the vehicle with integrated restraint systems, and either provide or account for integrated or under-seat storage. The seat shall accommodate 4 fully encumbered occupants of varying size within the central 90th percentile and protect them during events including, but not limited to: underbody blast, crash, rollover, Top/Bottom attack, and VBIED. The bench seat shall be able to protect varying combinations of occupant sizes ranging from a single 5th percentile female up to four 95th percentile males, and allow for a minimum of 26" from centerline to centerline of each occupant.

PHASE I: Define and determine the technical feasibility of developing an energy attenuation bench seat system that is lightweight, durable, and can protect the occupants from high energy inputs. The seat must protect and accommodate the central 90th percentile Soldier population while fully encumbered and be lightweight and durable enough to handle the rugged conditions encountered by ground vehicles. Seats must be FMVSS 207/210 compliant. The seat must, at a minimum, meet FMVSS 208 Injury Criteria (additional Injury Criteria will be provided once on contract) for the following tests: drop tower testing (up to 350g half sine pulse, delta V 10 m/s), and FMVSS 213 Child Seat Corridor Sled Testing.

PHASE II: Develop and test at least 5 prototype seat systems that can protect and accommodate the Soldiers during high energy events including, but not limited to: blast, crash, rollover, and VBIED. Based on the findings in Phase I, refine the concept, develop a detailed design, and fabricate a simple prototype system for proof of concept. Identify steps necessary for fully developing a commercially viable seat system. Seats must be FMVSS 207/210 compliant. The seat must, at a minimum, meet FMVSS 208 Injury Criteria (additional Injury Criteria will be provided once on contract) for the following tests: drop tower testing (up to 350g half sine pulse, delta V 10 m/s), and FMVSS 213 Child Seat Corridor Sled Testing.

PHASE III DUAL USE APPLICATIONS: Commercialization to Stryker (PM-SBCT), with potential integration in Next Generation Combat Vehicles (NGCV). Potential additional military applications include, but are not limited to other Combat Vehicles.

REFERENCES:
1. www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA608804

2. www.arl.army.mil/arlreports/2007/ARL-TR-4236.pdf

3. http://armypubs.army.mil/doctrine/DR_pubs/dr_a/pdf/atp4_25x13.pdf

KEYWORDS: Energy attenuation, seats, bench, underbody blast, crash, rollover, vehicle borne improvised explosive device (VBIED), top/bottom attack, mitigate energy, accommodate and protect, central 90th percentile Soldier population

A20-099 TITLE: Secure FPGA Zeroization for Military Systems Abandonment

TECHNOLOGY AREA(S): Ground/Sea Vehicles

OBJECTIVE: Use reconfigurable logic hardware to create general purpose, secure circuitry with zeroize functionality for military systems abandonment in theater. This ensures that the enemy cannot reverse engineer US military systems, while also reducing microelectronics development costs.

DESCRIPTION: Current Army ground vehicle systems operate using Application Specific Integrated Circuits (ASIC), due to Size, Weight, AP-C requirements. One could move to implement designs on a reprogrammable logic board such as a Field Programmable Gate Array, with a System on a Chip (SOC) acting as the design synthesis (programming) tool host on the printed circuit board. The FPGA fabric can be used to implement the functionality that would normally be hosted using an ASIC. FPGAs, by nature (unless using an anti-fuse FPGA design), are reprogrammable. Recent advancements by the major FPGA manufacturers, Altera (Intel) & Xilinx, have brought FPGA systems much closer to the SWAP-C that ASICs operate at. These recent advancements have also brought FPGA encryption and hardening to the level that was required with ASIC designs, making it a valid platform for military systems.

Currently, efforts are only made to harden those electronics that are deemed Critical Program Information (CPI) so that they are either time-impossible, or extremely high effort to reverse engineer. However, non-CPI electronics do not receive the same hardware resiliency, and thus are still at risk of exploitation if captured. If the warfighter must abandon a vehicle in theater, valuable electronics may be attached to that ground vehicle that should be destroyed. Current standard, operating destruction procedures in require the use of pyrotechnics (thermite grenades), which can fail to completely destroy the ASIC hardware. That leaves the enemy with hardware that could be reverse engineered off the intact portion.

By hosting the design on a reprogrammable device, one can achieve the same or near-same level of SWAP-C as would be hosted by an ASIC, but have a reprogrammable design fabric to work with. Using the SOC on the device, hosting a light embedded OS with scripts to execute zero-ization at the touch of a button, one could use the design to create a kill-switch. By rewriting the fabric with a blank design, one would effectively delete the existing logic, thus making it nearly impossible to exploit the hardware. This means that the design would be tamper resistant.

A key example of where this proposed technology would have been extremely useful in was in the year 2001, where China had 'captured' a damaged EP-3E spy plane that had to make an emergency landing on Hainan Island Chinese military base. China had ample time to reverse engineer any of the electronics systems onboard that airplane, before returning it back to the USA, partially dismantled.

As such, any hardware ASIC design that can be ported to reprogrammable logic would be the target for this proposal, making upcoming platforms such as the NGCV far more cyber-resilient. And if shown to work, could be something applicable to all DOD agencies and OGAs. The US Army is seeking proposed designs and guidance on how such a re-synthesizable design might be implemented.

PHASE I: Offeror shall conduct a feasibility study through research on whether current general purpose FPGA boards and design logic can be adapted to this design. This study shall include viability and potential applications, not covered by this topic, for military, medical, and commercial implementations.

PHASE II: Depending on the results of the Phase I feasibility study, the Offeror shall implement the logic design of a system from a military ground vehicle on an FPGA platform (i.e. Altera or Xilinx) to show a proof of concept prototype.

Offeror will propose the system architecture that is to be used (hardware, software, etc.). Offeror will create design logic for an FPGA using respective FPGA environments. This logic will implement a systems design that meets military data encryption standards. Offeror shall also create software that can synthesize the FPGA logic with a zeroized design if given a command to do so. This software shall be able to interface with a user interfacing system (hardware).

At the end of Phase II, Offeror shall have a working prototype of this system with a Technology Readiness Level of at minimum, TRL6. Offeror shall also have a business model ready for marketing the proposed system to commercial vendors.

PHASE III DUAL USE APPLICATIONS: Offeror will develop systems that can be retrofit with current military ground vehicles. This will provide the US military with capabilities of protecting government and our contractor's intellectual property during wartime. It will also prevent enemies from reverse engineering our hardware and using our own designs to harm our warfighters,

Additionally, this design can see commercial viability by allowing for companies to protect their trade secrets and intellectual property, either from competitors, foreign nations, or malicious actors.

REFERENCES:
1. "Understanding Zeroization To Clear System Data For FIPS-Approvedmode Of Operation - Technical Documentation - Support - Juniper Networks". Juniper.Net, 2016, https://www.juniper.net/documentation/en_US/junos-fips12.1/topics/concept/understanding-zeroization.html. Accessed 14 May 2019.

2. IBM. Building A High-Performance, Programmable Secure Coprocessor. Princeton, IBM T.J. Watson Research Center, Yorktown Heights, New York, 1998, pp. 1-38, https://www.princeton.edu/~rblee/ELE572Papers/building_hp_secop.pdf.

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KEYWORDS: Reconfigurable , Logic , Zeroize , Organic , Circuit , FPGA , System on a Chip , SOC , tamper , Electronics , Microelectronics , Zeroization

A20-100 TITLE: Reconfigurable Computer Architecture for Flexible Input / Output (I/O)

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Develop a reconfigurable computing-based platform that provides reprogrammable hardware implementations for multiple communication protocols, cryptographic algorithms, and heterogeneous architectures for ground vehicle sensor/system integration (e.g. signal concentration for routing through Next Generation Combat Vehicle slip ring), hardware accelerated capability insertion, and mitigation of semiconductor device obsolescence.

DESCRIPTION: The Army has long been interested in leveraging the benefits of Field Programmable Gate Array (FPGA) and System on Chip (SoC) technologies to mitigate performance and obsolescence issues associated with the extended life cycle of Army weapon systems. Historically the Army spends over a decade to design, test, and field a new weapon system and this means that, in many cases, the computing hardware and communication technology is obsolete by the time it is fielded [1]. To decrease this impact of this, weapon system functionality can often be migrated to software but this can be detrimental when the software implementation incurs a significant performance penalty or when the software cannot be written portably, resulting in code that is tightly coupled to a specific microprocessor or microcontroller; this is especially true when the software performs safety-critical functions, needs to perform deterministically and targets a specific instruction set architecture (ISA). Incorporation of FPGA technology has traditionally been recognized as one way to protect against electronics obsolescence while preserving the ability to implement performance upgrades [2]. High-level synthesis languages and semiconductor intellectual property (IP) cores have matured to the degree that it may be possible for the Army to leverage them on a computing platform which can incorporate open-source soft-core processors (e.g. RISC-V) to mitigate software obsolescence [3], readily instantiate new circuitry via logic synthesis to support emerging capabilities (e.g. artificial neural networks), and also provide a path for updating to different communication technologies primarily through logic synthesis (e.g. migration of 1 Gigabit Ethernet to 10 Gigabit Ethernet). This topic seeks innovative approaches to leverage reconfigurable computing and FPGA technology to increase the flexibility, longevity, capabilities, and performance of computing platforms within Army ground vehicles, specifically used to implement emerging capabilities on a Bradley and/or Optionally-Manned Fighting Vehicle (OMFV), to process multiple types of I/O and is reconfigurable to evolve along with vehicle programs and technology. A highly competitive solution should, with minimal changes to the electronics, provide reconfigurable: (1) hardware acceleration for running selectable cryptographic algorithms (e.g. Secure Hash Algorithm [SHA]-256, SHA-512, Advanced Encryption Standard [AES]-128, AES-256) (2) hardware-supported video processing and distribution (3) heterogeneous architecture to support simultaneous hosting of real-time, safety-critical and general purpose Linux software (4) support for multiple channels of serial communication (e.g. RS-422, RS-232, Controller Area Network [CAN], Inter Integrated Circuit [I2C]) (5) support for multiple channels of Ethernet (e.g. Gigabit Ethernet [GbE], 10 GbE, Audio-Video Bridging [AVB]/ Time Sensitive Networking [TSN]) (6) support for multiple types of analog and discrete signals (e.g. audio, RS-170) (7) Provides an Interface Configuration Document (ICD), hardware performance specification, and Technology Readiness Level (TRL) 6 test report.

PHASE I: Investigate the design space for reconfigurable computing based, ruggedized platforms. Define metrics for assessing obsolescence risk reduction and re-configurability, as well as difficulty/cost associated with using reconfigurable computing technology, IP cores, hardware, and tools. Develop initial reference designs to illustrate I/O processing/conversions, communications/cryptographic migration, and heterogeneous computing scenarios.

PHASE II: Fully develop the technology and demonstrate general features of the Flexible I/O platform, which consists of hardware, firmware, software, and synthesizable logic in the form of hardware description language (HDL) or IP cores. Evaluate using the metrics defines in Phase I. Execute selected computing/migration scenarios and collect metrics as defined in Phase I. Perform additional testing to assess performance and operational impacts and provide an ICD and hardware performance specification.

PHASE III DUAL USE APPLICATIONS: Phase III applications include deploying Flexible I/O platform in the Bradley or OMFV vehicle for processing/distribution of 3rd Gen FLIR video information and signal compression/decompression for transmission through slip-ring. Phase III potential applications include the use of Flexible I/O for long-life span, advanced Internet-of-Things (IoT), Industrial Control System (ICS), medical imaging devices, or autonomous systems.

REFERENCES:
1. Research and Technology Organization, “Strategies to Mitigate Obsolescence in Defense Systems Using Commercial Components”, DTIC https://apps.dtic.mil/dtic/tr/fulltext/u2/a394911.pdf June 2001

2. R. Dupree, “Determination of the Timeline for U.S. Army Aviation Systems to Reach Operational Obsolescence Following Termination of Modernization Funding”, DTIC https://apps.dtic.mil/dtic/tr/fulltext/u2/a417438.pdf June 2003

3. G. Peckham, “Programmable Logic Holds the Key to Addressing Device Obsolescence” Electronic Engineering Times https://www.eetimes.com/author.asp?section_id=36&doc_id=1332754 December 2017

KEYWORDS: FPGA, Softcore Processor, Heterogeneous Computing, Reconfigurable Computing, IP Cores, Obsolescence

DEPARTMENT OF THE NAVY (DON)
20.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions for ADAPT & Standard Topics

IMPORTANT

- DON is soliciting proposals against three distinct types of SBIR topics:
  - Accelerated Delivery and Acquisition of Prototype Technologies (ADAPT): N201-X01 and N201-X02
  - Standard: N201-001 through N201-087
  - Direct to Phase II: N201-D01
- Each set of topics has a separate and unique set of proposal requirements and submission instructions.
- **This document includes instructions for the following topics**:
  - ADAPT: Pages NAVY-2 through NAVY-8
  - Standard: Pages NAVY-9 through NAVY-16
- DON requires proposers to thoroughly review unique proposal requirements and submission instructions for topics of interest prior to proposal submission

INTRODUCTION

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For program and administrative questions contact the SYSCOM Program Manager listed in the table included in each set of instructions; **do not** contact them for technical questions. For technical questions about a topic, contact the Topic Authors listed within each topic during the period **10 December 2019 through 13 January 2020.** Beginning **14 January 2020,** the SBIR/STTR Interactive Technical Information System (SITIS) (https://sbir.defensebusiness.org/) listed in Section 4.15.d of the Department of Defense (DoD) SBIR/STTR Program Broad Agency Announcement (BAA) must be used for any technical inquiry. For general inquiries or problems with electronic submission, contact the DoD SBIR/STTR Help Desk at 1-703-214-1333 (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET) or via email at dodsbirsupport@reisystems.com.

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DON's mission can be obtained from the DON website at www.navy.mil.

(Continued on next page.)

DEPARTMENT OF THE NAVY (DON)
20.1 Small Business Innovation Research (SBIR)
PROPOSAL SUBMISSION INSTRUCTIONS – ADAPT TOPICS

IMPORTANT

- **The following instructions apply to ADAPT topics:**
  - **N201-X01**
  - **N201-X02**

- A Phase I proposal template, unique to ADAPT topics, will be available to assist small businesses to generate a Phase I Technical Volume (Volume 2). The template will be located on https://www.navysbir.com/links_forms.htm.

- The DON provides notice that Basic Ordering Agreements (BOAs) may be used for Phase I awards, and BOAs or Other Transaction Agreements (OTAs) may be used for Phase II awards.

- The optional Supporting Documents Volume (Volume 5) is available for the SBIR 20.1 BAA cycle. The optional Supporting Documents Volume is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation.

THE FOLLOWING INSTRUCTIONS SOLELY APPLY TO ADAPT TOPICS (N201-X01 and N201-X02)

INTRODUCTION

The DON SBIR Program is advertising Accelerated Delivery and Acquisition of Prototype Technologies (ADAPT) topics that quickly address DON high priority challenges in high impact areas for the naval community that are also determined to apply to dual use applications in the commercial sector. ADAPT utilizes a unique award structure, accelerates decision timelines, and minimizes to the extent possible application processes in an effort to rapidly deliver prototype technologies. ADAPT activities are limited to topics N201-X01 and N201-X02 and include requirements specified in the instructions below and summarized here:

Unique ADAPT features and requirements:

- Five (5) page Technical Proposal (Volume 2)
- Phase I Base only, no Phase I Option
- Phase I Base cost not to exceed $200,000
- Phase I Base period of performance is four (4) months
- No discretionary Technical and Business Assistance (TABA) will be authorized for Phase I
- ADAPT topics are broad in scope with multiple Focus Areas. Each proposer must select a primary Focus Area under which to propose under each topic, however, a proposer may choose to include secondary Focus Area(s) within the proposal submission.
- Phase I awardees will have the option to participate in the H4XLabs Business Accelerator.

For program and administrative questions, contact the Navy SBIR/STTR Program Management Office listed in Table 1; **do not** contact them for technical questions.

TABLE 1: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	Email
N201-X01 and N201-X02	Navy SBIR/STTR Program Management Office	navy-sbir-sttr@navy.mil

PHASE I GUIDELINES

Follow the instructions in the DoD SBIR/STTR Program BAA at https://sbir.defensebusiness.org/ for requirements and proposal submission guidelines. Please keep in mind that Phase I must address the feasibility of a solution to the topic**. It is highly recommended that proposers follow the ADAPT Phase I Proposal Template** as a guide for structuring proposals. The template will be located on https://navysbir.com/links_forms.htm.

PHASE I PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the ADAPT topic proposal will be deemed noncompliant and may be REJECTED.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR BAA section 5.4(a).

- **Technical Volume (Volume 2).** Technical Volume (Volume 2) must meet the following requirements:
  - Not to exceed five (5) pages, regardless of page content
  - Phase I Base period of performance only, no Phase I Option
  - Single column format, single-spaced typed lines
  - Standard 8 ½" x 11" paper
  - Page margins one-inch on all sides. A header and footer may be included in the one-inch margin
  - No font size smaller than 10-point*
  - Content requirements as specified in the ADAPT Phase I Proposal Template which will be located on https://navysbir.com/links_forms.htm. The content instructions in the template supersede DoD SBIR/STTR BAA sections 5.4(b) and (c).
  - Include the primary Focus Area number for the topic you are proposing to as a prefix to the Phase I Proposal title. For example, "(2)" before the Proposal title to indicated Focus Area 2.

  *For headers, footers, listed references, and imbedded tables, figures, images, or graphics that include text, a font size smaller than 10-point is allowable; however, proposers are cautioned that the text may be unreadable by evaluators.

  Volume 2 is the technical proposal. Additional documents may be submitted to support Volume 2 in accordance with the instructions for Supporting Documents Volume (Volume 5) as detailed below.

  Disclosure of Information (DFARS 252.204-7000)

  In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this or any subsequent award, the proposer shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons. Simply identifying fundamental research in the proposal does NOT constitute acceptance of the exclusion. All exclusions will be reviewed and noted in the award. NOTE: Fundamental research included in the technical proposal that the proposer is requesting be eliminated from the requirements for prior approval of public disclosure of information, must be uploaded in a separate document (under "Other") in the Supporting Documents Volume (Volume 5).

- **Cost Volume (Volume 3).** The Phase I Base amount must not exceed $200,000. Costs for the Base must be clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

- **Period of Performance.** The Phase I Base Period of Performance must not exceed four (4) months.

- **Company Commercialization Report (Volume 4)**. Volume 4 is not available for the 20.1 BAA. Please refer to the DoD SBIR/STTR BAA section 5.4(e) for further information.

- **Supporting Documents Volume (Volume 5)**. DoD has implemented a Supporting Documents Volume (Volume 5). Volume 5 **may** include the following optional documents:
    - Letters of Support relevant to this project
    - Additional Cost Information - The "Explanatory Material" field in the online DoD Cost Volume (Volume 3) is to be used to provide sufficient detail for subcontractor, material, and travel costs. If additional space is needed these items may be included within Volume 5.
    - SBIR/STTR Funding Agreement Certification
    - Technical Data Rights (Assertions) - If required, must be provided in the table format required by DFARS 252.227-7013(d) and (e)(3) and be included within Volume 5.
    - Allocation of Rights between the prime and subcontractor
    - Disclosure of Information (DFARS 252.204-7000) (see Technical Volume 2 above, upload as "Other")
    - Prior, Current, or Pending Support of Similar Proposals or Awards – If a proposal is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, another DoD Component, or the same DoD Component reveal this information in the appropriate area of the Proposal Cover Sheet (Volume 1) and provide details in Volume 5 (see ADAPT Phase I Technical Volume template on https://www.navysbir.com/links_forms.htm for required information, upload as "Other")
    - Foreign Citizens - Identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant (see ADAPT Phase I Technical Volume template on https://www.navysbir.com/links_forms.htm for required information, upload as "Other")

Optional documents (as identified above) are intended to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any optional documents in Volume 5 during the evaluation.

NOTE: The inclusion of documents or information other than that listed above (e.g., resumes, test data, technical reports, publications) may result in the proposal being deemed "Non-compliant" and REJECTED.

A font size smaller than 10-point is allowable for documents in Volume 5; however, proposers are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD has implemented the optional Fraud, Waste and Abuse Training Certification (Volume 6). DON does not require evidence of Fraud, Waste and Abuse Training at the time of proposal submission. Therefore, DON will not require proposers to use Volume 6.

DON SBIR PHASE I PROPOSAL SUBMISSION CHECKLIST

- **Subcontractor, Material, and Travel Cost Detail.** In the Cost Volume (Volume 3), proposers must provide sufficient detail for subcontractor, material and travel costs. Enter this information in the "Explanatory Material" field in the online DoD Volume 3. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).

- **System for Award Management (SAM).** It is critical that proposers to the ADAPT topics are registered in SAM, www.sam.gov, by February 26, 2020 or verify their registration is still active and will not expire within 60 days of BAA close. Additionally, proposers should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal.

- **Performance Benchmarks.** Proposers must meet the two benchmark requirements for progress toward Commercialization as determined by the Small Business Administration (SBA) on June 1 each year. Please note that the DON applies performance benchmarks at time of proposal submission, not at time of contract award.

- **Discretionary Technical and Business Assistance (TABA).** Due to the shorter period of performance proposed under ADAPT, TABA may not be proposed. TABA costs included in Volumes 2 or 3 will be disapproved. Guidance for submitting TABA in Phase II will be provided to Phase I awardees.

EVALUATION AND SELECTION

The DON will evaluate and select Phase I and Phase II proposals using the evaluation criteria in Sections 6.0 and 8.0 of the DoD SBIR/STTR Program BAA respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. As noted in the sections of the aforementioned Announcement on proposal submission requirements, proposals exceeding the total costs established for the Base and/or any Options as specified by the sponsoring DON SYSCOM will be rejected without evaluation or consideration for award. Due to limited funding, the DON reserves the right to limit awards under any topic.

Approximately one week after the Phase I BAA closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request.

Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests of Phase I and II selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the Navy SBIR/STTR Program Management Office listed in Table 1. If the protest is to be filed with the GAO, please refer to instructions provided in section 4.11 of the DoD SBIR/STTR Program BAA.

CONTRACT DELIVERABLES

Contract deliverables for Phase I are specified in Table 2.

Table 2: PHASE I DELIVERABLES (Required)

Deliverable	**Due Date[1]**	**Delivery Method**
Phase I Kick-Off Briefing Material	15 days from start of contract	Upload[2]
Progress Report	90 days from start of contract	Upload[2]
Phase II Proposal[3]	120 days from start of award	Upload[2]
Phase I Feasibility Briefing Materials[3]	120 days from start of award	Upload[2]
Phase I Final Report	120 days from start of award	Upload[2]

[1]Due dates are approximate; dates provided in Phase I contract take precedence over dates listed above.
[2] Uploaded to https://www.navysbirprogram.com/navydeliverables/.
[3] Required only for participation in a competitive Phase II evaluation and selection. If the proposer does **NOT** wish to be considered for Phase II, these deliverables are **NOT** required. Content requirements will be provided in the Phase I contract.

AWARD AND FUNDING LIMITATIONS

Awards. Historically, the DON has awarded a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I. In addition to the negotiated contract award types listed in Section 4.14.b of the DoD SBIR/STTR Program BAA for Phase II awards, the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Funding Limitations. In accordance with the SBIR and STTR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. ADAPT offers a unique funding structure. The maximum Phase I Base proposal/award amount for ADAPT is $200,000. No Phase I Option will be considered. Phase II for ADAPT will consist of multiple Rounds of funding with progression between Rounds contingent upon meeting defined milestones as outlined in the Phase II Guidelines section.

PAYMENTS

The DON plans to make three payments during the Phase I award. Payment amounts represent a percentage of the Phase I award as follows:

Days From Start of Base Award	Not to Exceed Payment Amount
15 Days	50% of Phase I Award
90 Days	35% of Phase I Award
120 Days	Balance of Phase I Award

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa. Please refer to instructions provided in section 7.2 of the DoD SBIR/STTR Program BAA.

ADDITIONAL NOTES

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DON makes any award that involves an IRB or similar approval requirement, the proposer must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the DON's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and recombinant DNA is included under a Phase I or Phase II proposal, please carefully review the requirements at: http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

Government Furnished Equipment (GFE). Due to the typical lengthy time for approval to obtain GFE, it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed and it is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

Business Accelerator Services. The DON SBIR Program continues to implement a new Dual-Use Business Accelerator pilot in conjunction with this 20.1 BAA. As part of this pilot, the DON SBIR Program will offer all Phase I awardees under ADAPT topics N201-X01 and N201-X02 the opportunity to receive coaching on business and investor financing, market identification, and transition planning through H4XLabs. The Accelerator will be virtual and will be adapted to individual company needs; however, proposers that plan to participate in the Accelerator (if awarded a Phase I) are encouraged to include travel costs for two cohort trips of one to two days each to Silicon Valley, CA and the Washington, DC area. A firm may propose travel for up to four trips if more in-person services are desired. Details on the Accelerator will be provided to awardees at time of Phase I award.

PHASE II GUIDELINES

All Phase I awardees under ADAPT may participate in the DON's competitive Phase II selection and award process. To be eligible for Phase II, Phase I awardees must submit the Phase I deliverables as specified in their Phase I contract (and referenced above in Table 2). Deliverables specific to the DON's competitive

Phase II selection and award process will be due to the Government approximately 30 days before the end of the Phase I contract. Details on the due date, content, and submission requirements for Phase II will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification. Phase II evaluation criteria are specified in DoD SBIR/STTR BAA section 8.0. Phase II selections will be based on an evaluation of the Phase II proposal, Phase I Final Report, and Phase I Feasibility Briefing Materials. At the conclusion of the evaluation of these items, each Phase I awardee will receive a select/non-select notification from the Government.

Phase II for ADAPT will consist of multiple Rounds of funding with progression between Rounds contingent upon meeting defined milestones. For Phase II, proposers must meet defined milestones for each Round to be considered for the next Round. Full details on the Round structure and Phase II proposal requirements will be provided to Phase I awardees; however, general descriptions for Phase II Rounds I, II, and III are provided below:

Round I. Prototype Demonstration of Viability – Round I further builds on the Phase I functional prototype to meet DON user's needs. Round I is limited to a firm fixed price of $500,000 and the period of performance is not to exceed 6 months. Only those firms that produce technologies suitable for testing and demonstration of operational and/or commercial viability will be eligible for continuation to the next Round and additional funding.

Round II. Pilot Testing in an Operational Environment – Round II, if funded, is limited to a firm fixed price of $1,000,000 and the period of performance is not to exceed 9 months. Only those firms that produce technologies suitable for further testing in anticipation of DON deployment into an operational environment and/or commercialization in the private sector will be eligible for continuation to the next Round and additional funding.

Round III. Operational Test and Evaluation in Multiple User Scenarios - Round III is intended for additional operational testing, if required, using multiple prototypes and users simultaneously in a DON operational environment. SBIR funding, if available for Round III, will require non-SBIR government or private funds included as a 1:1 Cost-Match, with SBIR funds not to exceed $1,500,000.

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR/STTR Technical Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and/or their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

DEPARTMENT OF THE NAVY (DON)
20.1 Small Business Innovation Research (SBIR)
PROPOSAL SUBMISSION INSTRUCTIONS - STANDARD TOPICS

IMPORTANT

- **The following instructions apply to Standard topics only:**
  - **N201-001 through N201-087**
- **DON updates the Phase I Technical Volume (Volume 2) page limit to not exceed 10 pages.**
- A Phase I proposal template specific to DON topics will be available to assist small businesses to generate a Phase I Technical Volume (Volume 2). The template will be located on https://www.navysbir.com/links_forms.htm.
- The DON provides notice that Basic Ordering Agreements (BOAs) may be used for Phase I awards, and BOAs or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- Discretionary Technical Assistance (DTA) was renamed Discretionary Technical and Business Assistance (TABA).
- The optional Supporting Documents Volume (Volume 5) is available for the SBIR 20.1 BAA cycle. The optional Supporting Documents Volume is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation for Standard topics, N201-001 though N201-087.

THE FOLLOWING INSTRUCTIONS SOLELY APPLY TO STANDARD TOPICS (N201-001 through N201-087)

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DON's mission can be obtained from the DON website at www.navy.mil.

For program and administrative questions, contact the Program Managers listed in Table 3; **do not** contact them for technical questions.

TABLE 3: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N201-001 to N201-004	Mr. Jeffrey Kent	Marine Corps Systems Command	jeffrey.a.kent@usmc.mil

Topic Numbers	Point of Contact	SYSCOM	Email
		(MCSC)	
N201-005 to N201-024	Ms. Donna Attick	Naval Air Systems Command (NAVAIR)	donna.attick@navy.mil
N201-025 to N201-068	Mr. Dean Putnam	Naval Sea Systems Command (NAVSEA)	dean.r.putnam@navy.mil
N201-069 to N201-077	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	loreanne.ponirakis@navy.mil
N201-078 to N201-087	Mr. Michael Pyryt	Strategic Systems Programs (SSP)	michael.pyryt@ssp.navy.mil

PHASE I GUIDELINES

Follow the instructions in the DoD SBIR/STTR Program BAA at https://sbir.defensebusiness.org/ for requirements and proposal submission guidelines. Please keep in mind that Phase I must address the feasibility of a solution to the topic. It is highly recommended that proposers follow the Phase I Proposal Template that is specific to DON topics as a guide for structuring proposals. The template will be located on https://navysbir.com/links_forms.htm. Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.

PHASE I PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the proposal will be deemed noncompliant and may be REJECTED.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR BAA section 5.4(a).

- **Technical Volume (Volume 2).** Technical Volume (Volume 2) must meet the following requirements:
  - Not to exceed **10** pages, regardless of page content
  - Single column format, single-spaced typed lines
  - Standard 8 ½" x 11" paper
  - Page margins one-inch on all sides. A header and footer may be included in the one-inch margin.
  - No font size smaller than 10-point*
  - Include, within the **10-page limit of Volume 2**, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified.

  *For headers, footers, listed references, and imbedded tables, figures, images, or graphics that include text, a font size smaller than 10-point is allowable; however, proposers are cautioned that the text may be unreadable by evaluators.

  Volume 2 is the technical proposal. Additional documents may be submitted to support Volume 2 in accordance with the instructions for Supporting Documents Volume (Volume 5) as detailed below.

Disclosure of Information (DFARS 252.204-7000)
In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this or any subsequent award, the proposer shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons. Simply identifying fundamental research in the proposal does NOT constitute acceptance of the exclusion. All exclusions will be reviewed and noted in the award. NOTE: Fundamental research included in the technical proposal that the proposer is requesting be eliminated from the requirements for prior approval of public disclosure of information, must be uploaded in a separate document (under "Other") in the Supporting Documents Volume (Volume 5).

Phase I Options are typically exercised upon selection for Phase II. Option tasks should be those tasks that would enable rapid transition from the Phase I feasibility effort into the Phase II prototype effort.

- **Cost Volume (Volume 3).** The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. Costs for the Base and Option must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

- **Period of Performance.** The Phase I Base Period of Performance must not exceed six (6) months and the Phase I Option Period of Performance must not exceed six (6) months.

- **Company Commercialization Report (Volume 4)**. Volume 4 is not available for the 20.1 BAA. Please refer to the DoD SBIR/STTR BAA section 5.4(e) for further information.

- **Supporting Documents Volume (Volume 5)**. DoD has implemented a Supporting Documents Volume (Volume 5). The optional Volume 5 is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation. Volume 5 must only be used for the following documents:
    - Letters of Support relevant to this project
    - Additional Cost Information - The "Explanatory Material" field in the online DoD Cost Volume (Volume 3) is to be used to provide sufficient detail for subcontractor, material, travel costs, and Discretionary Technical and Business Assistance (TABA), if proposed. If additional space is needed these items may be included within Volume 5.
    - SBIR/STTR Funding Agreement Certification
    - Technical Data Rights (Assertions) - If required, must be provided in the table format required by DFARS 252.227-7013(d) and (e)(3) and be included within Volume 5.
    - Allocation of Rights between prime and subcontractor
    - Disclosure of Information (DFARS 252.204-7000) (see Technical Volume 2 above)
    - Prior, Current, or Pending Support of Similar Proposals or Awards – If a proposal is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, another DoD Component, or the same DoD Component reveal

this information in the appropriate area of the Proposal Cover Sheet (Volume 1) and provide details in Volume 5 (see Phase I Technical Volume template on https://www.navysbir.com/links_forms.htm for required information, upload as "Other")

- Foreign Citizens - Identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant (see Phase I Technical Volume template on https://www.navysbir.com/links_forms.htm for required information, upload as "Other")

NOTE: The inclusion of documents or information other than that listed above (e.g., resumes, test data, technical reports, publications) may result in the proposal being deemed "Non-compliant" and REJECTED.

A font size smaller than 10-point is allowable for documents in Volume 5; however, proposers are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD has implemented the optional Fraud, Waste and Abuse Training Certification (Volume 6). DON does not require evidence of Fraud, Waste and Abuse Training at the time of proposal submission. Therefore, DON will not require proposers to use Volume 6.

DON SBIR PHASE I PROPOSAL SUBMISSION CHECKLIST

- **Subcontractor, Material, and Travel Cost Detail.** In the Cost Volume (Volume 3), proposers must provide sufficient detail for subcontractor, material and travel costs. Enter this information in the "Explanatory Material" field in the online DoD Volume 3. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).

- **Performance Benchmarks.** Proposers must meet the two benchmark requirements for progress toward Commercialization as determined by the Small Business Administration (SBA) on June 1 each year. Please note that the DON applies performance benchmarks at time of proposal submission, not at time of contract award.

- **Discretionary Technical and Business Assistance (TABA).** If TABA is proposed, the information required to support TABA (as specified in the TABA section below) must be added in the "Explanatory Material" field of the online DoD Volume 3. If the supporting information exceeds the character limits of the Explanatory Material field of Volume 3, this information must be included in Volume 5 as "Additional Cost Information" as noted above. Failure to add the required information in the online DoD Volume 3 and, if necessary, Volume 5 will result in the denial of TABA. TABA may be proposed in the Base and/or Option periods, but the total value may not exceed $6,500 in Phase I.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The SBIR and STTR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Firms may request, in their Phase I Cost Volume

(Volume 3) and Phase II Cost Volume, to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase I TABA amount is up to $6,500 and is in addition to the award amount. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the $1,600,000 or lower limit specified by the SYSCOM). As with Phase I, the amount proposed for TABA cannot include any profit/fee application by the SBIR/STTR awardee and must be inclusive of all applicable indirect costs. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to $50,000 per project.

Approval of direct funding for TABA will be evaluated by the DON SBIR/STTR Program Office. A detailed request for TABA must include:

- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR applicant
- Propose a TABA provider that is the SBIR applicant
- Propose a TABA provider that is an affiliate of the SBIR applicant
- Propose a TABA provider that is an investor of the SBIR applicant
- Propose a TABA provider that is a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA must be included in the Cost Volume (Volume 3) as follows:

- Phase I: The value of the TABA request must be included on the TABA line in the online DoD Volume 3 and, if necessary, Volume 5 as described above. The detailed request for TABA (as specified above) must be included in the "Explanatory Material" field of the online DoD Volume 3 and be specifically identified as "Discretionary Technical and Business Assistance".
- Phase II: The value of the TABA request must be included on the TABA line in the DON Phase II Cost Volume (provided by the DON SYSCOM). The detailed request for TABA (as specified above) must be included as a note in the Phase II Cost Volume and be specifically identified as "Discretionary Technical and Business Assistance".

TABA may be proposed in the Base and/or Option periods. Proposed values for TABA must NOT exceed:

- Phase I: A total of $6,500
- Phase II: A total of $25,000 per award, not to exceed $50,000 per Phase II project

NOTE: The Small Business Administration (SBA) is currently developing regulations governing TABA limitations. All regulatory guidance produced by SBA will apply to any SBIR contracts where TABA is utilized only after the Government Contracting Officer issues a modification to the contract.

If a proposer requests and is awarded TABA in a Phase II contract, the proposer will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must attend a one-day DON STP meeting during the first or second year of the Phase II contract. This meeting is typically held in the spring/summer in the Washington, D.C. area. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

EVALUATION AND SELECTION

The DON will evaluate and select Phase I and Phase II proposals using the evaluation criteria in Sections 6.0 and 8.0 of the DoD SBIR/STTR Program BAA respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. As noted in the sections of the aforementioned Announcement on proposal submission requirements, proposals exceeding the total costs established for the Base and/or any Options as specified by the sponsoring DON SYSCOM will be rejected without evaluation or consideration for award. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

Approximately one week after the Phase I BAA closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests of Phase I and II selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the DON SYSCOM Program Managers listed in Table 1. If the protest is to be filed with the GAO, please refer to instructions provided in section 4.11 of the DoD SBIR/STTR Program BAA.

CONTRACT DELIVERABLES

Contract deliverables for Phase I are typically a kick-off brief, progress reports, and a final report. Required contract deliverables must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

AWARD AND FUNDING LIMITATIONS

Awards. The DON typically awards a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I. In addition to the negotiated contract award types listed in Section 4.14.b of the DoD SBIR/STTR Program BAA for Phase II awards, the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Funding Limitations. In accordance with the SBIR and STTR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. Additionally, to adjust for inflation DON has raised Phase I and Phase II award amounts. The maximum Phase I proposal/award amount including all options (less TABA) is $240,000. The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. The maximum Phase II proposal/award amount including all options (including TABA) is $1,600,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of less than $1,600,000 based on available funding. The structure of the Phase II proposal/award, including maximum amounts as well as breakdown between Base and Option amounts will be provided to all Phase I awardees either in their Phase I award or a minimum of 30 days prior to the due date for submission of their Initial Phase II proposal.

PAYMENTS

The DON makes three payments from the start of the Phase I Base period, and from the start of the Phase I Option period, if exercised. Payment amounts represent a set percentage of the Base or Option value as follows:

Days From Start of Base Award or Option	Payment Amount
15 Days	50% of Total Base or Option
90 Days	35% of Total Base or Option
180 Days	15% of Total Base or Option

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa. Please refer to instructions provided in section 7.2 of the DoD SBIR/STTR Program BAA.

ADDITIONAL NOTES

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DON makes any award that involves an IRB or similar approval requirement, the proposer must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the DON's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and recombinant DNA is included under a Phase I or Phase II proposal, please carefully review the requirements at: http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

Government Furnished Equipment (GFE). Due to the typical lengthy time for approval to obtain GFE, it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed and it is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

PHASE II GUIDELINES

All Phase I awardees can submit an **Initial** Phase II proposal for evaluation and selection. The Phase I Final Report, Initial Phase II Proposal, and Transition Outbrief (as applicable) will be used to evaluate the proposer's potential to progress to a workable prototype in Phase II and transition technology to Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification.

NOTE: All SBIR/STTR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations (for all DON topics, this means by invitation only).

The DON typically awards a Cost Plus Fixed Fee contract for Phase II; but, may consider other types of agreement vehicles. Phase II awards can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR/STTR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 5122 of the National Defense Authorization Act of Fiscal Year 2012. The statute set-aside is 1% of the available SBIR/STTR funding to be used for administrative support to accelerate transition of SBIR/STTR-developed technologies and provide non-financial resources for the firms (e.g., the DON STP).

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR/STTR Technical Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and/or their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

NAVY SBIR 20.1 Topic Index

ADAPT Topics – N201-X01 to N201-X02

Standard Topics – N201-001 to N201-087

N201-039	Power Dense Single Core Three-Phase Transformer
~~N201-040~~	[Navy has removed topic N201-040 from the 20.1 SBIR BAA]
N201-041	Bridge-to-Bridge Radio for Unmanned Surface Vehicles
N201-042	Rolling Shutter and Fast Panning Effects Mitigation
N201-043	Holistic Integration of Air Anti-Submarine Warfare Capability for Effective Theater Undersea Warfare
N201-044	2 micron Wavelength Kilowatt Class High Energy Laser/Amplifier
N201-045	Development of a Debris Prediction Method for Hardened Structures
N201-046	Through-Hull Underwater Submarine Communications
N201-047	Modular Architecture Framework Model and Application Program Interface for Common Core Combat System
N201-048	MK 48 Torpedo Composite Fuel Tank
N201-049	Towed Array Position Estimation System
N201-050	Real-time Insights for Combat System Integration and Testing
~~N201-051~~	[Navy has removed topic N201-051 from the 20.1 SBIR BAA]
N201-052	Wide Band Large Aperture Beam Director Head Window
N201-053	Development of New Generation Earth Covered Magazine (ECM) Structure Design using Composite Materials
N201-054	Coordinated, Layered Defense Capabilities of Multiple Torpedo Countermeasures
N201-055	Coaxial Insulated Bus Pipe for High Energy Application
N201-056	Data Exchange Subsystem Architectural Framework, Algorithm Set and Applications Program Interface for Common Core Combat System
N201-057	Software Ecosystem Architectural Model and Application Program Interface for Common Core Combat System
N201-058	Affordable and Efficient High-Power Long Wavelength Infrared Quantum Cascade Lasers
N201-059	Automated Management of Maritime Navigation Safety
N201-060	Unmanned Passive Navigation without GPS
N201-061	Mine Countermeasures Unmanned Surface Vehicle Common Deploy and Retrieve System
N201-062	Hydrophone Incorporating Open Architecture Telemetry
N201-063	SUBSAFE Electrical Hull Penetrator Connectors for Directed Energy (DE) Weapon Systems
N201-064	Digital Theater-level System Model for Cyber Security Analysis
N201-065	Element-Level Digital Communications Array
N201-066	Acoustically Transparent Mid-Frequency SONAR Projector
N201-067	Kinematic Contact Tracking Using Hybrid Features
N201-068	Compact High-energy Efficient System for Removing Carbon Monoxide from Ambient Air on Submarines and Other Closed Manned Environments
N201-069	Low-cost, High Efficiency, and Non-rigid, Perovskite-based Single-junction or Tandem Solar Cells
N201-070	Sensors and Autonomy for Unmanned Maritime Missions
N201-071	Ultra-Fast Metastable Implant Activation System for Selective Area Doping of III-Nitrides
N201-072	Aligned Nanotube Reinforcement of Polymer-matrix Laminates
N201-073	Low Phase Noise Laser for Radio Frequency (RF) Photonics
N201-074	High Power Microwave (HPM) Waveform-enhancing Sub-nanosecond Semiconductor Pulse Sharpener
N201-075	Enabling Technologies for Marine eDNA Sampling
N201-076	At-Scale Detection of Hardware Trojans on Chip Circuits
N201-077	Machine Clustered and Labeled Decision Tracks Derived from AI-enabled Intent Recognition
N201-078	Small-scale Health Monitoring Device for In-tube Environment Monitoring
N201-079	Extremely Accurate Star Tracker
N201-080	Remote Telescope Control Software (RTC SW) System
N201-081	Automatic Coding Standards Validation Tool
N201-082	Visible to Near-Infrared Integrated Photonics Development for Quantum Inertial Sensing
N201-083	High Performance Natural Composite
N201-084	Remote Telescope Control Hardware (RTC HW) System
N201-085	Machine Learning-Based Data Analysis

N201-086	Avionics Packaging Technology
N201-087	High-Power Superluminescent Diodes for High-Precision Interferometric Inertial Sensors

NAVY SBIR 20.1 Topic Descriptions

ADAPT Topics – N201-X01 to N201-X02

N201-X01 TITLE: ADAPT - Advanced, Agile Manufacturing of Limited-Production Swarming Unmanned Systems (UxS) to Support Humanitarian Assistance and Disaster Relief (HADR) Operations

TECHNOLOGY AREA(S): Battlespace

ACQUISITION PROGRAM: NAVAL Shipyards, Fleet Readiness Centers (FRC), Marine Corps Logistics Command (MARCORLOGCOM)

OBJECTIVE: Volatilities in global weather and geo-political climate are increasing the frequency and magnitude of natural and manmade disasters. Providing rapid response to affected areas is critical to saving lives, as the immediate aftermath of a disaster presents the greatest risks to survivors and to first responders. The highly dynamic environments resulting from debris and infrastructure destruction creates a significant challenge in moving supplies into and survivors out of disaster zones. The Navy and Marine Corps seek to develop and demonstrate rapid, distributed, on-demand manufacturing of unmanned systems capable of supporting multiple payloads dependent on the situation.

DESCRIPTION: The Department of the Navy (DON) seeks to develop and demonstrate rapid, distributed, on-demand, small-scaled, domestic manufacturing of unmanned systems capable of supporting multiple payloads depended on the situation. DON intends to collaborate with innovative small businesses for technologies and methods related to the following Focus Areas:

1. Agile manufacturing on-demand solutions for Unmanned Systems (UxS) products
2. Control systems for unmanned platforms to include either Group 1 – Unmanned Aircraft Systems (UAS) or conversion of manned watercrafts into Unmanned Surface Vehicles (USV)
3. Notional payload concepts based on using commercial-off-the-shelf (COTS) technologies

1. Agile manufacturing on-demand solutions for UxS products: define and develop customizable systems with the ability to fabricate close to the point-of-need. This includes access to manufacturing of components and assemblies across multiple facilities to accommodate surge requirements. This includes supply chain authentication and management required for the rapid local UxS assembly.
2. Control systems for unmanned platforms to include either Group 1 – UAS or USV: develop reconfigurable control systems demonstrating the ability for self-swarming organization and redistribution, fratricide-collision avoidance, and waypoint-based navigation. These systems must be rapidly tailorable to enable the conversion and use of any available assets as UxS under emergency conditions.
3. Notional payload concepts based on using COTS technologies: demonstrate capability for rapid acquisition and configuration for modular payloads to enable rapid response in Humanitarian Assistance and Disaster Relief (HADR) operations. Needed capabilities include communication, improved situational awareness, supply delivery, and victim extraction.

PHASE I: Please add the primary Focus Area number you are proposing to as a prefix to the Phase I Proposal title.

Proposers will develop and demonstrate an initial functional prototype meeting at least one primary Focus Area of the three Focus Areas listed under this topic. However, a proposer may choose to include secondary Focus Area(s) within the proposal submission. Technical proposals are limited to 5-pages and must provide sufficient information to allow assessment that the initial prototype demonstrated at the end of Phase I will function in a relevant environment in a manner meeting the specified capability. This information may include, but is not limited to, detailed designs, component and system laboratory testing, or a minimum viable product (MVP) [Ref. 1]. Ideally, the Technology Readiness Level (TRL) [Ref. 2] at the start of Phase I will be TRL 4-5 with the functional prototype at or near TRL 6 at Phase I completion. At the end of Phase I, the initial functional prototype will be demonstrated, a detailed report on prototyping test results, and detailed plans for the small-scaled manufacturing of the prototypes will be provided to the Government. Proposals must include a discussion of the dual-use defense and commercial market opportunities for the technology being proposed, including a preliminary assessment of commercial market potential. Phase I period of performance shall not exceed 4 months, and the total fixed price shall not exceed $200K.

PHASE II: During Phase II, the functional prototype from Phase I can be further developed and refined into an operational prototype based on defense and commercial customer feedback. Phase II will consist of three Rounds of funding with progression between Rounds contingent upon meeting defined milestones. For this topic, proposers must meet defined milestones for each Round to be considered for the next Round. Full details for Phase II proposal requirements will be provided to Phase I awardees; however, general descriptions for Phase II Rounds I, II, and III are provided below:

Round I. Demonstration of Viability – Round I further builds on the Phase I functional prototype to meet DON user's needs. Round I is limited to a firm fixed price of $500,000 and the period of performance is not to exceed 6 months. During this Round, the proposer will focus on moving beyond proving basic achievement of meeting DON needs to meeting all of the usability features required for integration and deployment. The proposer will produce no-less-than 100 units of the prototypes under consideration. The proposer will be expected to work with actual end users and systems integration personnel to ensure that requirements beyond technological performance of the prototype are identified (e.g., Human System Interface, logistics, training, maintenance, installation). The proposer will use feedback from DON users, systems integrators, and other potential defense and commercial beneficiaries and stakeholders to modify and adapt its prototype to meet defense operational and technical needs and to meet potential dual-use commercial applications. At the end of Round I, the prototype must demonstrate operational and/or commercial viability. The proposer must recommend test procedures to demonstrate viability and an appropriate facility for the test; however, the Government is not required to use the proposed testing procedures or facilities. It is very likely that Government personnel will be present for the demonstration. Only those firms that produce technologies suitable for testing and demonstration of operational and/or commercial viability will be eligible for continuation to the next Round and additional funding. The Government reserves the right to fund some, none, or all of the Round I participants into Round II depending on the availability of SBIR funds and the capabilities of final Round II prototypes to meet DON needs.

Round II. Pilot Testing in an Operational Environment – Round II, if funded, is limited to a firm fixed price of $1,000,000 and the period of performance is not to exceed 9 months. During Round II, the proposer will produce no-less-than 320 units of the prototypes under consideration, and meet with DON command stakeholders and operational end users to conduct pilot tests of fully functional prototypes in an operational environment. These tests are designed to be performed using DON operational personnel in real end user environments and scenarios. All testing will be coordinated with DON command and operational stakeholders. Results of this testing will inform stakeholders on the capabilities of the developed technology and the probability for its deployment in an operational environment. During Round II, the SBC will use feedback from DON users, systems integrators, and other potential defense and commercial beneficiaries and stakeholders to adapt their prototype to optimize defense operational and technical benefits and to provide optimal dual-use commercial market fit. Only those firms that produce technologies suitable for further testing in anticipation of DON deployment into an operational environment and/or commercialization in the private sector will be eligible for continuation to the next Round and additional funding. The Government reserves the right to fund some, none, or all of the Round II participants into Round III depending on the availability of SBIR or non-SBIR funds and the capabilities of final Round II prototype operational testing.

Round III. Operational Test and Evaluation in Multiple User Scenarios - Round III is intended for additional operational testing, if required, using multiple prototypes and users simultaneously in a DON operational environment. This Round may require delivery of no-less-than 1,000 prototypes and/or licenses of the technology for testing purposes. If non-government personnel are utilized as part of the testing, appropriate Non-Disclosure Agreements will be obtained to protect against disclosure of the proposer's intellectual property (if properly marked). The proposer may be required to support the conduct of the tests, but the operation of the prototypes in the test must be capable of being performed by the Government. SBIR funding, if available for Round III, will require non-SBIR Government or private funds included as a 1:1 Cost-Match, with SBIR funds not to exceed $1,500,000 under the 1:1 Cost-Match. The required number of end users and prototypes as well as the operational scenarios to be run are not yet defined. Therefore, this Round is currently undefined.

PHASE III DUAL USE APPLICATIONS: Given the need for these capabilities at numerous sites, the Federal Government will coordinate funding to maximize benefit for affected sites. Depending on financial estimates, a phased procurement may be required to reach full implementation at the necessary sites. Coordination between the Government and the provider will be required during Phase III to ensure support and proper proficiency of the solution is in place prior to completion of the effort.

Finally, the Federal Government sees the development of these capabilities as benefiting industrial maintenance activities in partnership with the Navy. The ability to keep critical assets in operation is a common need for which the Navy is seeking willing partners.

REFERENCES:
1. Minimum Viable Product: https://en.wikipedia.org/wiki/Minimum_viable_product

2. Technology Readiness Levels: https://www.army.mil/e2/c/downloads/404585.pdf

3. Information on Business Accelerator Pilot opportunity with H4XLabs for ADAPT Phase I Awardees (defined in Business Accelerator Services section in Proposal Submission Instructions for ADAPT Topics). https://www.h4xlabs.com/sbir

KEYWORDS: Unmanned Systems; UxS; Unmanned Aircraft Systems; UAS; Unmanned Surface Vehicles; USV; Humanitarian Assistance and Disaster Relief; HADR

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-X02 TITLE: ADAPT - Naval Depot Modernization and Sustainment

TECHNOLOGY AREA(S): Battlespace, Human Systems

ACQUISITION PROGRAM: NAVSEA Naval Shipyards, NAVAIR Fleet Readiness Centers (FRC), USMC Logistics Command (MARCORLOGCOM)

OBJECTIVE: The Department of the Navy (DON) sustainment community is urgently seeking modern tools, solutions, and processes to reliably and safely get DON assets back in the field as quickly as possible. Technologies for maintaining and sustaining ships, aircraft, and ground vehicles have advanced significantly in the past 50 years. Yet, the DON sustainment community has struggled to identify, pilot, and integrate those same technological advances into public shipyards, fleet readiness centers, and ground vehicle depots. As DON platforms increase in complexity and scale, demand outstrips the capability of current maintenance systems resulting in multi-year delays of national assets, such as the USS Boise.

DESCRIPTION: DON seeks modern tools, solutions, and processes to reliably and safely get assets back in the field as quickly as possible and intends to collaborate with innovative small businesses within the following and related Focus Areas:
1. Expeditionary Depot Capability (Command, Control and Communications)
2. Artificial Intelligence (AI)-Generated Work Instructions (Artificial Intelligence/Machine Learning)
3. Self-Healing Data Collection Using Artificial Intelligence (AI) (Artificial Intelligence/Machine Learning)
4. Robotics Material Handling (Command, Control and Communications)
5. Integrated Global Logistics Network to Allow Model-Based Enterprise (MBE) (Command, Control and Communications)

6. Global Parts Tracking System (Command, Control and Communications)
7. Facility Health Monitoring and Prioritization (Command, Control and Communications & Autonomy)
8. Master Command and Control for Multiple Activity Visibility (Command, Control and Communications)
9. Cold Spray Technology Advancements (Command, Control and Communications)

1. Expeditionary Depot Capability (Command, Control and Communications): The Navy desires the capability to operate modular and air droppable maintenance machinery remotely to enhance resiliency in deployed environments. The Navy is currently limited by its fixed number of maintenance depots at specific locations. Capabilities are specialized at these "brick and mortar" locations, which forces naval platforms to return to these sites or to send teams out to the affected platform(s). Remotely operated maintenance systems will maximize naval forces' ability to remain forward deployed by reducing time in fixed facilities (e.g., depot facilities, dry docks), reducing travel time to and from the facilities, and using the specialized labor at a safe stand-off from deployed locations.
2. Artificial Intelligence (AI)-Generated Work Instructions (Artificial Intelligence/Machine Learning): Certain repairs on naval platforms happen with such infrequency that mechanics cannot execute the repairs without extensive re-learning/re-engineering. Institutional knowledge is not effectively transferred, especially since seasoned mechanics rotate faster than these infrequent repairs occur. Mechanics faced with one of these repair scenarios often can only recall the anecdotal protocols from the previous one or two repairs. Furthermore, there is no systematic way to know whether recent repairs qualify as best practices. By establishing a repair data system to capture infrequent repairs, the naval maintenance community can analyze the data (via root cause analyses) to create and share best practices. In a future state, this could enable work instructions to be automatically generated with a high fidelity further accelerating the planning and execution of work.
3. Self-Healing Data Collection Using Artificial Intelligence (AI) (Artificial Intelligence/Machine Learning): Large swaths of data have been compiled and can provide invaluable insights if data entry errors can be corrected. Human correction of the errors (e.g., USS Abraham Lincoln to CVN72) is not efficient/effective nor predictive in nature. AI algorithms can groom or heal the (meta) data to make it more useful in trending deficiencies and corrective actions across multiple platforms. Navy seeks an automated self-healing data collection system to effectively correct inaccurate entry of parts numbers, and track/identify the root cause for repeated reports of faulty equipment.
4. Robotics Material Handling (Command, Control and Communications): The Navy needs to integrate commercial advancements in robotics technology at its depot locations to improve material movement. Trained labor is consumed querying inventories, traveling to different locations, searching warehouses, and returning to the work site before actually using their skills to restore a platform. Solutions to locate and deliver parts to work sites would enable skilled labor to focus on trade-specific efforts.
5. Integrated Global Logistics Network to Allow Model-Based Enterprise (MBE) (Command, Control and Communications): As each Navy depot builds its own digital model for resource planning and facility layouts, the depots have generated their own datasets with unique standards. The Navy needs the ability to track facility capacity (e.g., equipment, tooling) across the enterprise in the event repair efforts need to be re-allocated. Standards need to be established to ensure datasets can be integrated enterprise-wide. While individual depot planning models are likely effective at a local level, in aggregate, this limits decision makers' ability to track and compare resource planning at an enterprise level.
6. Global Parts Tracking System (Command, Control and Communications): Locating and delivering repair parts currently consumes hundreds of man-years of effort to affect combat platform maintenance. Naval depots seek an efficient way to track parts across various depots to enable automated picking and shipping to support maintenance operations.
7. Facility Health Monitoring and Prioritization (Command, Control and Communications & Autonomy): Facility managers lack the tools to monitor the health status of various infrastructure. They seek an integrated facility health monitoring system that will be able to track real-time health status of buildings, identify and prioritize areas for repair, and predict where future failures might arise.
8. Master Command and Control for Multiple Activity Visibility (Command, Control and Communications): Depots and distributed maintenance workers do not have a common operating picture or common process guide to conduct operations and receive real-time feedback on efforts. Navy seeks a way to track naval depot maintenance capacity and specialties enterprise-wide to optimize resource allocation.
9. Cold Spray Technology Advancements (Command, Control and Communications): Naval depots seek additional cold spray technology advancements to address structural metallic repairs and create robust, portable systems to reduce repair time and effectively execute larger area repairs in deployed/austere environments. Metallurgical analyses, powder development and system design advances are facets to the advancements required aboard ships,

inside ground vehicle compartments, and for other applications.

PHASE I: Please add the primary Focus Area number you are proposing to as a prefix to the Phase I Proposal title.

Proposers will develop and demonstrate an initial functional prototype meeting one primary Focus Area of the nine Focus Areas listed under this topic. However, a proposer may choose to include secondary Focus Area(s) within the proposal submission. Technical proposals are limited to 5-pages and must provide sufficient information to allow assessment that the initial prototype demonstrated at the end of Phase I will function in a relevant environment in a manner meeting the specified capability. This information may include, but is not limited to, detailed designs, component and system laboratory testing, or a minimum viable product (MVP) [Ref. 1]. Ideally, the Technology Readiness Level (TRL) [Ref. 2] at the start of Phase I will be TRL 4-5 with the functional prototype at or near TRL 6 at Phase I completion. At the end of Phase I, the initial functional prototype will be demonstrated and a detailed report on prototyping test results will be provided to the Government. Proposals must include a discussion of the dual-use defense and commercial market opportunities for the technology being proposed, including a preliminary assessment of commercial market potential. Phase I period of performance shall not exceed 4 months, and the total fixed price shall not exceed $200K.

PHASE II: The functional prototype demonstrated at the end of Phase I will be further developed and refined into an operational prototype based on defense and commercial customer feedback. Phase II will consist of three Rounds of funding with progression between Rounds contingent upon meeting defined milestones. For this topic, proposers must meet defined milestones for each Round to be considered for the next Round. Full details for Phase II proposal requirements will be provided to Phase I awardees; however, general descriptions for Phase II Rounds I, II, and III are provided below:

Round I. Prototype Demonstration of Viability – Round I further builds on the Phase I functional prototype to meet DON user's needs. Round I is limited to a firm fixed price of $500,000 and the period of performance is not to exceed 6 months. During this Round, the proposer will focus on moving beyond proving basic achievement of meeting DON needs to meeting all of the usability features required for integration and deployment. The proposer will be expected to work with actual end users and systems integration personnel to ensure that requirements beyond technological performance of the prototype are identified (e.g., Human System Interface, logistics, training, maintenance, installation). The proposer will use feedback from DON users, systems integrators, and other potential defense and commercial beneficiaries and stakeholders to modify and adapt its prototype to meet defense operational and technical needs and to meet potential dual-use commercial applications. At the end of Round I, the prototype must demonstrate operational and/or commercial viability. The proposer must recommend test procedures to demonstrate viability and an appropriate facility for the test; however, the government is not required to use the proposed testing procedures or facilities. It is very likely that government personnel will be present for the demonstration. Only those firms that produce technologies suitable for testing and demonstration of operational and/or commercial viability will be eligible for continuation to the next Round and additional funding. The government reserves the right to fund some, none, or all of the Round I participants into Round II depending on the availability of SBIR funds and the capabilities of final Round II prototypes to meet DON needs.

Round II. Pilot Testing in an Operational Environment – Round II, if funded, is limited to a firm fixed price of $1,000,000 and the period of performance is not to exceed 9 months. During Round II, the proposer will meet with DON command stakeholders and operational end users to conduct pilot tests of fully functional prototypes in an operational environment. These tests are designed to be performed using DON operational personnel in real end user environments and scenarios. All testing will be coordinated with DON command and operational stakeholders. Results of this testing will inform stakeholders on the capabilities of the developed technology and the probability for its deployment in an operational environment. During Round II, the proposer will use feedback from DON users, systems integrators, and other potential defense and commercial beneficiaries and stakeholders to adapt their prototype to optimize defense operational and technical benefits and to provide optimal dual-use commercial market fit. Only those firms that produce technologies suitable for further testing in anticipation of DON deployment into an operational environment and/or commercialization in the private sector will be eligible for continuation to the next Round and additional funding. The government reserves the right to fund some, none, or all of the Round II participants into Round III depending on the availability of SBIR or non-SBIR funds and the capabilities of final Round II prototype operational testing.

Round III. Operational Test and Evaluation in Multiple User Scenarios - Round III is intended for additional operational testing, if required, using multiple prototypes and users simultaneously in a DON operational environment. This Round may require delivery of multiple prototypes and/or licenses of the technology for testing purposes. If non-government personnel are utilized as part of the testing, appropriate Non-Disclosure Agreements will be obtained to protect against disclosure of the proposer's intellectual property (if properly marked). The proposer may be required to support the conduct of the tests, but the operation of the prototypes in the test must be capable of being performed by the government. SBIR funding, if available for Round III, will require non-SBIR government or private funds included as a 1:1 Cost-Match, with SBIR funds not to exceed $1,500,000 under the 1:1 Cost-Match. The required number of end users and prototypes as well as the operational scenarios to be run are not yet defined. Therefore, this Round is currently undefined.

PHASE III DUAL USE APPLICATIONS: Given the need for these capabilities at numerous sites, the Federal Government will coordinate funding to maximize benefit for affected sites. Depending on financial estimates, a phased procurement may be required to reach full implementation at the necessary sites. Coordination between the Government and the provider will be required during Phase III to ensure support and proper proficiency of the solution is in place prior to completion of the effort.

Finally, the Federal Government sees the development of these capabilities as benefiting industrial maintenance activities in partnership with the Navy. The ability to keep critical assets in operation is a common need for which the Navy is seeking willing partners.

REFERENCES:

1. Minimum Viable Product: https://en.wikipedia.org/wiki/Minimum_viable_product

2. Technology Readiness Levels: https://www.army.mil/e2/c/downloads/404585.pdf

3. Risk Management Framework Information Document (Uploaded to SITIS 12/10/2019)

4. Information on Business Accelerator Pilot opportunity with H4XLabs for ADAPT Phase I Awardees (defined in Business Accelerator Services section in Proposal Submission Instructions for ADAPT Topics). https://www.h4xlabs.com/sbir

KEYWORDS: Artificial Intelligence; AI; Machine Learning; ML; Data Analytics; Autonomy; Command, Control, and Communications; Robotic, Model Based Enterprise; Sensors, Industrial Internet of Things, IIOT; Cold Spray; 5G

Questions may also be submitted through DOD SBIR/STTR SITIS website.

Standard Topics – N201-001 to N193-149

N201-001 TITLE: Broadband for Photonic Receiver

TECHNOLOGY AREA(S): Battlespace, Electronics, Sensors

ACQUISITION PROGRAM: PfM CES, PMIS, Multi-Function Electronic Warfare (MFEW) ACAT IV-M POR

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative and operationally suitable consolidated (minimized size and weight) antenna solution for sensing and transmitting broadly across the electromagnetic spectrum.

DESCRIPTION: Marine Corps Systems Command (MCSC) provides vehicle-mounted Electronic Warfare Systems (EWS) for geo-locating, direction finding, and countering threats on the ground and in the air. In order for these systems to be maximally effective against the breadth of potential threats, they must be able to sense and defeat a variety of complex threat signals across the electromagnetic spectrum at once.

With the emergence of ultra-wideband photonic receiver technology that can very rapidly process, de-conflict, and identify threats across the entire frequency range of the electromagnetic spectrum, there comes a need for complimentary broadband antenna hardware to sense threats and transmit to defeat them. Current antenna technologies are limited in frequency range and thus multiple antennae are required to cover broad ranges, especially at the lower end of the frequency range.

Requirements for the Broadband Antenna for Photonic Receiver are as follows: Demonstrate a broadband antenna for a photonic receiver in the frequency range from DC to 20GHz (threshold), CD to 80+GHz (objective). This should be achieved with threshold of 4 antennae with a preference that multiple antennae occupy the same physical space. Antennae that occupy the same physical space will be considered one antenna, even if they are electromagnetically multiple antennae. No single antenna should exceed a 1ft cube in size. The total weight for the antennae solution must not exceed 50lbs (threshold) with an objective of 10lbs. As a threshold, the composite antennae solution must both receive and transmit across the entire frequency range. As an objective, it should be able to receive and transmit simultaneously at the same frequency. The antenna must have a ±45° field of view (threshold). Viable solutions must have a flat gain response within each octave of less than 1dB gain (threshold), less than 0.5dB gain (objective). Small regions of non-flatness (up to 3dB off the gain) are acceptable so long as they can be adequately characterized and assumed within the antenna pattern. A preference is provided to a systems with a gain response better than unity (0 dB) over the frequency range. The broadband antenna is intended to be used as part of a vehicle-mounted expeditionary EWS, so it should be water resistant and capable of functioning on the move. The system should be designed to meet MIL STD 810H, but testing of prototypes is not included in the scope of the research. The solution must use standard radio frequency interfaces to easily integrate with PORs and the required frequency interfaces need to be defined in any proposal. A preference is provided to minimizing the number and type of interfaces needed to cover the entire frequency range.

The Phase I effort will not require access to classified information. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and the Marine Corps in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop concepts for a broadband antenna that can be integrated with a photonic receiver and vehicle-mounted EWS, and that meets the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs and establish that the concepts can be developed into a useful product for the Marine Corps. May establish feasibility through modeling and simulation. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction and includes specification for a prototype.

PHASE II: Develop a scaled prototype integrated with representative receiver(s) that cover the frequency range for evaluation purposes in an actual or simulated electromagnetic environment representative of the breadth, volume, and complexity of an operational electromagnetic environment. Evaluate the prototype to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for integration with an electronic warfare system as the front-end anteanna. Demonstrate system performance through prototype evaluation and modeling or analytical methods that demonstrate the preprocessing capability with a test case for each of the three objectives listed in the description above. Use evaluation results to refine the prototype into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop a ruggedized broadband antenna for integration and evaluation to determine its effectiveness in an operationally relevant environment. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

As the communications industry grows and advances in capability exponentially, antenna technology remains an important enabler to maximize performance while minimizing cost and footprint. The developer of this broadband antenna could potentially market the solutions or products derived lessons learned to the communications industry.

REFERENCES:
1. 2018 U.S. Marine Corps Science & Technology Strategic Plan. https://www.onr.navy.mil/-/media/Files/About-ONR/2018-USMC-S-and-T-Strategic-Plan.ashx?la=en&hash=73B2574A13A8EC6AAE60CF4670E05C6F97309B8F

2. Marine Corps Reference Publication 3-32D.1, Electronic Warfare. United States Marine Corps. Publication Control Number144 000246 00. 02 May 2016. https://www.marines.mil/Portals/1/Publications/MCRP%203-32D.1%20(Formerly%20MCWP%203-40.5).pdf?ver=2016-08-04-062544-020

3. "Counter Radio-Controlled Improvised Explosive Device (RCIED) Electronic Warfare (CREW)." The Official Website of the United States Marine Corps. http://www.candp.marines.mil/Programs/Focus-Area-4-Modernization-Technology/Part-7-Force-Protection/CREW/

KEYWORDS: Electronic Warfare; Electromagnetic Spectrum; Broadband Antenna; Photonics; Receive and Transmit; Sensing; Flat Gain Response

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-002 TITLE: Focused Directed Energy Antenna System (FoDEAS) for Long-Range Vehicle/Vessel Stopping with reduced overall system size, weight, power consumption, thermal cooling, and system cost (SWAP/C2)

TECHNOLOGY AREA(S): Weapons

ACQUISITION PROGRAM: Joint Non-Lethal Weapons Directorate

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on

this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a Focused Directed Energy Antenna System (FoDEAS) using high power microwave (HPM) – (wideband) frequencies to electronically attack threat vehicle and vessel engines and embedded threat electronics. Provide long-range, non-lethal vehicle/vessel stopping capabilities with a wideband HPM antenna that incorporates frequency carve-outs that allows the use of this Non-Lethal Weapon (NLW) without interference to or with critical communication, navigation, and/or radar (frequencies) systems.

DESCRIPTION: Typical directed energy weapon (DEW) systems that employ high-power microwaves to electronically attack and disable/neutralize critical electronics on-board vehicle or vessel targets rely on a high peak power narrow band (single frequency) waveforms. These HPM DEW often employ a very large (~ 10-15 foot diameter) and heavy (> 150 pound) high gain (25 – 30 dBi) antenna system. These large/heavy narrow band antenna systems are designed to accommodate 10's to 100's of Megawatts of high peak power and they achieve their high antenna gain and resulting high beam directivity via their large antenna diameters [Ref 1]. These HPM DEW systems produce short duration waveform pulses of energy that disable control electronics embedded in threat vehicle/vessel engines. A second class of HPM DEW systems are HPM systems that operate by employing waveforms that are composed of multiple frequencies in a (full) single waveform. These HPM weapons system are called wideband HPM weapons. These wideband HPM sources have several advantages over narrow band sources (e.g., klystrons or magnetrons source which tend to be bulky, heavy, expensive, and require significant maintenance costs). Wideband HPM sources generate their power/waveforms by employing various high-speed switching technologies that drive smaller, lower power vacuum-tube devices or semiconductor switches [Ref 2] but they also typically project this power using omni-directional antenna systems [Ref 3]. These omni-directional wideband antenna systems are often more effective at neutralizing the electronics on-board vehicle and vessel engines (as there are more frequencies available to interact with critical electronic components) but as they are omni-directional (non-focused – non-directional), they do so typically at shorter ranges [Ref 4]. Typically, the most effective wideband HPM counter-electronic frequencies fall with the 100 MHz to 900 MHz and 1 – 3 GHz (VHF/UHF) wavebands.

So shorter effective ranges based on typical omni-directional antenna systems is the first key disadvantage to employing wideband HPM DEW systems. Wideband HPM sources pose a second problem in that given their most effective counter-electronic capabilities fall in the 100 MHz to 900 MHz and 1 – 3 GHz frequency ranges, these exact frequency ranges are where several key military and commercial communications, navigation, and radar system operate at specific single frequencies. Thus, these wideband HPM systems could interfere with these systems and impede the operation and performance of these other systems. An example of this would be frequency bands used by global positioning systems (GPS). Deployment of vehicle stoppers using compact wideband technology can be greatly accelerated by the development of such systems with frequency 'carve-outs' of the order of 20 MHz centered around critical frequencies such as those used for GPS. This will enable the directed and targeted use of this technology on hostile vehicles without interference with other critical systems either in an urban environment or in a battlefield.

PHASE I: Analyze, select, and define a compact/lightweight wideband high power microwave source technology that operates in the 100 – 900 MHz or 1-3 GHz frequency ranges. Develop a corresponding compact/lightweight HPM antenna technology development plan and complete an HPM antenna technical design that handles the HPM source power requirements and also incorporates frequency 'carve-outs' to allow for non-interference operation with specific DoD and commercial communication, navigation, and/or radar (frequencies) systems as defined in references [4] and [5]. The prototype design in Phase II shall be complaint with the following basic system prototype MIL Standards: MIL-STD-810 (Environmental Engineering Considerations); MIL-STD-461 (Electromagnetic Interference (EMI)); and MIL-STD-881 (Prototype Specifications). Ensure that the overall size and weight of the proposed system (HPM source and antenna system) is less than 350 pounds, has an antenna diameter less than 1.5 meters, and provides a peak field intensity that can stop vehicle and vessel engines at ranges of 250 meters or more. Develop a Phase II plan.

PHASE II: Develop a scaled wideband HPM/Antenna System prototype for test and evaluation to determine its capability in meeting the performance goals defined in the Phase II development plan and the JNLWD/Marine Corps requirements for a long-range Vehicle/Vessel Stopper system. Demonstrate the system prototype performance through prototype evaluation against a Government-owned vehicle and vessel engine target set (located at Naval

Surface Warfare Center Dahlgren Division) and by modeling/analytical methods over the required range of parameters including numerous deployment cycles. Based on evaluation results, refine the prototype into an initial design that will meet Joint Service requirements. Prepare a Phase III development plan to transition the technology to the JNLWD and support a transition to a Joint Program Office within the DoD.

PHASE III DUAL USE APPLICATIONS: Support the JNLWD/Marine Corps in transitioning the technology for Joint (to include Marine Corps) use. Develop this long range compact HPM vehicle/vessel stopper prototype for evaluation to determine its effectiveness in an operationally relevant environment. Support the JNLWD/Marine Corps for test and validation to certify and qualify the system for Joint DoD use.

A compact, long--range vehicle/vessel stopping capability has significant commercial applications beyond the DoD. Other government agencies, such as the Department of Justice (DoJ) and the Department of Homeland Security (DHS), have vehicle and vessel stopping missions. Local civilian law enforcement, specifically has these type of missions to support both port security and vehicle interdiction (car chases). Currently overall system size, weight, and cost have hindered the use of these systems by these agencies. This SBIR topic specifically addresses overall system size, weight, power consumption, thermal cooling, and system cost.

REFERENCES:
1. Law, David B. “Joint Non-Lethal Weapons Program (JNLWP) - Next-Generation Non-Lethal Directed Energy Weapons and Enabling Technology Portfolios.” National Defense Industrial Association (NDIA), 2016 Armament Systems Forum, Fredericksburg, Virginia, 25-28 April 2016. http://spie.org/news/6484-next-generation-non-lethal-technologies?SSO=1

2. Taylor, Clayborne D. and Giri, D.V. “High-Power Microwave Systems and Effects.” CRC Press, 1st edition, June 1, 1994. https://www.amazon.com/Microwave-Systems-Effects-Electromagnetics-Library/dp/1560323027

3. Cadilhon, Baptiste et al. “Ultra Wideband Antenna for High Pulsed Power Applications.” CEA, avenue des Sablieres, Le Barp, France (www.intechopen.com): 2011. https://www.intechopen.com/books/ultra-wideband-communications-novel-trends-antennas-and-propagation/ultra-wideband-antennas-for-high-pulsed-power-applications

4. Camacho, Joseph P. “Federal Radar Spectrum Requirements.” National Telecommunications and Information Administration (NTIA) Special Publication 00-40: May 2000. https://www.ntia.doc.gov/files/ntia/publications/ntia00-40.pdf

5. Drozd, Andrew L. “Spectrum-Secure Communications for Autonomous UAS/UAV Platforms.” MILCOM 2015 Symposium. Tampa, Florida: 26-28 October 2015. https://www.afcea.org/events/documents/MILCOM2015PPTDrozd-ANDROIII.pdf

KEYWORDS: Directed Energy; High Power Microwaves; HPM; Ultra-wideband; Wideband HPM; Vehicle Stopper; Vessel Stopper; Non-Lethal Weapons; NLW

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-003 TITLE: Powered Paraglider with Increased Capabilities

TECHNOLOGY AREA(S): Air Platform

ACQUISITION PROGRAM: Airborne Reconnaissance Equipment

OBJECTIVE: Develop a powered paraglider capable of launching reconnaissance forces from naval shipping and transiting to shore.

DESCRIPTION: Current powered paragliders (PPGs) are generally used as recreational vehicles in the United States and Europe with most of the manufacturing taking place in Europe. Current PPGs are generally either foot or wheel launched. PPGs in the United States are regulated by the Federal Aviation Administration (FAA) under Federal Aviation Regulation (FAR) Part 103: Ultralight Vehicles. FAR Part 103 limits PPGs to operating during hours of daylight, weigh less than 254 pounds empty, have a fuel capacity not exceeding 5 U.S. gallons, are not capable of more than 55 knots of calibrated airspeed at full power in level flight, and have a power off stall speed which does not exceed 24 knots calibrated airspeed.

A PPG's major components consist of a fabric wing, harness, cage, propeller, and motor. Current commercial PPGs could be improved in various areas to meet the Marine Corps requirements. Technologies from outside the commercial PPG environment could be merged to increase performance and/or automation. Developing a PPG capable of transporting a person and 80 lbs. of equipment could replace current non-powered parachutes. The PPG must include reliability and safety systems for personnel use as well as a methodology for ship launches. Proposed approaches can utilize parameters outside FAA FAR part 103. Proposed PPGs should meet the following performance specifications:

Launch method: Threshold (T) Foot launched, Objective (O) Air launched
Flight ceiling: (T) 5,000 feet Mean Sea Level (MSL), Objective (O) 10,000 ft. MSL
Weight capacity not including PPG: (T) 105-300 lbs., (O) 105-330 lbs.
Range: (T) 165 nautical miles (nm), (O) 220 nm
Propulsion: (T) internal combustion engine, (O) Electric

PHASE I: Develop concepts for a PPG meeting the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs and establish the concepts for development into a useful product for the Marine Corps. Establish feasibility through material testing and analytical modeling, as appropriate. Provide a Phase II development plan with performance goals and key technical milestones and that addresses technical risk reduction.

PHASE II: Develop a prototype for evaluation. Evaluate the prototype to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the PPG. Demonstrate system performance through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Use evaluation results to refine the prototype into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop a PPG for evaluation to determine its effectiveness in an operationally relevant environment. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

PPGs with increased capabilities outside FAA FAR part 103 could be used by other agencies for a less expensive alternative to drones, helicopters, and other aircraft. PPGs with increased capabilities may also have use on the recreational market.

REFERENCES:
1. Jovicic, Stevan, Tirnanic, Saša, Ilic, Zoran & Brkljac, Nenko. " APPLICATIONS OF POWERED PARAGLIDERS IN MILITARY, POLICE SPECIAL FORCES, SEARCHING AND RESCUE UNITS". 6th International Scientific Conference on Defensive Technologies, Belgrade, Serbia, 9-10 October 2014. 10.13140/2.1.1245.9529.

2. Nagy, Andras and Rohacs, Jozsef, "UNMANNED MEASUREMENT PLATFORM FOR PARAGLIDERS." 28th International Congress of the Aeronautical Sciences, 2012.

http://www.icas.org/ICAS_ARCHIVE/ICAS2012/PAPERS/832.PDF

3. Goin, J. The Powered Paragliding Bible 5: A Complete Guide and Reference for Paramotor Pilots. Polk City, FL: Airhead Creations dba FootFlyer.com, 2018. https://books.google.com/books/about/The_Powered_Paragliding_Bible_5.html?id=vnekswEACAAJ

4. Behar, Michael. "The Icarus Race: Into the Wild With a Fan on Your Back". Air & Space Magazine, September 2017. https://www.airspacemag.com/flight-today/icarus-race-180964345/

KEYWORDS: Paraglider; Electric; Motor; Ultralight Vehicle; Powered; Engine

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-004 TITLE: Small High-Speed Amphibious Role-Variant Craft (S.H.A.R.C.)

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: Mines and Countermeasures (MCM)

OBJECTIVE: Develop a small high-speed watercraft that can serve as a littoral surface connector capable of delivering smaller autonomous, remote, and manned vehicles and systems; and would have a rail system to attach modular mission packages for operations directly from the vessel or decking that supports vehicles containing modular mission packages. This solution supports the President's National Defense Strategy by providing:

- Joint lethality in a contested environment
- Forward force maneuver and posture resilience
- Advanced autonomous systems
- Resilient and agile logistics

Per the Commandant's Guidance this solution provides for:

- Expeditionary Advanced Basing Operations (EABO)
- Littoral Operations in a Contested Environment (LOCE)
- Naval Integration
- Mine Countermeasure Forces
- Amphibious Capability
- Lethal Long-Range Unmanned Systems
- Stand-In Forces
- Affordable Cost
- Deceiving the Enemy

DESCRIPTION: A "21st century Higgins Boat" capability is needed to serve as littoral connectors to support the landing of smaller remote autonomous systems for expeditionary advanced base operations. The development and proliferation of long-range precision weapons by peer competitors—China and Russia—have changed amphibious warfare by pushing ships farther from the coastlines. Both the long-range capability and low cost of these weapons require the DoD to develop smaller faster littoral connectors to deliver low–cost, autonomous systems. This platform would enable the delivery of smaller land vehicles, weapon systems, fuel bladders, water, and electric generation equipment. These payloads could be offloaded to support long-term advanced naval bases or operated from the watercraft to support short team Expeditionary Advanced Bases (EABs). The modular payloads could also include unmanned aerial systems (UAS) and unmanned underwater systems (UUS) launchers that could deliver unmanned systems distant from the shoreline.

Multiple commercial high-speed watercraft exist in the market that meet some of the specifications listed below. They are essentially current versions of World War II Higgins Boats. These partially meet the specifications and through moderate engineering can meet a significant portion of the requirements.

The parameters of the vessel include the following;
-Width of deck and front ramp 60 inches at narrowest point
-Length of deck from aft to stern 156 inches
-Must have a deck rail system to tie down modular mission packages
-Able to power external modular mission packages
-Payload capacity 10,000 lbs.
-Range ~200 nautical miles at full throttle with max payload
-Speed >25 knots at payload capacity
-Draft <30 inches when fully loaded
-Able to land and unload vehicles onto land without use of dock
-Capable of autonomous/remote control operation

PHASE I: Develop concepts for an improved smaller high-speed amphibious role-variant craft that meets the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs and establish that the concepts can be developed into a useful product for the Marine Corps. Establish feasibility through material testing and analytical modeling, as appropriate. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Develop a scaled prototype for evaluation. Evaluate the prototype to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the smaller high-speed amphibious role-variant craft. Demonstrate system performance through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Use evaluation results to refine the prototype into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop smaller high-speed amphibious role-variant craft for evaluation to determine its effectiveness in an operationally relevant environment. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

The system has the ability to support commercial logistics operations. One potential application could be the movement of equipment and supplies between off-shore energy production platforms: oil, wind turbines, wave-motion. It may also be used to offload cargo from ships to shore.

REFERENCES:
1. Freedburg Jr., Sydney. “Marines Need Speed from Ship to Shore.” Breaking Defense, July 2019. https://breakingdefense.com/2017/10/marines-need-speed-from-ship-to-shore/

2. King, Doug and Friedman, Brett. “Why the Navy Needs a Fighting Connector: Distributed Maritime Operations and the Modern Littoral Environment.” War on the Rocks, 31 July 2019. https://warontherocks.com/2017/11/navy-needs-fighting-connector-distributed-maritime-operations-modern-littoral-environment/

3. Dove, Rita. "Lady Freedom among Us." The Electronic Text Center, Alderman Lib., U of Virginia, 19 June 1998. (David Seaman, ed.) http://etext.lib.virginia.edu/subjects/afam.html

4. Berger, General David H. “Commandant’s Planning Guidance, 38th Commandant of the Marine Corps.” July 2019.
https://www.hqmc.marines.mil/Portals/142/Docs/%2038th%20Commandant's%20Planning%20Guidance_2019.pdf

?ver=2019-07-16-200152-700

5. Matis, James. “2018 National Defense Strategy: A Summary.” 2018. https://www.hsdl.org/?view&did=807329

6. Department of Defense. MIL-STD-810G, Environmental Engineering Considerations and Laboratory Tests. 31 October 2008.

KEYWORDS: High Speed Watercraft; Landing Craft; Small Surface Connector; Utility Craft; Amphibious Craft; Utility Watercraft; Littoral

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-005 TITLE: Wireless In-Ear Sensors for Warfighter Monitoring

TECHNOLOGY AREA(S): Biomedical, Human Systems

ACQUISITION PROGRAM: NAE Chief Technology Office

OBJECTIVE: As a means to monitor factors contributing to warfighter readiness, develop wireless sensors that can be integrated into commercial off-the-shelf (COTS) earplugs to enable continuous in-ear monitoring of warfighter noise exposure and physiological status.

DESCRIPTION: Hearing protection devices are mandatory for warfighters operating in noisy environments to reduce their exposure to potentially damaging noise levels. These hearing protection configurations often involve the use of earplugs. Earplugs used by warfighters range from COTS, disposable, universal-fit foam earplugs to reusable, custom-molded earplugs fit to the individual. Communications and Active Noise Reduction (ANR) technologies incorporated into in-ear hearing protection are working, but the earplug could serve as a platform to collect a large amount of valuable data from the warfighter via the ear. Data to collect includes: noise dosimetry, head vibration/bone conduction effects, ear canal pressure, head acceleration, and physiological data such as heart rate, body temperature, and pulse oximetry.

The Navy seeks a cost-effective system to collect warfighter data from the ear using wireless sensor capabilities. The initial focus of this SBIR effort should be binaural in-ear noise dosimetry, with the capability for the system to integrate additional sensors to capture supplementary types of data mentioned above. The sensors should be miniaturized to easily fit deep (beyond the second bend) inside most ear canals and capable to be used with a variety of earplugs (e.g., COTS foam/flange, custom fit). The proposer should conduct analysis to ensure it is safe for human in-ear use with potential risks and mitigations identified. Methodologies used to ensure safe-for-human use should be presented. A description of insertion and removal processes should be provided. The miniature wireless sensors should be durable enough for repeated use, but cost-effective so that they may be replaced if damaged or lost. The system should be acoustically transparent so as not to alter the noise attenuation of the earplug, thus allowing for accurate analysis of the earplug performance.

The rate of data collection for the system should allow for continuous monitoring of the warfighter, with the data transmitted wirelessly to a recording device to capture exposure vs. time for subsequent analysis, with the preferred ability to conduct live monitoring of data when desired. All components of the system worn on the head must fit under helmets (HGU-68/P, HGU-84/P, and HGU 56/P) and earmuffs (Aegisound DC2, Aegisound Argonaut, David Clark maintainer headsets, David Clark aviation headsets) without interfering with the attenuation properties of these devices. The proposer should clearly identify and discuss any expected calibration process of the entire system, including sensors. For noise dosimetry applications, the dynamic range of the system must comply with, but not be limited by, ANSI S1.25. Consideration should be made on collecting both in-ear and external continuous noise levels [70 – 140 dB], as well as capabilities to collect noise doses in impulse noise environments [140-170 dB peak sound pressure level (SPL) ambient noise]. The device must be suitable for aviation and shipboard environments. Initial focus should be on compatibility with universal and custom fit earplugs (ex. Sound Guard, EAR Classic, Elvex Quattro, Westone solid custom molded, and Westone CEP tips). Consideration would be given to a multi-sensor suite built into an earplug for use with the system as a long-term solution.

It is preferred that reusable components of the system not exceed $1,000 per unit and any small in-ear components or disposable units should not exceed $150. It is understood that prototypes and low quantity production of the system may be higher than these limits. The projected cost of the production units will be given careful consideration. The proposer should provide a cost-benefit analysis for anything exceeding these values.

Note: If required, NAVAIR will provide Phase I performers with the appropriate guidance for human research protocols so that they have the information to use while preparing their Phase II Initial Proposal. Institutional Review Board (IRB) determination as well as processing, submission, and review of all paperwork required for human subject use can be a lengthy process. As such, no human research will be allowed until Phase II and work will not be authorized until approval has been obtained, typically as an option to be exercised during Phase II.

PHASE I: Design wireless in-ear noise dosimeters for use with readily available COTS earplugs. Demonstrate proof of concept of critical features of the design through computational modeling or experimental testing. Outline concept for additional monitoring capabilities. Develop integration and calibration methods, and cost estimates. The Phase I effort will include prototype plans to be developed under Phase II.

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II, should it be required.

PHASE II: Develop and produce ten functional prototype wireless in-ear noise dosimeters and demonstrate/validate their performance with several types of COTS earplugs (foam, flange, custom-molded). Expand upon and investigate the concept of miniaturized wireless sensors beyond noise dose monitoring to cover other forms of personnel monitoring that could be done via the ear. Develop lifecycle cost and supportability estimates of such sensors.

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II, should it be required.

PHASE III DUAL USE APPLICATIONS: Transition technology into production via sales to the Department of Defense and through commercial sales.

Wireless earplug sensors and the data obtained from them would be invaluable to both military and civilian communities that seek methods to monitor personnel in the field and evaluate real-world performance and safety of COTS earplugs. Further development in miniaturized wireless dosimeters and other sensors (sensors for blood pressure, temperature, heart rate, blood oxygenation, stress, etc.) would have many applications in numerous industries in the civilian sector.

REFERENCES:
1. “Hearing Conservation Program.” Department of Defense, Navy and Marine Corps Public Health Center, 2010. https://www.med.navy.mil/sites/nmcphc/Documents/oem/dodi-6055-12.pdf

2. “MIL-STD-1474E Design Criteria Standard Noise Limits.” Department of Defense, Army Research Laboratory, 2015. https://www.arl.army.mil/www/pages/343/MIL-STD-1474E-Final-15Apr2015.pdf

3. “MIL-STD-1472F Design Criteria Standard: Human Engineering.” Department of Defense, Redstone Arsenal, AL, 1999. https://www.denix.osd.mil/shf/references/military-standards/mil-std-1472f-human-engineering/

4. (1992). “ANSI/ASA S1.25-1991 (R2017) Specification For Personal Noise Dosimeters.” Acoustical Society of America, 1999. https://webstore.ansi.org/standards/asa/ansiasas1251991r2017

KEYWORDS: Dosimetry; Monitoring; Hearing Protection; Sensor; Wireless; Earplug

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-006 TITLE: Inclusion Detection in Steel for Bar Stock, Gears, and Bearing Components

TECHNOLOGY AREA(S): Air Platform, Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: PMA231 E-2/C-2 Airborne Tactical Data System

OBJECTIVE: Accurately determine the inclusion content of steel bar stock, gear, and bearing components in finished or semi-finished states by non-destructive means i.e., without the use of traditional destructive method of cross-sectioned specimens.

DESCRIPTION: The Naval aviation community, as owner and operator of aerospace systems, continuously seeks improvement in the manufacturing arena. The Navy occasionally faces issues with inclusions in aerospace components made from high-grade steel. The Navy seeks an innovative, cost-effective, accurate, preferably hand-held, non-destructive technology that would allow inspection of high-grade steel components for inclusion content without destroying the material. This would increase the possibility of identifying non-conforming material and parts early in the production process, minimizing the work expended. For components, the proposer should create a focused method to identify inclusions in critical targeted areas of the load carrying components, which would result in a decrease in the cost to the Government or original equipment manufacturers (OEMs) by removing the need to inspect suspect components by destroying potential conforming components. The innovative technology should be capable of measuring and determining the position of the inclusion content of steel material by non-destructive means. Accuracy targets are requested in the 0.001” particle size with full volume inspection of the material. Maximum material thickness is expected to be no greater than 14” round steel bar stock. Particle location determination is requested within the inspected material. The ability to inspect complex geometries, like gear teeth, is required. The information provided to the operator when using the method should be instantaneous in order to provide feedback on the specific targeted area of material. This method must have the ability to be used in environments including steel manufacturing sites, component production sites and repair facilities. If not possible to be hand-held it will need to be portable enough to allow use on installed components or components outside of stationary or lab-type environments.

Current destructive methods start with a polished sample coupon of material followed by a microscopic visual inspection, or a computer-aided surface inspection. Neither method reviews the material used in the component itself. Only a small section of material is reviewed relative to the component produced. Existing non-destructive methods, like eddy current or CT scan, do not provide the fidelity required to categorize the material to the level desired. The depth of penetration and sizes of particles that can be detected limit the usefulness of the current non-destructive inspection (NDI) technology.

Although not required, it is highly recommended to work in coordination with the OEM to ensure proper design and to facilitate transition of the final technology.

PHASE I: Design and develop a concept for a non-destructive technology allowing a determination of inclusion content within steel bar stock or components. Conduct a breadboard demonstration of the concept. Include size, distribution, and location of inclusions within the bar stock or within identifiable component regions - all desired characteristics for determination - plus inclusion material identification, which is a secondary goal for determination.

The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop and demonstrate a prototype with the capability of the non-destructive detection of inclusions with blind steel samples. Ensure that the demonstration includes production size and grade steel stock. For steel components, demonstrate with in-process (partially finished) and post-production components. Aim for inclusion sizes down to 0.001". Meet the requirement for rapid, near instantaneous analysis of the steel material in the intended environments, which are steel manufacturing sites, component production sites, and repair facilities.

PHASE III DUAL USE APPLICATIONS: Perform final testing that would include on the ground evaluation in fleet/repair/production environments. Transition a fleet ready device or a commercial offering on an inspection device. The intent is to provide higher levels of steel cleanliness verification. With verification of the cleanliness of steel material and components, there is the potential for either longer duration of use with existing designs or higher power density components.

Successful technology development would benefit steel manufacturing, engine/transmission component manufacturers, and construction industries.

REFERENCES:
1. "ASTM E588 -03 Standard Practice for Detection of Large Inclusions in Bearing Quality Steel." ASTM International: West Conshohocken, 2003. https://www.astm.org/DATABASE.CART/HISTORICAL/E588-03.htm

2. Zhang, L. and Thomas, B. "Inclusions in Continuous Casting of Steel. XXIV National Steelmaking Symposium." Univ. of Illinois at Urbana-Champaign, pp. 138-183. http://ccc.illinois.edu/PDF%20Files/Publications/03_Mexico_Nov_Inclusion_review_v5a_updated.pdf

KEYWORDS: Inclusion; Steel; Inspection; Material Cleanliness; Non-Destructive Detection; Sub-Surface

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-007 TITLE: Long-Range Maritime Battle Damage Assessment

TECHNOLOGY AREA(S): Air Platform

ACQUISITION PROGRAM: PMA290 Maritime Surveillance Aircraft

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative radar-based imaging approaches to perform long-range battle damage assessments of ships.

DESCRIPTION: The timeliness, accuracy, and completeness of battle damage assessments (BDA) is critical to the success of any military engagement. BDA have traditionally utilized relatively short-range optical sensors onboard aircraft operating in close proximity. However, the safe airspace access required to observe the target at close range is not possible in anti-access/area denial situations. BDA utilizing long-range radar tracking and imaging is an alternative. Radar does not provide the level of high resolution and high definition consistent with human visual characteristics. As a result, there is a need for innovative approaches to extract comparable information from radar returns for the BDA of ships at sea from ranges that may exceed 50 nautical miles (nmi). Gross changes such as the vessel going dead-in-the-water or rotating antennas ceasing operation are easily discernable with radar. More challenging is determining if the vessel is listing and what type of external structural damage has occurred. Advances are needed in single and multi-channel inverse synthetic aperture radar (ISAR) imaging techniques. Advantages of interferometric ISAR should be considered, as some fielded radar systems are capable of supporting that mode. Consideration should be given to scenarios that allow imaging to be underway immediately prior to weapon impact, at the time of the impact, and at various times after impact. Transition of this product is to be as an appliance within the Navy's Minotaur control application.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Utilize self-generated simulated data to develop single and multi-channel (possibly interferometric) ISAR imaging approaches capable of providing ship BDA comparable in respects to that possible from short-range (20 km or less in mid-latitude oceanic environments) visual imagery. (Note: While computational resource restrictions will not be imposed in Phase I, the product will ultimately be hosted on existing Navy maritime surveillance platforms such as the P-8A, MQ-4C, MQ-8B and MH-60R.) The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Further design and develop the concept identified in Phase I. Working with the sponsor, prepare an at-sea airborne radar collection plan for use during a Navy live fire missile exercise involving a target ship and remote airborne collection platform. Utilize the collected data to mature the techniques explored in Phase I. Provide a complete assessment of the approaches and develop a transition plan.

Work in Phase II may become classified. Please see note in Description paragraph.

PHASE III DUAL USE APPLICATIONS: Mature the algorithms to be suitable for transition to Navy maritime surveillance radar systems or as a capability within the Navy's Minotaur control application. Possible dual use applications include long-range ship imaging and status assessment by organizations like the Coast Guard or possibly commercial radar satellite providers.

REFERENCES:
1. Lim, K. G. "Battle Damage Assessment Using Inverse Synthetic Aperture Radar (ISAR)." Naval Postgraduate School, Dudley Knox Library: Monterey, CA, 2004-12. https://calhoun.nps.edu/bitstream/handle/10945/1223/04Dec_Lim.pdf?sequence=1&isAllowed=y

2. De-yun, Z., Li-na, Z., Kai, Z. and Kun, Z. "Battle Damage Assessment with Change Detection of SAR Images." 34th Chinese Control Conference: Hangzhou, 2015. https://ieeexplore.ieee.org/document/7259637/

KEYWORDS: Battle Damage Assessment; BDA; Long Range Imaging; Ship Imaging; Inverse Synthetic Aperture Radar; Maritime Surveillance; Radar

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-008 TITLE: Augmented Reality and Aircraft Wiring

TECHNOLOGY AREA(S): Air Platform, Electronics, Materials/Processes

ACQUISITION PROGRAM: PMA275 V-22 Osprey

OBJECTIVE: Design and develop the enabling technology to allow universal tagging/marking and database architecture for aircraft wiring identification, visualization, and comparison via a hardware agnostic Augmented Reality (AR) solution.

DESCRIPTION: Ongoing NAVAIR efforts, from production installations to DEPOT maintenance events, require the inspection of thousands of wires, harnesses, connectors, etc. The continually expedited timelines required for these events, paired with the limited human capacity to quickly locate, identify, and correlate those wires to as-is or desired state, has the potential to negatively impact timelines, quality, safety, and readiness.

Current AR systems, including Microsoft HoloLens, Google Glass, and other handheld applications, utilize marker-based or markerless location-based approaches to determine a subject field of view (FOV), query a database for relevant digital information related to that marker or location, and overlay the digital information within a user's field of view. While current methods are effective for some broad commercial applications, they do not possess the necessary fidelity and/or robustness for effective use on aircraft installed wiring systems. Current marker-based approaches have not been validated to meet MIL-W-5088 [Ref 4] and MIL-M-81531 [Ref 5]; markerless location-based FOV solutions lack the visual acuity within confined and complex aircraft spaces. Specific challenges include: variations in harness depth when multiple harness are stacked together within particular aircraft location; camera fidelity and software recognition of individual wires strung through an exposed bundle; and longevity/legibility of potential marker application due to dirt, aircraft fluid, and other debris present during normal military aircraft operation. The goal is to develop a solution that can perform with one or both of the identified methods for FOV identification and overlay, or develop a currently unknown and more appropriate solution. For a marker-based solution, [Ref 4] and [Ref 5] would be met in a manner facilitating marker utilization with no additional manpower requirements from maintainers to find and clean all appropriate markers. For a location-based solution, the proposer should use relative position in the aircraft for FOV identification and overlay. Both of these FOV solutions would need to be paired with a visual hardware and software system sensitive enough to identify proper vs. improper harness routing (based on a 3D model) per [Ref 3] as well as wire type identification for exposed bundles per [Ref 3]. The Navy seeks a solution to quickly identify non-conformances in harness routing for maintainers from production teams, organizational maintenance personnel, and DEPOT artisans and that is hardware agnostic. Additionally, this will improve the execution of engineering change proposals, aircraft-capability upgrade modifications, and major DEPOT Planned Maintenance Intervals (PMI) or Integrated Maintenance Planning (IMP) events like providing immediate updates to aircraft databases to reflect changes. This would allow the AR platform to immediately highlight non-conformances or discrepancies in harness routing, material selection, and issues often missed by human quality assurance personnel. Marking technologies should conform to wire/cable markings requirements outlined in NEMA WC27500 Aerospace and Industrial Cable [Ref 1], SAE AS22759 Aerospace Wiring [Ref 2], and SAE AS5942 Marking of Electrical Insulating Materials [Ref 4]. This would be ideally suited for new acquisition platforms and support equipment as well as any platforms or support equipment preparing to undergo major modifications.

PHASE I: Design, develop, and determine the feasibility of a proposed marking/location-based approach as well as database integration opportunities. Ensure that the marking technologies conform to wire/cable markings requirements [Refs 1, 2, 4]. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Further develop a prototype and demonstrate its application on uninstalled aircraft wiring harnesses within aircraft representative spaces. If available, demonstrate the capability on existing platform and/or platform representative examples, leveraging actual 3D design models and installed harnesses.

PHASE III DUAL USE APPLICATIONS: Perform final development and testing for any marking applicability to include conformance testing to applicable SAE/MIL-STDs. Support final system application testing onboard aircraft with full system test, in coordination with NAVAIR Test and Evaluation.

With the proliferation of AR, digital visual acuity systems, point cloud generation, and artificial intelligence-/machine learning/deep learning-backed virtual visual overlays, the commercial potential for this technology spans any production or modification industry requiring the ability to mark and reference small components vs. individual markers/locations. These industries include the aircraft, automobile, vessel, solar, battery, microprocessor, industrial bulk material, and computer.

REFERENCES:
1. “NEMA WC 27500 - Aerospace and Industrial Electrical Cable.” https://www.nema.org/Standards/ComplimentaryDocuments/REVISEDANSI_NEMAWC%2027500-2015%20Contents%20and%20scope.pdf

2. “SAE AS5649 - Wire and Cable Marking, UV LASER.” https://www.sae.org/standards/content/as5649/

3. “SAE AS22759 (M22759, MIL-W-22759) Mil-Spec Wire & Cable.” Aerospace & Defense: A.E. Petsche Co. (n.d.). http://www.aepetsche.com/products/wire-cable/mil-spec/sae-as22759/

4. “MIL-W-5088 Wiring, Aerospace Vehicle.” Department of Defense: Lakehurst, 1984. http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-W/MIL-W-5088L_11283/

5. “MIL-M-81531 Marking of Electrical Insulating Materials.” Department of the Navy, Naval Air Systems Command, 1967. http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-M/MIL-M-81531_11197/

KEYWORDS: Aircraft; Wiring; Wire; Marking; Augmented Reality; Visualization

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-009 TITLE: Software Framework for Integrated Human Modeling

TECHNOLOGY AREA(S): Biomedical, Human Systems, Information Systems

ACQUISITION PROGRAM: PMA276 H-1 USMC Light/Attack Helicopters

OBJECTIVE: Design and develop an open Application Programming Interface (API) and data fusion framework for the integration of current and future commercial human modeling software; and that has the ability to incorporate the output of commercial off-the-shelf (COTS) digital human modeling and medical modeling software to create a whole-body simulation of a human.

DESCRIPTION: Digital human modeling (DHM) efforts in the DoD have primarily been used to assess ergonomic and human factors situations. The current commercial software on the market is highly specialized toward providing human analysis for narrow tasks and situations. It does not, contrary to the name, typically model the whole human system. The result of this software specialization is a plethora of part-task analysis software that operates mostly independently. Each software by itself is unable to inform the larger picture and holistically model the human system.

For example, existing ergonomic software incorporates anthropometric survey data to accurately model humans with diverse size and shapes. However, the software does not incorporate a variety of other factors that can affect the interpretation of an ergonomic analysis. Combining anthropometric data with musculoskeletal modeling data and injury modeling data would enable the generation of a highly accurate human reach envelope for both normal and abnormal human avatars. Likewise, dehydration data, hypoxia data, and other stressor data can be combined to provide a more accurate cognitive task analysis for humans operating under abnormal conditions and in stressed environments.

The goal of this SBIR topic is not to replace existing software, but to enhance the ability of the existing software packages to leverage data developed from each other by developing an architectural framework that can incorporate the output of COTS digital human and medical modeling software to build a detailed digital representation of a human. As a more developed and accurate digital representation of a physical human begins to develop, this software can provide input for these existing software packages to provide more accurate task analysis results.

Previous attempts at exploring this issue have met with limited success [Ref 1]. This project should build on previous efforts to form the architecture and underlying framework for a system that would enable the interpretation and storage of human modeling data to be usable on a variety of consumer computer hardware. The proposer should convert the data that is output from various COTS software into an interface agnostic format, easily transformed to other industry formats. For example, the anthropometric and posture data developed in an ergonomics-focused software could be exported into this developed open standard and then be imported into another ergonomic software package, either through the software's support of this open standard or through the transformation of the open standard to a proprietary standard that this software supports. Through this, the project would enable additional functionality in existing COTS software without modification of the underlying software. In addition, this storage of data in an interface agnostic format would allow for the standard representation of a human's physiological state and enable the creation of standard medical use cases, such as through the incorporation of existing open human body modeling standards [Ref 2].

PHASE I: Identify the major factors and attributes that are essential for generating a basic digital model of the human body and its associated components. Identify the initial software packages that will provide the input and output of this human model. Design, develop, and demonstrate a simple proof of concept framework that can ingest at least two sources of data, create a human model, and export the data for use in a COTS task analysis software. The Phase I effort will include prototype plans to be further developed under Phase II.

PHASE II: Develop an extensible and scalable framework for current and future modeling software. Develop the API for ingesting and exporting data from the human system model, and also the graphical user interface (GUI) for examination and manipulation of data stored in the human model. Integrate the major modeling packages task analysis software into the previously developed framework. Identify and incorporate sources of physiology data to better inform the human model.

PHASE III DUAL USE APPLICATIONS: Refine the framework and continue to add capability, in terms of both functionality and support of existing and future COTS software. Develop capability to support modeling in the private industry.

This SBIR topic will result in a framework that will enable cross-collaboration between COTS software. This framework will enhance the value of existing software packages, promote development of new features, and enable interoperability between software packages. Potential use by forensics or the medical community where human modeling would be useful.

REFERENCES:

1. Bonin, D., Wischniewski, S., Wirsching, H., Upmann, A., Rausch, J. and Paul, G. "Exchanging Data Between Digital Human Modeling Systems - A Review of Data Formats." 3rd International Digital Human Modeling Symposium: Tokyo, 2014. https://eprints.qut.edu.au/66306/7/66306.pdf

2. Higgins, G. "The Digital Human: Open Source Software Framework for Organ Modeling and Simulation." Defense Technical Information Center (DTIC): Washington DC:, 2001. https://apps.dtic.mil/docs/citations/ADA399560

KEYWORDS: Medical Modeling; Digital Human Modeling; Statistical Models; Physiology; Data Fusion

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-010 TITLE: Compact Source for Focused and Tunable Narrowband Radio Frequency

TECHNOLOGY AREA(S): Air Platform, Electronics, Weapons

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a compact source outputting a very high power burst of energy in a narrowband and tunable frequency region, which can be carried by a rotary wing aircraft in a small pod and can be utilized for such applications as directed energy high power microwave and electronic attack tactical jamming to disturb, deny, and damage. Perform spectrum agile high-power and short-interval transmissions to advance emerging electronic attack and directed energy weapons through benefits in size, weight, and power (SWaP).

DESCRIPTION: Electronic dominance, specifically airborne, in radio frequency (RF) requires both high power transmissions and frequency agility while maintaining minimal size and weight. Typical approaches to spectrum dominance such as electronic warfare (EW) and high-power microwave (HPM) prove to require a large payload capacity but offer a myriad of frequencies and power levels. Jamming weapons such as pods under fixed wing and rotary aircraft also can perform with spectrum capabilities from 100 MHz to 18 GHz [Ref 1] at various duty cycles. Recent advances in HPM sources coupled with nonlinear transmission lines (NLTLs) have seen gigawatt-class peak radiators in a wide frequency spectrum with low duty cycle [Ref 2]. Use of gyromagnetic NLTLs for HPM generation from 500 MHz [Ref 3] to 5 GHz [Ref 4] is typical. Advances in solid state and traveling-wave tube (TWT) amplifiers have shown kilowatt class outputs in frequencies over 5GHz in compact sizes. The Navy seeks a middle ground solution between HPM and EW for the development of a high-power jammer able to provide prolonged saturation and preferably physical destruction of RF seeker electronics.

Successful technology development should result in an extremely high-power and frequency-tunable jammer source, coupled to an antenna with directivity. Integration of this system must be designed into a pod carried fixed or rotary wing aircraft; pod parameters will be provided in Phase I. The prime power, or power input to the jamming system, will be limited by the pod and associated aircraft link power, such that, to meet the input power requirements of the source, some form of stored energy is required within the pod. The proposer should describe HPM and EW narrowband sources and associated antenna performance parameters in terms of frequency, bandwidth, effective radiated power (ERP), duty cycle/factor, efficiency, and directivity. The ERP objective goal is 10 MW with a threshold goal of 1 MW with a 20° beamwidth threshold goal, 5° objective goal. The duty-cycle objective goal is 20% with a threshold goal of 1%, with the understanding that energy storage is a requirement due to input power constraints, and effects on dwell time. The proposal must consider supplied input power negligible compared with on-state power demand, requiring all energy to be supplied from energy storage. The technology must operate in a tunable frequency span of 300 MHz to 1 GHz threshold, 30 MHz to 5 GHz objective while having a bandwidth at tuned frequency of 5% threshold, 1% objective. Pulse width of the jamming pulse will affect bandwidth.

KEY PARAMETERS

• Tunable Frequency: 300 MHz to 1 GHz / 30 MHz to 5 GHz (Threshold/Objective)
• Bandwidth at tuned frequency: 5% / 1% (Threshold/Objective)
• High power transmitter: 1 MW ERP / 10 MW ERP (Threshold/Objective)
• Duty-cycle: 1% / 20% (Threshold/Objective)
• Efficiency: 60% / 80% (Threshold/Objective)
• Directivity: 20° beamwidth / 5° beamwidth (Threshold/Objective)

PHASE I: Investigate the art of the possible for narrowband, very high power, RF tuning and delivery. Identify vulnerabilities in target system electronics for several candidate systems (communication, radar). Develop a conceptual design for a middle ground pod jamming solution between EW and HPM meeting the requirements in the Description. Include methodology and potential prototype performance that will demonstrate the proposed concept with the output pulse parameters as described. Conduct a sub-scale component demonstration. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop detailed designs for a prototype system that improves performance parameters that meet Navy requirements as specified in the Description. Build a prototype system, according to this design, that meets threshold parameters at a minimum. At a Navy test facility demonstrate that the prototype delivers, or is scalable to deliver, the requisite power and RF spectrum to damage three candidate systems at tactically relevant and significant ranges as agreed upon by Government sponsor and proposer. Report performance results.

PHASE III DUAL USE APPLICATIONS: Finalize development based upon Phase II outcome and transition to appropriate platforms and commercial industries. Advanced electronic attack and HPM techniques have been used for counter-improvised explosives and counter-unmanned aerial vehicles systems, which benefits the defense industry. Advanced NLTLs will enhance the telecommunication industry by easing requirements of amplifiers.

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KEYWORDS: Amplifier; Directed Energy; DE; Electronic Warfare; EW; High Power Jammer; High Power Radio Frequency; HPRF; High Power Microwave; HPM; Narrowband; NB; Next Generation Jammer; NGJ; Non-Linear Transmission Line; NLTL; Pulse Repetition Frequency; PRF; Radio Frequency; RF; Solid State; Traveling-Wave Tube (TWT)

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-011 TITLE: Minimization of Chronic Neck Pain in Military Aircrew and Vehicle Occupants

TECHNOLOGY AREA(S): Biomedical

ACQUISITION PROGRAM: PMA276 H-1 USMC Light/Attack Helicopters

OBJECTIVE: Design and develop computational models to understand and analyze acute and chronic neck pain for combat air vehicle pilots and occupants taking into consideration the interaction between seating systems, posture, and body-borne equipment and the generation of neck pain. Included in this effort is the requirement to develop an aircrew specific neck pain scale.

DESCRIPTION: Pilots and crew of combat air vehicles, including fixed-wing attack, fighter, and rotary-wing aircraft, can be exposed to inertial and task position stressors that generate pain. Repeated painful exposures with or without tissue damage are precursors to pain sensitization and chronic pain. Chronic pain leads to reduced operational readiness and long-term medical treatment. In his 25 SEPT 2017 letter, VADM Shoemaker called for "research to better understand, prevent and treat the musculoskeletal consequences of helicopter service." The Navy needs a means of protection to minimize the development of chronic neck pain while maintaining short duration, high onset acceleration protection afforded by ejection and crashworthy seating. Equally important, though less well understood, is the contribution of long-duration, static/quasi-static loading to chronic pain development. Current seating systems designed to be a 'one-size-fits-all' with minimal adjustability were intended for short and moderate duration exposures. Aircraft seating systems encompass a range of seat back angles from 0 degrees (vertical) to 17 degrees pitched back and seat pan angles from 0 degrees (horizontal) to 12 degrees pitched-up. Seated postures vary ranging from long periods holding the same position while visually scanning the area or instruments through turning to look over their shoulders ("check six" position). All the while, aircrew are restrained in their seats for missions as long as 12 hours and must be able to reach switches and controls overhead, behind, to the side, and in front of them. Aircrews are often outfitted with performance enhancement devices that are mounted to the helmet, e.g., night vision devices, that increase the load and moment on the cervical spine.

An optimal protective approach would take into account variability of operator anthropometry; the physical, inertial loading exposures of air combat vehicles [Ref 3]; the task posture of the operator (often hunched forward with right elbow on the thigh); the relevant specific neck/spinal anatomy; head-support mass and its center of mass; and the mechanisms of pain associated with neck pain. The Navy has a strong need to analyze and quantify the influence of various mechanical stressors (vibration from 1 to 20 Hz, buffeting [Ref 3]) on pilot injury potential and to develop novel designs of occupant seating and restraint systems that reduce spinal injury and chronic pain risk to all aircrew sizes during routine and catastrophic events. Computational models and parametric simulations are required to determine potential contributors to acute and chronic operator neck pain and the specific pain mechanisms involved. Given the challenge of relating mechanical stresses to associated pain, it is suggested that proposers include a neurologist experienced working with pain patients as a consultant. Computational models should be structured such that recommendations toward improvements to seating (position, seat-back angle), helmet (weight and center of mass), and restraint systems (e.g., combined shoulder / lap belt), postures [Ref 6] and operational guidelines are possible. The models should also be able to determine the predicted design(s) efficacy.

Customized versions of rating scales/questionnaires for aircrew, such as an aircrew specific Neck Disability Index (NDI), would be helpful for healthcare providers who serve aviators in order to better and more quickly recognize complaints, identify the problem, and monitor the efficiency and effectiveness of treatment. Unfortunately, NDI does not include any occupation-related neck pain questions and under-reports the severity and disability of flying-related neck pain [Ref 1]. A customized version of a pain rating scale is required due to their occupational challenges in military environment and the need for operational readiness. Higher expectations and needs exist for military aviators with regard to medical fitness compared to civilian aviators due to the many extreme situations they may face, ranging from combat missions requiring helmets with night vision or cuing systems, high-G emergency handling to Survival, Evasion, Resistance, and Escape (SERE) situations.

PHASE I: Design, develop, and determine the feasibility of using human biomechanical models to expose a simulated occupant to inertial and positional stressors, simulating the effect on the neck and onset of pain and predicting the spinal sensitization and pain time course. Develop a preliminary aircrew neck-pain scale. The Phase I effort will include plans to be developed under Phase II.

PHASE II: Develop a human biomechanical model accounting for anthropometric variation of military population (5th to 95th percentiles for height and weight), including gender-related factors. Include models of seating (geometry and cushions), restraints, cockpit geometry, and protective clothing / equipment; the target platform includes fast jet tactical aircraft (e.g., F/A-18). Validate the combined model against published data, including but not limited to the references listed below. Use the model to analyze existing operational procedures and propose improved operational guidelines. Validate the aircrew neck-pain scale. Develop a prototype of the most promising protective concept that provides adaptive seating, comfort and adjustability for the maximum range of anthropometric sizes. Conduct experimental testing and evaluation.

PHASE III DUAL USE APPLICATIONS: Conduct operational unit evaluation of the prototype and implement necessary design changes. Re-evaluate the predicted performance based on implemented changes and revise the prototype based on results of evaluation until desired optimum protection is achieved.

In addition to operators of land and sea combat vehicles, operator neck pain is a problem in the commercial transportation field. Such a protective capability would be valuable in mitigating the development of pain and chronic neck pain for operators of commercial air, land and sea vehicles. Commercial shipping, air and trucking industries could all benefit from the developed technology.

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KEYWORDS: Neck Pain; Human Modeling; Neck Pain Scale; Anthropometric Variants; Neck Pain Stressors; Adaptive Seating

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-012 TITLE: Multi-Octave, High Power Efficiency Active Electronically Scanned Array (AESA)

TECHNOLOGY AREA(S): Air Platform, Electronics, Ground/Sea Vehicles

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop electronically steerable radio frequency (RF) transmitters over multi-octave bandwidth yet with optimum power efficiency to achieve simultaneous multi-octave bandwidth high-efficiency performance.

DESCRIPTION: Electronically steerable RF transmitters are highly demanded in battlefield communication and electronic warfare systems. Traditional approaches are mostly based on phased arrays in which phase shifters are used to steer the antenna beam and power amplifiers are used to provide the transmitted power. Such architectures, however, suffer in several aspects when multi-octave operations are needed. The grating lobes of antenna array may appear at the higher end of the operating band and destroy the aperture efficiency while the mutual coupling between the antenna elements in the lower end of the band may negatively affect the antenna to transmitter impedance match and thus the radiation efficiency. On the other hand, the trade-off between bandwidth and efficiency in any RF transmitter often must be made according to the famous Bode-Fano limit, which indicates that a good impedance match to a high-Q load cannot be achieved over a wide bandwidth. For this reason, multi-octave RF power amplifiers (PA) are usually not efficient as the existence of transistor parasitics limits the impedance match bandwidth unless a sub-optimal impedance matching condition is used. Similarly, in antenna systems, the form factor constraints often require high-Q, narrow band antenna elements rather than broadband antennas. Multi-octave impedance match to a single antenna is usually impossible. A conventional Ultra-Wide Band (UWB), electronically steerable RF transmitter can thus not be efficient for the above reasons, which in turn limits its maximum operating power for a fixed design of heat dissipation. Tunable components that may tune the matching between antenna and power amplifier to adapt to its operating frequency have been proposed. These components are mostly in the form of switches or variable capacitors made of microelectromechanical systems (MEMS) or phase change material, which may suffer limited power handling and add additional power loss caused by the tuning mechanisms.

Develop a novel, power-efficient, multi-octave electronic steering antenna array architecture that integrate power amplifier and antennas simultaneously for both bandwidth and efficiency while using a power amplifier network to generate a phase slope required for electronic scanning.

PHASE I: Design, develop, and demonstrate an efficient transmitter and antenna array architecture that allows efficient transmission of RF signal with more than 40 dBm power and with the overall system power efficiencies over 50% from 2GHz to at least 4GHz, preferably 8GHz, while being electronically steerable over at least +/-45 degrees. Identification of the appropriate electronics technologies and antenna design must be made during this phase, with feasibility demonstrated through simulation results. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Further develop and perform hardware demonstration of the Phase I concept and the predicted performance in a small scale, with aperture size equivalent to four to eight element phased array. Ensure that the minimum antenna gain will be no less than the ideal aperture gain by 3dB. Prepare the metrics of evaluation that include a chart of power efficiency as a function of both frequency and scanning angle.

PHASE III DUAL USE APPLICATIONS: Integrate Phase II designs to test installed on an aircraft platform with a goal of maintaining RF performance from Phase II in an installed aircraft environment. Successful technology development would benefit airborne- and ground-based radar systems, aviation, and large communication base stations.

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KEYWORDS: High-Bandwidth; High-Efficiency Antenna Array; Multi-Octave Transmitter; Integrated Antenna Array With Power Amplifiers

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-013 TITLE: High Power Quantum Cascade Lasers in the Spectral Range between 3.8 and 4.1 Microns

TECHNOLOGY AREA(S): Air Platform

ACQUISITION PROGRAM: PMA272 Tactical Aircraft Protection Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop quantum cascade lasers in the in the 3.8-4.1 micron wavelength range with high output power and brightness.

DESCRIPTION: High-power, cost-effective, compact, and reliable mid-wave infrared (MWIR) Quantum Cascade Laser (QCL) platforms operating in the continuous wave (CW) regime are highly desirable for current and future Navy applications. Individual QCLs emitting within the 4.6-5 micron wavelength band with about 5 Watts CW output power and a wall-plug efficiency of about 20% at room temperature (RT) have been demonstrated [Ref 1]. Another shorter MWIR spectral band between 3.8 and 4.1 microns is of interest for Naval applications. The atmospheric transmission in this band is about 45% to 50% higher than that of the 4.6-5 micron spectral band.

Furthermore, when QCLs emitting in both of the MWIR bands are beam-combined, higher emission power of QCLs in the 3.8-4.1 micron wavelength band [Ref 2] could alleviate the emission power, and their size, weight, and power (SWaP) dissipation requirements of QCLs in the 4.6-5 micron wavelength band. Despite their importance, very little technology development and advancement have been made for QCLs emitting in the 3.8-4.1 micron MWIR band, in stark contrast to their counterparts in the 4.6-5 micron band.

Therefore, the QCL performance in the 3.8-4.1 micron band significantly lags those in the 4.6–5 micron band. The highest reported continuous wave wall-plug efficiency is less than 7% [Ref 2] and typical CW optical power for commercial state-of-the-art 4-micron QCLs is less than 1 Watt (W) [Ref 2]. The performance and thermal characteristics of the QCLs in the shorter end of 4 micron spectral range are significantly poorer compared to those at the 4.6 micron range due to the following critical factors.

1. To accommodate the larger transition energies (shorter emission wavelengths), strong confinement of carriers in QCL active regions is necessary to curtail excessive carrier leakage through parasitic energy states located above the upper laser level. Strong carrier confinement requires deeper wells and taller barriers, which in turn creates highly strained epitaxial layers, which need optimized crystal growth conditions to prevent misfit dislocations within the laser core.
2. The high strain layers (with strain >1.5%) layers throughout the QCL core region [Ref 2] result in significantly lower thermal conductance [Ref 3] which, in turn, gives rise to wide electroluminescence spectra and subsequently high threshold-current densities, as the temperature of the active region rises [Ref 2].
3. Factors (1) and (2), combined with inherently higher drive voltages, have led to the CW power and wall-plug efficiency values of the QCLs in the 3.8-4.1 micron band to being only a small fraction of those of the QCLs in the 4.6-5 micron band.

Therefore, in order to significantly increase the CW power and wall-plug efficiency of 3.8-4.1 micron-emitting QCLs, compared to those so far obtained from conventional-design QCLs, it is the goal of this program to develop new active-region designs, similar to the shallow-well [Ref 4], the step-taper-active structure [Ref 5], or other innovative structures that will deliver temperature insensitive and CW output power device performance in the 3.8-4.1 micron wavelength range that is comparable to lasers operating in the 4.6 to 5 micron band. It is also the goal of this program to demonstrate greater than 1,000 hours laser lifetime performance. If active cooling of the laser is necessary, cooling using thermal-electric cooler technology for room temperature operation is highly preferable.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design a QCL emitting in the 3.8-4.1 micron wavelength range at room temperature with 5 W minimum CW power, 15% minimum CW wall-plug efficiency, and nearly Gaussian beam with beam propagation ratio (M2) less than 1.5 showing a path to meeting Phase II goals. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Optimize the QCL design from Phase I. Fabricate and fully characterize prototype QCLs in the 3.8-4.1 micron wavelength band with the minimum performance levels reached. Demonstrate a QCL prototype to meet all requirements. Demonstrate a QCL lifetime >1,000 hours with the performance criteria stated in Phase I.

It is probable that the work under this effort may become classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Fully develop and transition the high performance QCLs with the specifications stated in Phase II for DoD applications in the areas of Directed Infrared Countermeasures (DIRCM), advanced chemicals sensors, and Laser Detection and Ranging (LIDAR). The DoD has a need for advanced, compact, high performance MWIR QCL in Band IVA (3.8 – 4.1 micron) of which the output power can readily be scaled via beam combining for current and future generation DIRCMs, LIDARs, and chemicals/explosives sensing.

The commercial sector can also benefit from this crucial, game-changing technology development in the areas of detection of toxic gas environmental monitoring, and non-invasive health monitoring and sensing.

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KEYWORDS: Quantum Cascade Lasers; QCL; Band IVA; Band IVB3.8 Micron; 4.1 Micron; Mid-wave Infrared; Continuous Wave

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-014 TITLE: Compact Long-Wave Infrared Hyperspectral Imager with Monolithically Integrated Tunable Optical Filter

TECHNOLOGY AREA(S): Air Platform

ACQUISITION PROGRAM: PMA263 Navy and Marine Corp Small Tactical Unmanned Air Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate a battery operated ultra-compact long-wave infrared hyperspectral imager (HSI) with monolithically integrated tunable optical filter for detecting targets and threats in cluttered environments.

DESCRIPTION: Recent technological advances have made long wave infrared (LWIR) hyperspectral imaging (HSI) in the 8-12 micrometer wavelength range into a viable technology in many demanding military application areas where materials can be identified by their spectral signatures [Refs 1, 2]. In particular, the operational utility of HSI for detection, recognition and identification of hard-to-detect targets in environments cluttered with background noise is especially critical. Spectral imaging can aid the detection, acquisition and tracking of a potentially camouflaged, low-signature target, such as an unmanned aerial vehicle (UAV) during counter-UAV surveillance, etc., with significantly improved accuracy that cannot otherwise be detected using more conventional imaging means. LWIR spectral range is advantageous for penetrating fog, dust, and aerosols.

Conventional HSI systems [Refs 1, 2] tend to use large, bulky optical elements, such as a Michelson interferometer or other tunable optical filter components to spectrally resolve the input optical signals, and therefore usually have the characteristics of significant size, weight, and power (SWaP) consumption, mechanical complexity, as well as non-compliance with military specifications. Furthermore, the mechanical mechanism of the conventional tunable filtering system gives rise to slow spectral speed and thus, slow imaging speed. As a result, conventional HSI systems do not lend themselves to the field applications that require handheld portability and faster response times.

The goal of this effort is to develop a compact, LWIR HSI system based upon the monolithic integration of a tunable optical filter with a large-format LWIR focal plane array (FPA). The FPA should be based on either II-VI Mercury Cadmium Telluride materials, or III-V strained layer super lattice (SLS) structures. The tunable optical element can be a micro-electro-mechanical systems (MEMS)-based tunable Fabry-Perot filter or other hyperspectral tunable filter monolithically integrated with the FPA. The development effort also needs to include the necessary read-out and programmable electronics integrated with the monolithic FPA and tunable filter ensemble to enable real time spectral image processing.

System required parameters include:
1. Tunable wavelength range: 8-12 microns
2. Array size: at least 320 x 256 pixels
3. Pixel pitch: 12 microns or less
4. Tunable filter peak transmission: >55%
5. Tunable filter full-width at half-maximum: 500 nm or less
6. Tunable filter out-of-band rejection: > 15:1
7. Pixel-to-pixel wavelength variation across the FPA: < 4%
8. System weight with batteries: < 6 pounds
9. System size < 60 cubic inches

PHASE I: Design, develop, and demonstrate a compact LWIR HSI with monolithically integrated tunable optical filter to meet specifications identified in the Description. Analyze and model to identify the performance and limitation of proposed technologies. Identify any additional optics and electronics required for the HSI system configuration and operation. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Optimize the designs from Phase I. Provide updated analysis and models for any design improvement. Fabricate and characterize a system prototype to meet design specifications. Demonstrate prototype and provide an operating manual for laboratory and field-testing.

PHASE III DUAL USE APPLICATIONS: Fully develop and transition the compact hyperspectral imager with monolithic tunable optical filter based on the final design for Naval applications in the areas of target detection, recognition, and identification.

The commercial sector can also benefit from this compact hyperspectral imager with fast response time in the areas of detection of toxic gases, environmental monitoring, and noninvasive health monitoring and sensing.

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KEYWORDS: Hyperspectral Imager; Target Detection; Target Identification; Target Recognition; Long-Wave Infrared; Tunable Filter

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-015 TITLE: Autonomous and Intelligent Aircraft Maintenance Technologies

TECHNOLOGY AREA(S): Air Platform, Human Systems, Materials/Processes

ACQUISITION PROGRAM: NAE Chief Technology Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop autonomous Artificial Intelligence (AI)-based systems to work with or alongside aircraft maintainers to reduce manning and/or to augment the abilities of aircraft maintainers.

DESCRIPTION: There is a need to support reliability and maintainability of aviation assets that will directly reduce life cycle costs by augmenting or replacing manual operations. The Navy has demonstrated use of smart algorithms combined into optical detection systems to detect, identify, and quantify defects and damage. Augmented reality (AR)/virtual reality (VR) are used in industry today to greatly enhance maintenance and training, and are tools for doing both remotely. The Navy has recently experimented with AR/VR technologies for improved training. In the Navy's Fleet Readiness Centers, robotics are currently used for industrial processes such as coatings removal, coatings application and thermal spray metal repair application to increase precision, quality, and throughput. The Navy has recently demonstrated an autonomous mobile-portable robotic metallization system for on-aircraft maintenance that has shown the effectiveness of such technology deployed to Intermediate level maintenance. All of these technologies have proven to benefit all levels of aircraft maintenance. The next step is to combine AI algorithms, sensors, AR/VR, and/or robotics to develop smart autonomous systems or tools.

The Navy seeks the development of technologies specifically for the aircraft maintenance community to perform functions such as material inspection, non-destructive inspection, coatings inspection and repair, and training. A specific need exists in the maintenance, inspection and repair of special coatings that require precision, where the current methods are manual. The Navy also seeks the development of an AI system to map out damaged areas such as in corrosion maintenance; repair by removing precise layers of coating and then reapply precise layers of coating; and catalog historical data. Autonomous or Intelligent "smart" technologies have the potential to give artisan capabilities to intermediate or field-level aircraft maintainers, utilizing AR/VR to autonomous robots.

The technology, if wearable or handheld, must be minimal size, minimal weight, and the most power. Ideally, if worn or held, it should be lightweight and easy to use, compact as much as possible, ergonomic, and a as long of a battery life as possible or self-powered as this technology will be used in the field. These features are also preferable for a robotic system, but a robotic system must be able to maneuver, manipulate, or traverse around fixed-wing aircraft, rotary-wing aircraft, or unmanned aircraft, of all Type/Model/or Series (TMS). If an autonomous system, it should be capable of finding, fixing, and finishing with minimal or no human interaction.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Assess current aircraft maintenance practices such as cleaning, coatings removal, non-destructive inspection, and corrosion assessment. Determine areas that are candidates for autonomous maintenance, integration of AI, or other smart-based systems such as AR tools. Design, develop, and demonstrate feasibility of an approach. Perform an analysis of alternatives and benefit analysis to meet the requirements laid out in the Description. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop, construct, evaluate, and demonstrate a prototype autonomous AI-based technology or an AR/VR tool or technology for aircraft maintenance based upon the conclusion of Phase I. Perform demonstration of the technology on indicative aircraft structures or test on mock-ups of unmanned aerial systems, fixed-wing aircraft, or rotary-wing aircraft. Demonstrate prototypes in a lab environment with the anticipation of deployment to the field.

Work in Phase II may become classified. Please see note in Description paragraph.

PHASE III DUAL USE APPLICATIONS: Demonstrate and evaluate the technology on a demonstration aircraft. Transition the technology into an active Marine Corps Squadron or Navy Squadron, or Fleet Readiness Center/Depot, for implementation into the Navy. The technologies developed would apply directly to the commercial aviation industry, general aircraft maintenance, as well as potential broad application in the coatings industry.

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KEYWORDS: Autonomous; Artificial Intelligence; Virtual Reality/Augmented Reality; Robotics; Sustainment; Readiness

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-016 TITLE: Mid-Wave Infrared Fiber Amplifier

TECHNOLOGY AREA(S): Air Platform

ACQUISITION PROGRAM: PMA272 Tactical Aircraft Protection Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate a high-power mid-wave infrared (MWIR) fiber amplifier for quantum cascade lasers (QCLs) capable of output power scaling up to 1 kilowatt (kW).

DESCRIPTION: High power mid-wave infrared (MWIR) laser sources in the wavelength range of 4.6 to 5 micrometers are of great interest in defense applications. A major limitation to developing these sources is the lack of materials that lase directly in the MWIR. Materials that do lase directly in the MWIR are either inefficient, require cryogenic cooling, or have other challenges. Correspondingly, most high-power laser systems in this wavelength region rely on the use of nonlinear conversion processes, resulting in low efficiencies and high size, weight, and power (SWaP). Recently, QCLs [Ref 1] have emerged as a viable direct source, offering MWIR lasers for naval infrared countermeasure (IRCM) applications with increased performance. However, relatively low electrical-to-optical efficiencies of these QCL devices have resulted in approximately over 75-80% of the electrical energy input to the QCL dissipated as heat.

Future-generation IRCM systems and missile defense may benefit from the use of MWIR IRCM lasers with kW capability. None of today's commercially available QCLs and beam combining schemes are capable of delivering up to and beyond kW output power levels with diffraction limited beam quality. It is therefore the goal of this SBIR topic to further the development of MWIR rare earth-doped fiber amplifiers [Ref 2] for QCLs that potentially will reach kW level in continuous wave regime with excellent beam quality (M2 <1.5) and high slope efficiency. The successful demonstration of a MWIR fiber laser amplifier for QCL devices would serve to advance any application requiring higher power QCL performance.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design and analyze a best-performance MWIR fiber amplifier architecture in the wavelength range of 4.6 to 5 micrometers. Demonstrate fiber-based amplification of a QCL based on the best available rare earth-doped chalcogenide fiber and laser diodes or fiber lasers to pump the amplifier in a bench top experiment. Provide the first-light fiber amplification power-scaling results and show path to meeting Phase II goals. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Optimize the rare earth-doped chalcogenide fiber design and transition the Phase I laser to an all-glass, monolithic fiber amplifier architecture that is capable of producing up to 1 kW output power. Completely characterize the fiber amplifier architecture, in terms of gain at 4.5 micron, slope efficiency (percentage of the signal power with respect to pump power), and gain bandwidth. Demonstrate the developed prototype.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Fully develop and transition the high power MWIR fiber amplifier for DoD applications in the areas of Directed Infrared Countermeasures (DIRCM), advanced chemicals sensors and laser detection and ranging (LIDARs). The DoD has a need for advanced, high-power MWIR laser sources of which the output power can readily be scaled for current- and future-generation DIRCMs, LIDARs, and chemicals/explosives sensing.

The commercial sector can also benefit from the crucial, game-changing technology development in detection of toxic gases, environmental monitoring, and non-invasive health monitoring and sensing.

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Infrared_Emission_from_a_Fibre_Laser

KEYWORDS: Quantum Cascade Laser; QCL; Thermal Load; Scaling; Mid-Wave Infrared; MWIR; Brightness; Fiber Amplifier

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-017 TITLE: Modernization of the Laser Event Recorder

TECHNOLOGY AREA(S): Battlespace, Biomedical, Human Systems

ACQUISITION PROGRAM: PMA202 Aircrew Systems

OBJECTIVE: Design an aircraft or aircrew-mounted device to detect and alert when targeted/irradiated by a laser, and record laser-strike characteristics (e.g., wavelength, power, pulse duration, etc.), as well as the global positioning system (GPS) location at the time of detection.

DESCRIPTION: Laser strikes on both military and commercial aircraft have been on the rise since 2005. The Navy is interested in developing a device that can alert aircrew when they have been lased, as well as gather particular laser parameters of importance. The Navy had such a device, the Laser Event Recorder, but that device used now obsolete equipment/technology and no longer manufactured.

Develop a device with the following capabilities:
- Identify the wavelength of the laser strike (desired operational range = 190 - 2000 nm)
- Record the power/energy of the laser strike
- Record the time and duration of strike (if pulsed, measure the pulse lengths as low as one nanosecond (ns) and pulse repetition frequency (PRF))
- Capture a high resolution image and/or video of the source
- Determine the angle of arrival with respect to aircraft orientation and altitude
- Record the GPS coordinates
- Record data on removable media (such as an SD card)
- Device should keep false positives to a minimum
- Device should have a minimum field of view of 50 degrees in the horizontal and 40 degrees in the vertical

Additionally, there is a need to provide a visual notification (such as a light or text indicator) to alert the aircrew that they are receiving laser radiation. The total weight of the device can be no more than 300 grams (g) and the total volume no more than 100 cubic centimeters (cm3). Ruggedize the device to pass requirements in MIL-STD-810H [Ref 1] and pass the electronic interference requirements in MIL-STD-461G [Ref 2]. The device will require mounting to aircraft windscreen via suction cup or on the aircrew via either a Velcro patch or strap. All displays and indicators must be Night Vision Goggle (NVG) compatible in accordance with MIL-L-85762A [Ref 3]. The device must be powered via rechargeable battery and be capable of operating continuously for a minimum of eight hours.

PHASE I: Design and develop a concept for the device in accordance with the parameters and requirements in the Description. Demonstrate feasibility of the designed concept. The Phase I effort will include detailed prototype plans to be developed under Phase II.

PHASE II: Continue development of the concept proposed in Phase I and design and demonstrate a prototype device to address all parameters. Include planning, design for either aircraft or aircrew mounting, and perform preliminary testing for ruggedness.

PHASE III DUAL USE APPLICATIONS: Finalize designs and the technology with an emphasis on manufacturability. Transition final technology to end users and platforms. Successful technology development will have commercial applications in both law enforcement and commercial aviation sectors.

REFERENCES:

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KEYWORDS: Laser Strike; Incident Radiation; Laser Event Recorder; Laser Warning System; Laser Detection; Hazard Analysis

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-018 TITLE: Dynamic Digital Spatial Nulling Algorithms for Tactical Data Links

TECHNOLOGY AREA(S): Air Platform, Battlespace, Electronics

ACQUISITION PROGRAM: PMA263 Navy and Marine Corp Small Tactical Unmanned Air Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and/or innovate new or current algorithms including derivatives of space-time adaptive processing (STAP), space-frequency adaptive processing (SFAP), and key elements for nulling-aware routing for application on tactical data links to improve the communication range, interconnectivity and anti-jamming resistance. Document, assess, rank, recommend and report any algorithms based on applicability, performance and integration complexity to military communications and data terminals. Pursue feasible candidate(s) for a potential transition into Multifunctional Information Distribution System Joint Tactical Radio System (MIDS JTRS) terminals during Phase II prototyping efforts.

DESCRIPTION: Adaptive null steering was pioneered in the early 1960’s [Refs 1, 2, 3, 4] in the context of side-lobe cancelation (SLC) for the purpose of suppressing radar receiver interference and jamming. The ability to control the phase and amplitude of received signals on each channel of an antenna array makes it possible to implement various types of adaptive analog or digital processing techniques. This capability has been extensively used in analog, digital and hybrid analog/digital antenna systems to suppress jammer signals in radar and communications systems. Extension of these techniques to multi-element antennas to cancel multiple interference sources has occurred.

Many modern and legacy communications links have relied on dual antenna solutions for antenna diversity to improve the quality and reliability of a wireless link, but only a few protocols leverage null-steering due to platform constraints. Most platforms, mobile and non-mobile, rely on single or dual antenna systems for transmission and reception capability, placed in a number of different geometries. Adversarial nodes with 3D moment capacity pose a significant threat to these networks as an adversary can position itself to attack the crucial links [Ref 4]. Mobility of platforms and interferences sources make nulling decisions difficult as the null could be placed such that signals of interest are also affected.

The Navy needs innovative adaptive and deterministic steering algorithms to process dual digitized inputs, based on two separated antennas implemented in a Field Programmable Gated Array (FPGA) to improve by 30 – 60 dB, communications resilience in a contested environment. Additional antennas may be supported, but two will be assessed for optimality. Algorithms should also be able to accept and provide angle of interests of multiple interfering signals to allow for high-order media access control and routing protocol utilization for optimally steering gain. Analysis and simulations that allow for comparison of performance on proposed new algorithm and/or innovated application of current algorithms and estimates of the computational requirements should accompany the research. The interference removal should not degrade the link compared to a non-null steering setup. Algorithm parameters should be developed and identified that will be used for a future link layer algorithm that allows for cooperative nulling, allowing trades to be made between nulling adversarial and friendly nodes to preserve interconnectivity and data dissemination capability.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

Although not required, it is highly recommended to work in coordination with the original equipment manufacturer (OEM) to ensure proper design and to facilitate transition of the final technology.

PHASE I: Develop, design, and demonstrate the feasibility of new or existing innovative dual antenna processing techniques for tactical data links and establish the base figure of merit: geometries supported, null depth, ability to adapt to prevent friendly nulling. As part of the Phase I effort, simulations are required to establish the Figure of Merit (FOM) for the proposed algorithms by both the Offeror and the Government. FOMs allow for both offeror and government to have a single standard unbiased test methodology to validate algorithms FOMs, as each algorithm offer different performance for different interference sources. In the Phase I, the offeror will assume multiple interferences sources exist. MIDS JTRS is a NSA certified type 1 encryption system; hence, information assurance (IA) compliance will apply during the Phase II and subsequent transition efforts. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Produce, deliver, and implement (in software) prototypes for the proposed algorithms, encompassing both the design of the algorithms and anticipated affects. Conduct evaluations by testing the algorithms against signal sets. MIDS JTRS is a NSA certified type 1 encryption system; hence, information assurance (IA) compliance will apply during the Phase II and subsequent transition efforts.

The Government, at its discretion, may also provide threat signal data for testing. Independent testing at a Government facility at Government expense may be performed. Performance of the algorithms will be judged based on the base figure of merits assumed above. Prepare a Phase III development plan to transition the technology for Navy and potential commercial use.

Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the algorithms to Navy use. Refine further the algorithms, software code, validation, documentation, and IA compliance. Perform test and validation to certify and qualify software and firmware components for Navy use. Implement the capability in the form of fast, efficient algorithms that, once proven, can be coded in software-defined radios.

Spatial nulling algorithms have increasing application in the area of dense enterprise wireless local area networks and commercial antenna systems and cellular communication. Spatial nulling technology potentially has wide commercial applications to address LTE, 5G, WIFI technology deployment due proximity with other interferes, spectrum challenges, etc.

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KEYWORDS: Data Links; Software Defined Radios; Space-Time Adaptive Processing (STAP); Space-Frequency Adaptive Processing (SFAP); Digital Nulling; Figure Of Merits (FOM)

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-019 TITLE: Spatial Data Comparison for Markerless Augmented Reality (AR) Anchoring

TECHNOLOGY AREA(S): Human Systems, Information Systems

ACQUISITION PROGRAM: PMA251 Aircraft Launch & Recovery Equipment (ALRE)

OBJECTIVE: Develop a software solution to localize an augmented reality (AR) headset user within a space by making a comparison between spatial mapping data collected live from the headset and scanned/modeled data collected at an earlier time and stored on the device. The proposed solution should work with an existing, commercially available AR headset.

DESCRIPTION: The Navy and Marine Corps currently have several efforts underway looking at applying AR technology to provide maintainer guidance, and improve maintenance-action success rate and repair time. Many current commercial off-the-shelf (COTS) AR hologram anchoring solutions make use of the device's onboard camera and fiducial marker detection to localize a user in space and overlay instructions, animations, warnings, schematics, and technical data but these solutions are limited by the chosen device's camera quality and computational power. Target-based solutions also mandate that a physical marker be placed on the piece of equipment to be detected, which is unacceptable in a number of maintenance environments. More powerful image and object recognition technology exists that foregoes the need for a fiducial marker but these solutions are heavily dependent on the upload of government data to proprietary cloud services which severely restricts utilization due to both government data sensitivity and cyber limitations on internet access.

The need exists for a method of anchoring holographic overlays in space without the need for internet/cloud access and physical markers. Ideally, this solution would extract a bounding box of a piece of equipment using key feature set comparisons between a computer aided design (CAD) model/3D scan file and real-time spatial mapping room scans generated by the chosen AR device. Some system of aligning the live spatial mapping data with the stored digital twin would allow for the precise and accurate placement of holographic overlays anywhere within the user's scanned region without any dependency on camera functionality. Such a solution would need to achieve 90% precision and accuracy for equipment of varying size and complexity (from 1 to 500 cubic feet) while providing very limited performance degradation (maintaining 60 frames per second) on the device. This solution must also be capable of identifying the same piece of equipment in multiple and varying room spaces (i.e., identification independent of the space itself and the equipment's location within the space). Integration of the solution with the Unity Game Engine or other common AR application authoring tools is required and full documentation of all programming Application Program Interfaces (APIs) is expected to allow for future government developer use/interfacing.

PHASE I: Design, develop and demonstrate feasibility of a software to meet the requirements provided in the Description. Design a high-level software and use a simplified example of the methodology as a proof-of-concept. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Build and demonstrate a prototype system for a chosen AR headset and test in both interior and exterior environments to highlight capability in lighting conditions that range from bright sunlight to darkness in all weather conditions.

PHASE III DUAL USE APPLICATIONS: Further develop the solution on chosen AR device. Transition as Support Equipment within other Navy-developed applications.

Development of a software tool for environment/model alignment and hologram anchoring that foregoes the need for an off-premises cloud backend will be marketable to aircraft, automobile, and heavy equipment manufacturers along with all other companies that have sensitive/proprietary models they do not wish to cover with fiducial markers or upload to a private entity's servers.

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KEYWORDS: Augmented; Mixed; Reality; Spatial; Fiducial; Hologram

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-020 TITLE: Development of Agile Laser Eye Protection (LEP)

TECHNOLOGY AREA(S): Air Platform, Biomedical, Human Systems

ACQUISITION PROGRAM: PMA202 Aircrew Systems

OBJECTIVE: Design and develop “agile” laser eye protective filters that operate independent of the incident wavelength in real time. Additionally, optical transition technologies, such as photochromic or electrochromic sun protection, may be developed.

DESCRIPTION: With the recent increase in laser strikes on aircraft, the need exists to protect the eyes of our Navy aircrews. Current Laser Eye Protection (LEP) technology uses fixed filters that reject specific wavelength bands. This SBIR topic seeks to develop filter technologies that can reject any laser regardless of wavelength in the Ultraviolet (UV), Visible (VIS), and Near Infrared (NIR) wavelength ranges (190-2000 nm).

The “agile” filter technology needs to protect from both continuous wave (CW) and pulsed lasers having pulses as low as one nanosecond (ns). The device must provide at least an optical density (OD) of three while providing as much transmittance as possible. The solution needs to be physically compatible with existing aircrew helmets and oxygen masks as well as spectrally compatible with a full color display such as a commercially available LCD/LED computer monitor. Keep weight to a minimum with a goal of not more than 350 grams. If a visors solution is proposed, it must meet as many of the requirements detailed in MIL-DTL-43511D [Ref 1] as possible. If a spectacle solution is proposed, it must meet as many of the requirements in MIL-PRF-32432A [Ref 2] as possible. Both visor or spectacle solutions must have a base curvature of at least 6 diopters. If a powered solution is proposed, the device needs to be battery powered and operate continuously for a minimum of eight hours.

In addition, the Navy has an interest in designing and developing transition visors or spectacles that can adapt to varying lighting conditions (bright noon sun vs. overcast). The device must have a maximum photopic transmittance of 85% and a minimum photopic transmittance 15%. It should transition in less than 1 second (s) when worn behind a windscreen/ canopy and must be compatible with existing helmets and oxygen masks. If a visor solution is proposed, it must meet as many of the requirements detailed in MIL-DTL-43511D [Ref 1] as possible. If a spectacle solution is proposed, it must meet as many of the requirements in MIL-PRF-32432A [Ref 2] as possible.

PHASE I: Design, develop and demonstrate feasibility of filter technologies that detail the specific characteristics of the filters (weight, transmittance (photopic and scotopic), OD, optical power, maximum lens curvature, etc.). The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Developed and demonstrate prototype filter technology and work with the Navy for laboratory testing and user assessments.

PHASE III DUAL USE APPLICATIONS: Further refine and finalize technology from Phase II with an emphasis on manufacturability. Technologies developed through this effort are expected to have commercial applications in law enforcement, commercial aviation, construction, manufacturing, medical, and educational facilities among others.

REFERENCES:
1. Department of Defense. MIL-DTL-43511D Visors, Flyer's Helmet, Polycarbonate. Everyspec, 2006. http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-DTL/MIL-DTL-43511D_15101/

2. Department of Defense. MIL-PRF-32432A Military Combat Eye Protection (MCEP) System. Everyspec, 2018. http://everyspec.com/MIL-PRF/MIL-PRF-030000-79999/MIL-PRF-32432A_55832/

KEYWORDS: Laser Protection; Photochromic; Liquid Crystal; Tunable; Frequency Agile; Electrochromic; Vision Protection; Optical Limiter; Nonlinear Optics

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-021 TITLE: Cargo Handling Software for Navy and Marine Aircraft

TECHNOLOGY AREA(S): Air Platform

ACQUISITION PROGRAM: PMA261 H-53 Heavy Lift Helicopters

OBJECTIVE: Develop innovative software to assist aircrew in loadmaster duties and generate cargo configurations to achieve sufficient cargo restraint for Navy and United States Marine Corps (USMC) aircraft using handheld devices.

DESCRIPTION: The Navy is in need of a software tool that can design, evaluate, and display cargo-loading configurations to ensure restrained cargo is to the Navy required parameters within aircraft. This solution should be capable of autonomously designing the most effective and efficient cargo-loading configuration that meets all loading requirements without the use of additional tools and display this information to the user.

Aircraft cargo transportation is a complex mission requiring an understanding of aircraft limitations, cargo space dimensions, tie-down locations, aircraft center of gravity (CG), equipment limitations, and safety of personnel being transported, each of which are unique to different aircraft. This software must be capable of addressing each of these elements when designing, displaying and evaluating cargo-loading configurations.

The loading considerations listed above are detailed in Cargo Loading Guides (CLG). Crewmembers are trained to varying levels of competence in each platform’s specific CLG. Each platform’s CLG is different, some platforms contain specific cargo configurations, while others detail strategies to meet Navy or Marine Corps cargo requirements. Deficiencies of CLGs, gaps in training, and degradation of skill or knowledge of personnel, may introduce human error to crucial CG and tie down calculations that could result in aircraft damage, cargo damage, passenger injury, crew injury, failure of the mission, or loss of aircraft.

By providing means to evaluate and design cargo configurations within Navy or Marine Corps requirements and display certified cargo loading configurations this project will address the listed deficiencies, improve the safety of crewmembers and cargo, and expedite the cargo transportation process.

The software must provide a graphical user interface (GUI) to input and display air vehicle type and dimensions, cargo type and dimensions, desired cargo storage location within the aircraft, restraint requirements, available restraint equipment, and the location of available tie down rings. This software must integrate onto the Marine Air Ground Tablet (MAGTAB), requiring the software to be built in the Android Knox Software Development Kit (SDK). It must be usable by Navy and Marine Corps services and for heterogeneous platforms, both manned and unmanned.

PHASE I: Develop and demonstrate the feasibility of an innovative software for a handheld device that can display multiple unique aircraft loading spaces and aircraft tie down locations, measure and input unique cargo dimensions and locations within the aircraft, and calculate restraint provided by tie down provisions. Exhibit capability to display CLG publications and use a notepad and calculator tool within the software. Establish performance goals and approach for Phase II with emphasis on user interface and generation of optimized tie down patterns. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype software tool, deployed on a hand-held device and operating system including, but not limited to, Android OS, that can measure a unique cargo's dimensions, locate its tie down rings, and generate an optimal tie down pattern that meets Navy and Marine Corps requirements and provides cargo placement that does not exceed aircraft limitations, provided by the Government. Exhibit capability to display, evaluate and generate cargo configurations across different cargo loading zones and aircraft requirements. Demonstrate capability to save and display known and newly developed cargo configurations for different aircraft. Develop performance metrics for the prototype and path forward.

PHASE III DUAL USE APPLICATIONS: Evaluate the ability to integrate adaptive cargo loading analysis capability into software for implementation on the MAGTAB and assess the system performance against the metrics developed during Phase II efforts. Transition to appropriate platforms.

The implementation and improvement of measuring tools integrated onto hand-held devices is a commercially viable product that has use cases not limited to construction, auto mechanics, landscape architecture, landscaping, architecture, asphalt, mechanical contracting, heating, ventilation, and air conditioning (HVAC), industrial engineering, and manufacturing engineering. This project will also have the potential for application to commercial aircraft and transport vehicles with unique cargo loading zones requiring tie downs and weight and balance considerations for shipping companies such as FedEx or United Parcel Service (UPS).

REFERENCES:
1. MIL-STD-1791C, DEPARTMENT OF DEFENSE INTERFACE STANDARD: DESIGNING FOR INTERNAL AERIAL DELIVERY IN FIXED WING AIRCRAFT (23-OCT-2017) http://everyspec.com/MIL-STD/MIL-STD-1700-1799/MIL-STD-1791C_55770/

2. MIL-STD-1366E, DEPARTMENT OF DEFENSE: INTERFACE STANDARD FOR TRANSPORTABILITY CRITERIA (31 OCT 2006) http://everyspec.com/MIL-STD/MIL-STD-1300-1399/MIL-STD-1366E_2979/

3. MIL-STD-209K, DEPARTMENT OF DEFENSE INTERFACE STANDARD FOR LIFTING AND TIEDOWN PROVISIONS (22 FEB 2005) http://everyspec.com/MIL-STD/MIL-STD-0100-0299/MIL-STD-209K_22319/

KEYWORDS: Cargo; Loading; Tie-Down; Handling; Software; Restraint

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-022 TITLE: Big Data Mining for Maritime Situational Awareness

TECHNOLOGY AREA(S): Air Platform

ACQUISITION PROGRAM: PMA263 Navy and Marine Corp Small Tactical Unmanned Air Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative techniques to mine big data sources for information to use as reference knowledge by Situational Awareness (SA) applications for improving Maritime Situational Awareness (MSA).

DESCRIPTION: MSA applications have a need for sustainable sources of reference knowledge. A robust tactical surface picture requires the mining and effective utilization of massive amounts of information suitable for ingestion by machine learning (ML) engines. Gathering the desired understanding of the tactical situation can be resource intensive and difficult to sustain without the assistance of ML engines to make sense of it. This SBIR topic seeks to explore the feasibility of satisfying this need through the exploitation of big data sources. For U.S. Navy maritime operations, the MINOTAUR Family of Services (MFoS) is the means by which we plan to correlate and fuse sensor data, producing an integrated display shared across air, sea and subsurface platforms, and command centers. The desired result is a coherent battlespace awareness, fusing tactical sensors with national data to support synchronized actions in the maritime environment. Optimally leveraging this huge amount of information at the individual platform level to contribute to this shared tactical picture is extremely challenging without additional tools to make sense of it all. This is particularly true on airborne platforms where operators must manage multiple sensor systems simultaneously. MFoS populates and maintains a Tactical All Source Repository (TASR) containing vessel tracks derived from multiple cooperative and non-cooperative sensors, associated radar and optical imagery and electronic warfare information. In addition, MFoS captures, as available, vessel classification and identification information made by cooperative broadcast, by electronic interrogation, by operators or operator aids. While the accumulation and display of all of this information is quite efficient, quickly understanding its tactical relevance is challenging particularly with regard to detecting or predicting threating or anomalous behaviors. Ultimately, the goal is to understand who is operating in your area of responsibility, what are they doing, and if they pose a threat, in the most efficient manner possible.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Design and demonstrate the ability to interface with one or more existing sources of big data and examine/demonstrate the feasibility of the following:
• Algorithms for automating the curation of knowledge from big data sources
• Algorithms for automating the aggregation of curated knowledge
• Algorithms for automatically extracting the information types required by MSA applications.

Detailed knowledge of MFoS TASR data sources and presentation is unnecessary during Phase I to develop and assess proposed approaches. Only a general understanding (comparable to that provided in the Description above) on the nature of data contained within TASR is needed. Use publicly available sources of big data, not necessarily maritime in nature, as a surrogate in Phase I. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Mature the Phase I-developed algorithms and architectures and apply them for use with the MFoS TASR. The Government will provide exemplar data files to support this development. Utilize the style guidelines provided to maintain uniformity of information presentation with the MFoS operating environment. Establish a lifecycle maintenance plan. Develop requirements for and conduct performance assessments of the tool.

Work in Phase II may become classified. Please see Note in Description section.

PHASE III DUAL USE APPLICATIONS: Integrate the technology into the Navy's MFoS application utilizing its TASR as the source of big data. Big data mining would benefit a wide range of commercial applications ranging from exploring trends in social media to analysis of financial systems.

REFERENCES:
1. Challa, J. S., Goyal, P., Nikhil, S., Mangla, A., Balasubramaniam, S. S., & Goyal, N. DD-Rtree: A Dynamic Distributed Data Structure for Efficient Data Distribution Among Cluster Nodes for Spatial Data Mining Algorithms. 2016 IEEE International Conference on Big Data (Big Data) (pp. 27-36). Washington DC: IEEE. https://ieeexplore.ieee.org/document/7840586

2. Sun, P., Xu, L., & Fan, H. RHAadoop-Based Fuzzy Data Mining: Architecture, Design and System Implementation. 2016 IEEE International Conference on Big Data Analysis (ICBDA) (pp. 1-52). Hangzhou, 2016: IEEE. https://ieeexplore.ieee.org/document/7509796

KEYWORDS: Big Data; Information Analysis; Analytics; Minotaur; Tactical All Source Repository; Maritime Situational Awareness

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-023 TITLE: Alternate Sled Track Braking Mechanism

TECHNOLOGY AREA(S): Weapons

ACQUISITION PROGRAM: PMA280 Tomahawk Weapons Systems

OBJECTIVE: Develop a replacement sled braking mechanism for Supersonic Naval Ordnance Research Tracking (SNORT) that requires less setup time, and does not have the associated regulatory compliance and recurring cost issues as the existing SNORT water brake system.

DESCRIPTION: The water braking system used at the SNORT currently includes a diesel-powered water pump that delivers water to approximately the midpoint of the track. The water then flows downhill and recirculates back into the 600,000-gallon storage pond at the north end of the track. Baffles and dams, placed manually in the concrete foundation trough between the rails, slow the water down and increase the water height. Rocket sleds typically have a probe or scoop incorporated into their structure to interface with the water. The length of the probe is set to start contacting the water as the rocket motor propulsion is tailing off. Most sleds with water brake probes are stopped on the track and reused. Occasionally, the water braking system only provides separation between sled stages resulting in all sleds destroyed at the end of the track.

Maintaining, calibrating, and operating the existing water braking system is costly and has several areas requiring regulatory compliance. The diesel engine driven water pump is located in an underground vault which is designated a confined space. The confined space requires constant monitoring for hazardous atmospheric conditions such as the presence of Carbon Monoxide or low Oxygen levels. Annual calibration and maintenance costs are approximately $5,000. The engine requires an air permit to operate and the underground storage tank requires a permit. Inspectors must regularly log, and report on these permits, requiring escort of inspectors which is time consuming and costly. Annual permit and inspection costs are approximately $5,000. Certified inspectors are required to perform repairs, adding additional cost and complexity. Calibration and checkout of the water brake system is very time consuming because of the lag time between taking measurements, adjusting water flow rate, and waiting for the new flow rate to propagate through the two miles of track. This cycle takes approximately 2 hours. Water-profile adjustment costs are approximately $2,000 per year. Adjusting the water profile is difficult and has led to most changes being made to the sled probe or scoop and using the standard water profile. This approach can cause sub-optimal design constraints on the sled design or velocity/acceleration profile of the sled. Usually the result is high braking loads incorporated into the sled design adding weight, cost, and complexity. The goal is to design a new innovative braking mechanism without the drawbacks described above.

The braking mechanism should meet the following requirements:
a) Be a passive system with no outside inputs. Electricity, water, fuel, or coolant.
b) Maximum of 21,600 feet of braking length.
c) Equal or lower weight and drag penalties on the sled-side of the braking mechanism compared to existing probe designs. Spade brake example; 45 lbs. brake weight, 0.85 drag coefficient, 41,000 lbs. maximum braking force. High speed brake example; 110 lbs. brake weight, 0.85 drag coefficient, 95,000 lbs. maximum braking force. Detailed specifications will be provided to Phase I performers.

d) Fit into or around the existing track foundation for the trackside portion of the braking mechanism. The concrete foundation trough is nominally 41.625” wide, 26” deep (measured from top of rail), and has 6” 45 degree chamfers on both bottom corners.
e) Operate in desert climate without severe (greater than 10%) performance penalties. Direct sunlight, high winds, blowing dust, occasional rain, with ambient temperature ranging from 10°F to 120°F
f) Adjustments to braking profile made without precision equipment (alignment lasers, surveying equipment). Simple gauge bars or lightweight alignment fixtures are allowable.
g) Adjustments to braking profile completed by two personnel in under 2 hours per each mile of braking length.
h) Consumables (if any) costing less than $1,000 per use.
i) Reinstallation of consumables (if any) completed by two personnel in under 1 hour per each mile of braking length.
j) Consumables (if any) may not damage the track or introduce hazardous waste cleanup requirements.
k) Deceleration requirement; decelerate from velocities ranging from 1 to 3,000ft/s over a maximum distance of 10,000 feet
l) Braking force requirement; maximum of 100,000 lbs reaction load on sled tailorable from 100% down to 10% over the entire braking distance.

PHASE I: Design, develop, and demonstrate feasibility of replacement braking mechanism for SNORT as outlined in the Description. Characterize climate dependent performance penalties if any. Develop software model to simulate braking performance. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Finalize, test, and demonstrate a full-scale prototype of the replacement braking mechanism. Test braking capability with representative sleds as well as adjustment, maintenance, and repair time. Develop the testing campaign in coordination with the Government. Incorporate braking simulation into the Government’s sled-velocity calculation software.

PHASE III DUAL USE APPLICATIONS: Transition technology to platforms/industry after verifying the system meets program specific requirements and all the performance requirements as outlined in the Description.

Braking technologies have applications in the transportation and entertainment sectors. Transportation uses include various forms of rail transit systems. Entertainment uses are roller coasters and other rides that need braking.

REFERENCES:
1. Army Engineer Waterways Experiment Station Vicksburg MS Structures Lab. Condition Evaluation of Supersonic Naval Ordnance Research Track (SNORT). Vicksburg: Defense Technical Information Center, 1984. https://apps.dtic.mil/docs/citations/ADA140036

2. Jang, S.-M., Lee, S.-H., & Jeong, S.-S. Characteristic Analysis of Eddy-Current Brake Systen Using the Linear Halbach Array. IEEE Transactions on Magnetics (pp. 2994-2996). IEEE, 2002. https://arc.aiaa.org/doi/abs/10.2514/6.2015-2163

3. Meacham, M. B., Gallon, J. C., Johnson, M. R., Natzic, D. B., Thompson, N., Aguilar, D., . . . Rivellini, T. Rocket Sled Strength Testing of Large, Supersonic Parachutes. Pasadena: Aerospace Research Central, 2015. https://ieeexplore.ieee.org/abstract/document/706507

4. Wang, P., & Chiueh, S. Analysis of Eddy-Current Brakes for High Speed Railway. IEEE Transactions on Magnetics (pp. 1237-1239). IEEE, 1998. https://ieeexplore.ieee.org/abstract/document/1042435

KEYWORDS: Eddy Current; Sled; Sled Track; Rails; Braking; Deceleration

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-024 TITLE: Augmented Reality Headset for Maintainers

TECHNOLOGY AREA(S): Human Systems, Information Systems

ACQUISITION PROGRAM: PMA251 Aircraft Launch & Recovery Equipment (ALRE)

OBJECTIVE: Design and develop an augmented/mixed reality headset device able to integrate with current Navy Information Assurance (IA) infrastructure and can be usable at the Organizational (O-), Intermediate (I-), and Depot (D-) levels of maintenance aviation activities for the Navy and Marine Corps.

DESCRIPTION: There are several efforts, ongoing and planned, to develop technologies and functions that allow for augmented/mixed reality (AR/MR) devices to be applied to Navy and Marine Corps Maintainer use cases. Several of these efforts have proven successful in being able to view maintenance procedures on Commercial-off-the-Shelf (COTS) devices and being able to connect maintainers to engineering subject matter experts (SMEs) to assist in complex and irregular maintenance actions. To enable these functions and all of the existing and future capabilities provided by MR technologies, a hardware asset that meets the requirements of the Navy and Marine Corps network [Refs. 3, 4] and cyber infrastructure is necessary.

Although several COTS headsets currently exist, the Navy and Marine Corps environmental, cybersecurity, and data infrastructure requirements are unique and not addressed or targeted by existing augmented reality hardware. Existing MR hardware hosts standard operating systems and require a wireless connection to the internet to access several of its applications and to enable several features. Furthermore, existing hardware does not allow for DoD Common Access Card (CAC) readers or any secure methods of accessing the device using multifactor authentication. The proposed solution needs to allow all functionality within the headset (i.e., spatial cognition, displaying indications, sensor input, etc.), with a target Field-of-View of 50 degrees or more, weigh no more than 600 grams, and operate without requiring a network connection or having location information available.

A headset hardware solution is needed that allows the AR technology to be applied to the Navy and Marine Corps Maintainer use case, without needing to make changes to the current infrastructure. To enable this, a device that meets environmental requirements at each of the maintenance levels is required. The device would need to be ruggedized and marinized, without interfering with the maintainers visibility during their maintenance action and would also need to contain a display that is viewable in different maintenance locations (i.e., restricted data areas, weather conditions, and lighting conditions including direct sunlight). Furthermore, the device would need to perform its functions for 6-8 hours continuously without recharging.

The conditions required are as follows:

MIL-STD-810G Environmental Conditions, Methods 501.5, 502.5, 509.5, 516.6
Display viewable in direct sunlight and during night operations
EMI Compliance: MIL-STD-461E

HERO Compliance: OD 30393 HERO Design Guide

A method of enabling two-factor authentication is necessary, since the device will contain secure data in the form of maintenance procedures, drawings, and models. Current COTS AR headsets do not provide a method for securely accessing the devices, other than entering a password.

Finally, the device host Navy security software on its operating system (OS), without reducing the functionality and performance of the actual device. Therefore, the OS would need to meet all of the cyber requirements of our operating systems [Refs. 3, 4], and be supportable for release of new versions and updates. Furthermore, the integration of the headset into the Navy security system should minimize the following latency sources: Off-host delay, Computational delay, Rendering delay, Display delay, Synchronization delay, and Frame-rate-induced delay.

A secondary objective would be for the software enabling this solution to be packaged hardware-agnostic, for use on different iterations and versions of AR devices. Existing COTS AR devices require connection to a third-party network to function properly. The Navy is looking for a device tailored to fit the use case of the Navy and Marine Corps maintainer.

PHASE I: Design and demonstrate feasibility of a solution to address the requirements in the Description. Provide an Analysis of Alternatives with several conceptual designs defining and addressing each of the requirements listed in this Description. The designs must show software architecture as well as plans for accomplishing the two-factor authentication. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design, develop, and demonstrate a prototype meeting the requirements in a lab or live environment. Work with the NAVAIR cybersecurity to ensure the development aligns with the cyber requirements and with a Navy internal development team to align the effort with software applications being developed and installed on this hardware solution. The hardware will be loaded with applications and will undergo functional testing, including Electromagnetic interference (EMI), environmental, and shock/drop tests.

PHASE III DUAL USE APPLICATIONS: Support the testing of the developed solution at Organizational, Intermediate, and Depot levels of maintenance sites for completion of test, and transition to appropriate end users.

This SBIR topic provides benefits to the private sector by opening up the market to a far more customizable mixed/augmented reality headset. Current COTS configurations are severely restricted in terms of cyber capabilities and environmental qualifications. A ruggedized headset can easily have applications in a number of more complex factory environments. Improvements to visibility in high lighting conditions has applications to all other COTS headsets. This solution will be used in the defense and maintenance industries, with the possibility of providing benefits to the healthcare and automotive industry as well due to the added security capability.

REFERENCES:

1. Department of Defense Test Method Standard. MIL-STD-810G: Environmental Engineering Considerations and Laboratory Tests. EverySpec, 2008. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G_12306/

2. Department of Defense Test Method Standard. MIL-STD-461E: Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment. EverySpec, 1999. http://everyspec.com/MIL-STD/MIL-STD-0300-0499/MIL-STD-461E_8676/

3. Risk Management Framework (RMF) for DoD Information Technology (IT)F: http://www.dtic.mil/whs/directives/corres/pdf/851001_2014.pdf

4. Risk Management Framework: https://rmf.org/

KEYWORDS: Augmented; Mixed; Reality; Head-mounted display (HMD); Display; Headset

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-025 TITLE: Ship Rapid Damage Assessment System

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PMS 407, Surface Ship Modernization. Robust Combat Power Controls FNC

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a Ship Rapid Damage Assessment System to rapidly determine actionable information after a damage event occurs on board a naval vessel that will reduce the time and cost to effect repairs on that vessel.

DESCRIPTION: In order to facilitate the rapid repair of ships after major damage events such as grounding, collision, or battle casualty, it is critical to be able to immediately assess the location and extent of the damage. In addition, assessing the impact to ship mobility and its ability to provide resources, such as electrical power and cooling, in near real time is vitally important. Currently, critical time is lost while a damaged ship is transported to a shipyard where repair work will be performed. Only a fundamental visual and operational assessment of ship condition is evaluated to determine need for immediate return to a ship repair facility with no measures available to evaluate structural or electrical damage, which can propagate after a casualty event because of a lack of understanding of the ship's integrity. Rapid assessment through a Ship Rapid Damage Assessment System of the damage will allow for the pre-positioning of critical assets, the procurement of long lead-time items required for repair, and the initiation of other required planning activities taking place prior to the ship's arrival at the repair facility. The net effect is considerable shortening of the time that a Fleet asset is out of service after a major critical event.

It is anticipated that, in order to provide this capability, existing surviving data acquisition and sensor systems onboard naval platforms can be utilized in conjunction with the addition of new robust sensor systems and the development of advanced Artificial Intelligence (AI) reasoning methods that can synthesize the data provided from the sensor systems into a composite estimate of battle damage or other major casualties. This will provide information that is not easily determined but would have a significant impact on the time or cost to repair the platform if it were known in advance of the arrival of the ship at the repair facility. Early initial data collection contributes to advance planning and early information transfer to repair facilities, enabling cost and time-savings in production planning, parts ordering, and cost estimation. The proposed system must assess the location and extent of damage from grounding, collision, or battle casualty as well as the impact to mission and capability in near real time in order to facilitate the rapid repair of ships after suffering major damage.

The proposer will have to evaluate the problem of rapid damage assessment with the goal of determining what information is actionable and would serve to create efficiencies if it were available in the time between the occurrence of a significant damage event on board a naval platform, and the time it arrives at a repair facility. The Government will not provide data from damage events and it is the responsibility of the performer to obtain suitable data sets. The company will recommend test fixtures and methodologies to support performance, environmental, shock, and vibration testing and qualification.

It should be noted that the ship may not have power or other services available post a damage event. The proposed system must have the ability to be self-powered or adaptable to external power systems throughout the critical information chain required for an initial damage assessment.

Work produced in Phase II may become classified or the prospective contractor may require access to secure information to conduct its work. Note: The prospective contractor(s) must be U.S.-owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret-level facility and Personnel Security Clearances, in order to perform on advanced phases of the project as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of the contract.

PHASE I: Develop a concept for a Ship Rapid Damage Assessment System meeting the parameters identified in the Description. Demonstrate technical feasibility through modeling, analysis, and bench-top experimentation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Demonstrate the technology using simulated data generated by the proposer. Based on lessons learned in the technology demonstration, further refine, fabricate, and deliver a complete advanced prototype that will pass Navy qualification testing for demonstration and characterization of key parameters and objectives. Recommend test fixtures and methodologies to support performance, environmental, shock, and vibration testing and qualification. Working with the Navy, demonstrate the Ship Rapid Damage Assessment System capability on a relevant system to support improved system operations. Provide detailed drawings, code and specifications in Navy defined format.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use on current and future Navy ships. Develop the Ship Rapid Damage Assessment System for evaluation to determine its effectiveness in an operationally relevant environment. Support the Navy for test and evaluation to certify and qualify the system for Navy use.

Potential use of the system includes other Naval Ships, Coast Guard, and commercial ships. Other high integrity commercial and military systems requiring fail-safe operation can benefit from this technology.

REFERENCES:
1. Zhu, Ling, James, Paul and Zhang, Shengming. "Statistics and damage assessment of ship grounding." Science Direct 2002, Lloyd's Register of Shipping, 71 Fenchurch Street, London EC3M 4BS, UK, 21 March 2002. https://www.sciencedirect.com/science/article/pii/S0951833902000138#!.

2. Lee, Dongkon, Lee, Soon-Sup, Park, Beom-Jin and Kim, Soo-Young. "A study on the framework for survivability assessment system of damaged ships." Science Direct 2004, Maritime Safety and Pollution Control Laboratory, Korea Research Institute of Ships and Ocean Engineering, Department of Naval Architecture and Ocean Engineering, Pusan National University, Pusan, Republic of Korea, 19 December 2004. https://www.sciencedirect.com/science/article/pii/S0029801804002367

KEYWORDS: Battle Damage Assessment; Sensors for Ship Damage Assessment; Structural Health of Damaged Ships; Rapid Repair of Ships; Artificial Intelligence; Machine Learning

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-026 TITLE: Manufacturing Composite External Volumes with Enhanced Underwater Collapse Performance

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 397, COLUMBIA Class Submarine Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an ability to manufacture high-quality composite pressure housings for external volumes (EVs) with an enhanced hydrostatic pressure collapse performance by understanding how filament winding methods and materials can be used to control the collapse response.

DESCRIPTION: In order to adhere to Navy submergence requirements (MIL-STD-1688, MIL-STD-278, or other relevant commercial standard), all components and systems must be evaluated to assess their susceptibility to the underwater environment. Components external to submarine pressure hulls, such as EVs, are particularly difficult to evaluate due to the high potential for material flaws to cause catastrophic collapse under hydrostatic pressure loading. The catastrophic collapse of EVs can result in the release of a radiated pressure pulse that can negatively affect nearby components and other EVs. Composite materials provide unique characteristics and increased flexibility for application-specific customization. The Navy has successfully leveraged the benefits of composite materials for use as EV pressure housings, which are often used to isolate components from exposure to the harsh marine environment. The Navy seeks an enhanced understanding of how manufacturing methods affect material flaw distributions and subsequent collapse failure of EV composite pressure housings due to underwater hydrostatic pressure loading.

The Navy lacks a knowledge of how filament winding techniques (e.g., width of winding strip and overwrap frequency) and materials (e.g., glass fiber reinforcement strength) affect the quality and hydrostatic collapse response of composite pressure housings. To quantify part quality, non-destructive methods will be used to measure flaw distributions and document shape quality measurements. Manufactured composite pressure housings will be selected for hydrostatic pressure collapse testing to determine which methods and quality parameters have the greatest effect on housing failure. Additionally, to aid the Navy with numerical collapse predictions, manufacturing procedures will be developed to create flat filament wound material characterization samples, which are representative of the housing materials. Material characterization samples will also be assessed for quality and tested to better quantify the flaw distribution that is present in the as-manufactured housings. By identifying which manufacturing methods have the most control over the collapse pressure of composite housings and developing manufacturing methodology to create representative material characterization samples, the Navy will have enhanced control over the response and prediction of collapse for EVs with composite housings.

PHASE I: Investigate the effects filament winding methods, such as width of winding strip and overlapping frequency, have on housing quality. Cylindrical glass fiber reinforced composite pressure housings will be manufactured with a diameter and length between 6 inches and 36 inches. Only one- or two-part shapes (diameter and aspect ratio combinations) will be developed during Phase I, while multiple winding methods will be investigated. Part flaws will be quantified using non-destructive scanning methods (e.g., ultrasound) to measure size, distribution, and location of flaws. Shape quality will be quantified using techniques such as out-of-roundness and thickness measurements. Once high-quality manufacturing methods are obtained, with minimal flaws and acceptable shape measurements, a best practices and lessons learned guide to manufacture composite pressure housings will be developed. The Phase I Option, if exercised, will continue to investigate additional filament winding techniques that may result in high-quality, low-cost parts.

PHASE II: Building on lessons learned during Phase I, determine the effects of manufacturing composite housings with a variety of glass fiber types (e.g., E-glass, S-glass, S-2 glass, etc.). Quantify part and shape quality of the housings. Facilitate Navy performed hydrostatic collapse testing of the housings manufactured during Phase I to quantify how quality, winding method, and glass fiber properties influences the housing collapse performance. Develop a capability to manufacture flat filament wound material characterization samples. Execute instrumented quasi-static and high-strain rate characterization of the filament wound materials. Manufacture a variety of parts from small-scale to large-scale with the previously identified best manufacturing methods and materials, and collapse tested to provide evidence of how scale effects quality and performance. Expand manufacturing capabilities to EVs, which consist of other fiber types (e.g., carbon fiber) and hybrid designs (e.g., composite wrapped metallic cylinders) to add to the manufacturer’s ability to produce a wide range of Navy EVs.

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning this technology to a wide variety of other military and non-military undersea applications including, but not limited to, oil and gas extraction, exploratory work for deep-sea mining, and scientific exploration. These deep-sea activities are continually becoming more common due to decreases in terrestrial resources and improvements in marine technologies. As composite-housed components become more prevalent across all fields, the ability to design and manufacture them for increased safety by mitigating hydrostatic collapse is essential to continue safe human exploration and operations in the harsh environment of the deep sea.

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KEYWORDS: External Volumes; EVs; Submarines; Composites; Hydrostatic Pressure Collapse; Filament Wound Composite Shells

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-027 TITLE: Artificial Intelligence Software-Based Autonomous Battle-space Monitoring Agent for a Distributed Common Operational Picture Software Subsystem

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS 1.0, AEGIS Combat System Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an Artificial Intelligence (AI) Software-based Autonomous Battle-space Monitoring Agent (SABM) with the capability to augment or assist combat systems console operators in maintaining Situational Awareness (SA) of tactically relevant changes occurring within the ship’s Area of Responsibility (AOR).

DESCRIPTION: The current AEGIS Combat System implementation does not include a comprehensive distributed (that is, multi-platform) capability for capturing the complete battle-space operational, environmental, and tactical picture in a coherent integrated manner. Currently available commercial systems and software that might be considered for adaptation to partially address the Navy’s combat systems requirement for advanced situational awareness (e.g., the FAA Air Traffic Control System hardware and software) are dated in their designs. Their ability to integrate, support, or coordinate with stand-alone (i.e., autonomous) DoD-sourced or 3rd-party software applications in a real-time manner is minimal or non-existent. Additionally, the currently available commercial technology mentioned above is limited in that it lacks the capability to track, identify, and manage complex air, surface, and subsurface entities and threats present in a combat environment. Since no viable commercial alternatives exist or can be adapted to address these needs, it becomes necessary for the Navy to pursue a different avenue of exploration.

The Navy needs an AI Software agent intended to function within the AEGIS Combat System (BL10 or later) and a Common Core Combat System (CCCS) prototype combat system implementation and associated Distributed Common Operational Picture (DCOP) subsystem. A new capability needs to be developed within AEGIS to present a Common Operational Picture (COP) to the combat system's watch stander. The capability will provide the watch stander with complete SA. The technology will include detailed engagement-quality track data, identification data from various sources, estimated platform sensor or weapons capabilities derived from organic and non-organic databases, and observationally-derived behavioral data for each tactically relevant entity within the battlespace. The subsystem must be modular in nature and support the sharing of the COP across all participating platforms within the battlegroup in a manner that insures the data coherence of the COP on every platform. In order for such an AI-based software application to function within AEGIS, a DCOP software subsystem must be integrated within the AEGIS Combat System, or alternately, a suitable set of ancillary data collection algorithms must be developed to acquire the relevant data needed for the AI algorithm from data sources currently available within the AEGIS Combat System.

An AI-based autonomous SABM, when operating within an appropriate CCCS Ecosystem software environment or equivalent, and when given data access to a CCCS DCOP implementation or AEGIS equivalent, will provide the Combat System (CS) watch stander with an autonomous SA monitoring capability focused on augmenting the ability to successfully execute the mission. SABM will perform analytical monitoring tasks utilizing data derived from a combat-system supported accessible DCOP subsystem capable of providing both detailed real-time observable and known historical parameters exhibited by all observable battle-space entities within the AOR. The solution technology must be an architectural model, software framework and Algorithm description, with an outline for a functional SABM implementation.

AI has significantly advanced with the development of "Deep Learning" algorithms [Ref. 4]. These algorithms have led to the commercial development and deployment of several software AI products, such as Siri, Cortana, and Alexa, which endeavor to assist individuals in accomplishing routine daily tasks with a minimum of confusion, reduction in required time, or specifically directed research. Implementing an autonomous software agent battle-space monitor within a CCCS/DCOP (or equivalent AEGIS-based) combat system that leverages currently existing AI algorithms similar to the ones mentioned above [Refs 2, 3] could be extremely advantageous. Such an autonomous agent, utilizing the development of new combat-systems focused AI-based analytical algorithms, will advance the ability of CS watch standers to monitor dynamically changing tactical environments. The autonomous nature of such a software agent will allow it to function without the need for CS watch standers to constantly reconfigure the agent manually to adapt it to dynamically changing battle-space conditions.

Multiple independent SABM Agent instances, executing both within the organic ship CCCS Ecosystem as well as within non-organic CCCS Ecosystems (for example those hosted on other battle-group CCCS compliant surface platforms), should be capable of exchanging data and coordinating their analytical processes. Such analytical coordination and data exchange efforts should be capable of crossing surface platform computational boundaries (such as organic and non-organic coordination between surface platforms within the battlegroup) when necessary. The CS watch stander should have the ability to configure each SABM agent instance by identifying appropriate tasks and goals, configuring customized alerts, and defining behavioral traits and patterns which, when associated with existing battle-space entities, will help to identify potential ship threats. Each SABM agent instance should be capable of autonomously prioritizing ship tactical threats and, when coordinating with other organic and non-organic SABM instances, identifying and prioritizing threats and other battle-space AOR situational and environmental issues tactically relevant to the task group and mission.

The SABM architectural model, software framework, and AI Algorithm set will function within a software environment modeled on the CCCS/DCOP architecture and software framework.

Any architecture, software framework, or AI Algorithm set developed in response to this topic will be modular in nature and utilize open systems-based design principles and standards [Ref. 5], and well-defined and documented software interfaces. Architectural implementation attributes will include scalability and the ability to run within the computing resources available within the AEGIS Combat System BL10 or later hardware-computing environment.

The requisite algorithms, as well as any hosting system requirements, should be architected around modular principles with eventual utilization of the CCCS Ecosystem CS Application environment and DCOP battlespace situational awareness subsystem, and eventual implementation and integration within the AEGIS Combat System (BL10 or later). It should be noted that any potential Phase II and Phase III extensions would potentially require such implementation constraints.

The software implementation of the prototype SABM agent shall be capable of installation and integration within a prototype CCCS Ecosystem with access to a prototype DCOP battle-space situational awareness subsystem (or AEGIS equivalent). The target execution environment will be hosted on a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) processing environment as a standalone application (that is, no critical dependencies on network-based remotely hosted resources, save for sensor data emulators and network-based connections to other running CCCS instances). The prototype SABM agent implementation will demonstrate the following: First, it must demonstrate the ability to successfully monitor the battlespace DCOP and successfully perform DCOP data/potential threat analyses. Second, it must develop ship and battle-group-prioritized tactical threat lists and identify tactically relevant battle-space issues. Third, it must generate associated watch stander alerts. Lastly, it must demonstrate agent coordination across 2 or more independently executing SABM instances, one of which will be hosted on a separate computing platform hosting an independent (but network accessible) CCCS Ecosystem instance.

Any prototype must demonstrate that it meets the capabilities described above during a functional test to be held at an AEGIS or Future Surface Combatant (FSC) prime integrator supported Land Based Test Site (LBTS) identified by the Government, and capable of simulating an AEGIS BL9 compatible or newer combat system hardware test environment.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design a concept outlining the architectural model, software framework and AI-based algorithms needed to implement an Autonomous SABM. Establish feasibility through modeling and analysis commensurate with the design requirements outlined in the Description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design, develop, and deliver a prototype software implementation of a SABM agent. Demonstrate the prototype meets the parameters of the Description during a functional test to be held at an AEGIS or Future Surface Combatant (FSC) prime integrator-supported Land Based Test Site (LBTS) provided by the Government, representing an AEGIS BL9 compatible or newer combat system environment.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the SABM agent software to Navy use. Integrate the SABM agent into a prototype combat system implementation, consisting of one or more of the following: AEGIS BL9 or greater; CCCS experimental prototype, implemented on a virtualized hardware environment within an AEGIS hardware compliant land-based testbed.

This capability has potential for dual-use capability within the commercial Air Traffic Control system in the future development of an air traffic “common operational picture” monitor, capable of predicting and preventing collision events in complex traffic control patterns.

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KEYWORDS: Maintain Situational Awareness; Autonomous Situational Awareness Monitoring Capability; Combat-systems Focused AI-based Analytical Algorithms; Autonomously Prioritizing Ship Tactical Threats; Software Framework; AI-based Software Application

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-028 TITLE: Surfzone Optical Imaging

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PMS 495, Mine Warfare Systems Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a capability to image through waves and ocean turbulence in shallow coastal waters from small surface ships and/or airborne platforms.

DESCRIPTION: The Navy and Coastal Battlefield and Reconnaissance Analysis (COBRA) program is seeking innovative approaches to perform optical imaging in surf zones, and through the air water interface. Optically-based mine detection sensors face exacting challenges in forming images of sufficient quality for accurate object detection and discrimination through the air-water interface. Current technical approaches are unable to avoid the effects of the surface on target imagery. This R&D solution will mitigate the surface effects prior to and/or in the DSP (Digital Signal Processing) and significantly improve mission effectiveness. Specifically, the presence of non-regular and breaking waves result in caustic bands and significant image distortion due to lensing/defensing, and scattering and opacity due to white caps and foam. All of these effects are time variant, creating an extra level of complexity. This topic is soliciting hardware and software approaches to addressing these challenges. Software and hardware solutions will be form-fit-function compatible with the COBRA Mine Warfare (MIW) sensor. Successful proposals may address either or both lensing/defensing and/or scattering, although priority will be given to solutions that address the full problem. Hybrid approaches are expected for the full solution. For example, physical models have been developed and used to correct for caustic bands and lensing/defensing; however, they do not explicitly address scattering due to surf and foam. A hybrid approach may combine such a physical model with techniques developed for imaging in a scattering medium such as structured illumination or pseudorandom code modulation.

The figure of merit should be image quality; specifically, the approach must maintain a sufficiently high modulation transfer function at relevant spatial resolution for the intended application. The spatial resolution will be equal to or greater than current the COBRA Block I sensor. Detection algorithm development is not part of this opportunity; however, some knowledge of surf zone mine detection algorithms is needed to validate the approach. The through-surf imaging technique will be integrated with existing mine detection algorithms to baseline performance against uncorrected imagery. Relevant depths are approximately a few to 10 m, and image acquisition rate must be the video frame rate of relevant sensors. Size, Weight, and Power (SWaP) shall be compatible with the COBRA sensor.

Successful Phase I and Phase II efforts will produce a capability that is a suitable pre-planned product improvement (P3I) for COBRA as an engineering change proposal as well as a potential upgrade to other existing optical airborne mine detection platforms.

The Phase I effort will not require access to classified information. If need be, data of the same level of complexity as secured data will be provided to support Phase I work.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for surf zone imaging through waves and ocean turbulence in shallow coastal waters from small surface ships and/or airborne platforms. Demonstrate the feasibility of the proposal approach through a combination of analytical modeling and bread boarding activities with the goal of validating the analytical model through breadboard testing. Identify areas of technical risk and a path to retiring each risk. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design, develop, and deliver an advanced prototype for surf zone imaging. Conduct functional testing of the prototype-imaging sensor in a contractor laboratory environment and facilitate subsequent developmental testing in a representative field environment (i.e., in a surf zone). Integrate the data output and/or DSP algorithms into existing automated detection algorithms for performance assessment. Develop a Phase III plan.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Government in transitioning the surf-imaging tool for Navy use. Dual use opportunities include coastal and surf zone survey and mapping and coastal search and rescue operations.

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KEYWORDS: Surf Zone Imaging; Fluid Lensing; Through Wave Imaging; Mine Detection; Structured Illumination in I’s a Scattering Medium; Pseudorandom Code Modulation

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-029 TITLE: Affordable Radar Antenna with Electronic Elevation Scan and Multiple Beams

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PEO IWS 2: AN/SPS-49 Radar Tech Refresh Program.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a new antenna for the AN/SPS-49 radar that incorporates electronic beam steering in elevation, provides for multiple elevation beams, and incorporates the means for shaping of both transmit and receive beams to improve high elevation radar coverage.

DESCRIPTION: The AN/SPS-49 is a venerable radar deployed widely throughout the Fleet. In such legacy systems, life-cycle cost reduction is a constant goal and maintenance cost is the key driver. Being a rotating radar, periodic overhauls of the antenna are required to replace worn or weathered parts, repair physical damage, re-seal, and re-paint. Little can be done to avoid this. However, the SPS-49 antenna incorporates one feature that might be simplified by the introduction of innovative technology.

The SPS-49 antenna is a parabolic reflector fed by a H-plane sectoral horn. The reflector is asymmetric with the wide dimension aligned horizontally and the H plane of the horn aligned vertically with the narrow dimension of the reflector. Elevation scan in the SPS-49 antenna is accomplished through mechanical drives, powered by electrical motors that “rock” the entire antenna assembly to compensate for ship motion (roll and pitch). This mechanical assembly adds weight, is prone to wear, and requires robust electrical controllers located below deck. Furthermore, the antenna rotary joint must pass DC electrical power in addition to the radio frequency (RF) transmit power. Repair and replacement of these components contribute greatly to the overall SPS-49 sustainment cost. If the antenna elevation could be varied through electronic means, electro-mechanical parts would be eliminated, weight could be reduced, and the life-cycle cost of the radar would decrease, even though the antenna would still need to rotate.

The Navy seeks an innovative rotating antenna technology, compatible with the SPS-49 radar that provides simple, non-mechanical elevation scan over a limited range. The “antenna” in this case is considered only that (rotating) portion above the pedestal and rotary joint that forms and transmits the beam. The most mechanically and electrically simple, lightweight, and affordable solution that meets the performance requirements is desired. In addition to meeting the existing SPS-49 elevation requirement, a desired solution would be for the electronic elevation scan technique to also permit implementation of multiple elevation beams. A minimum of two elevation beams are required to allow elevation estimation against low-to-medium altitude targets, and appropriate beam shaping will be needed to achieve the required cosec2 coverage.

As a goal, more than two elevation beams are desired if this can be achieved while meeting the requirements for performance, beamforming, size, and weight described below. It is understood that, in meeting these objectives, the addition of duplexers and other beamforming electronics (as part of the antenna) may be necessary. However, if incorporating active elements, the antenna should not introduce harmonics or inter-modulation products in the transmitted signal. Examples of antennas that could enable electronic steering in the elevation plane (and potential implementation of multiple elevation beams) include the use of a vertical array of “row-boards” with individual phase control (by row) and corporate feed, phased array feeds with a main reflector surface, reflective printed-element arrays (“reflect arrays”) with element-level electronic phase shifting illuminated by a primary feed horn, and transmissive printed-element arrays (“transmit arrays” or “array lenses”) with element-level electronic phase shifting illuminated by a primary feed horn. While examples of these antenna types have been demonstrated before, the sheer size and power of the SPS-49 antenna and its requirements for beam shape and elevation scan represent a significant technical challenge, especially in light of the desire for a lightweight, rugged, and yet affordable design.

The current SPS-49 antenna reflector is approximately 24 feet wide and 8 feet tall. The weight of the rotating assembly (reflector, feed, and supporting structure) is approximately 2000 pounds. Due to ship structural considerations, i weight and overall size cannot be exceeded. At a minimum, the desired antenna must transmit across the band 850-950 MHz with a total elevation scan of ±25 degrees. The peak power supplied to the antenna at the output of the rotary joint is 300 kW maximum (at 4% duty cycle) and the desired aperture efficiency (relative to the power supplied at the rotary joint) is 65% minimum. The transmitted beam should have a 3 dB beam width in the azimuthal direction of no more than 3.5°. In the elevation plane the combined transmit and receive patterns shall provide cosec2 coverage to 30 degrees. The antenna gain shall be at least 28 dB (measured relative to the power supplied by the rotary joint). Azimuthal side lobes shall not exceed -30dB (relative to the peak antenna gain) in the region of 10° on either side of the main beam. Beyond 10° from the main beam, side lobes shall not exceed -15 dBi (relative to isotropic). The interface to the antenna is through a rotary joint, which is not considered part of this effort. Proposed designs should assume a waveguide feed and an available communications path (analog or digital) to control the elevation scan. If the proposed technology will incorporate electronics integrated within the antenna assembly, low voltage power (nominally 24 V maximum) can also be assumed available through the rotary joint. However, active liquid cooling is unavailable.

A prototype antenna is desired and, should a reflect array, transmit array, or similar type antenna be selected, the feed is considered an integral part of the design. However, as a full-size prototype will likely be prohibitively expensive, a partially populated antenna array is acceptable, provided that the full antenna performance can be determined through extrapolation (by analysis, modelling, and simulation) of measured prototype data. Likewise, cost, size, and weight shall be extrapolated from the partially populated prototype. The prototype need not be subjected to environmental testing (which is also prohibitively expensive), but the prototype design shall anticipate the need for environmental enclosures (radomes, gaskets, seals, etc.) and structural strengthening for shipboard operation and rotation at 12 rpm when determining final size, weight, and cost. Estimates of weight shall include a mechanical structure capable of withstanding high winds (90 knots operational and 120 knots without damage) and icing in accordance with MIL E 16400 (and without sustaining damage with ice loading of seven pounds per square foot of antenna surface).

PHASE I: Propose a concept for an affordable and lightweight antenna meeting the objectives and performance parameters described above. Demonstrate feasibility through a combination of analysis, modelling, and simulation. The feasibility analysis shall include predictions of performance parameters, size, weight, and cost described in the Description. The Phase I Option, if exercised, will include development of initial design requirements, performance specifications, and a capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype (or partially populated array prototype) that meets the requirements defined above. Ensure that the prototype should be sufficiently complete (populated) such that measured data is meaningful and can be extrapolated (using analysis, modelling, and simulation) to predict the performance of a full prototype antenna. The size, weight, and cost of a full, qualified (deployable) antenna shall also be extrapolated from the data obtained from the prototype design. At the conclusion of Phase II, the prototype antenna (and supporting data) will be delivered to the Government for additional testing, design analysis, and to facilitate future systems integration.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Government use. This is expected to entail the finalization of specifications, completion of a final design, production of a drawing package, selection of materials, testing, and support during system and ship integration. The final antenna will be tested according to the SPS-49 system specification and applicable military specifications for shipboard equipment. The final product will therefore be a complete antenna, suitable and qualified for replacement of the existing SPS-49 antenna.

The technology should also find additional applications for other surface shipboard radar systems and possibly land-based military radars. Potential commercial applications include weather and air traffic control systems.

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KEYWORDS: Reflect Arrays; Transmit Arrays; Array Lenses; Phased Array; Electronic Elevation Scan; Electronic Phase Shifting

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-030 TITLE: Automated Configuration Deployment and Auditing

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO-IWS5: Surface ASW Combat System Integration, Surface ASW System Improvement

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on

this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an architecture that automates capabilities within Naval Control Systems (NCS) to minimize operator-associated cybersecurity vulnerabilities and streamline rapid fielding of modular capability updates.

DESCRIPTION: Naval Control Systems (NCSs) are comprised of a complex combination of hardware systems, operating systems, and software elements. The installation and configuration of the tactical software, to include operating system, middleware, and applications, is currently a time-consuming, operator-intensive, and error-prone process. Current commercially available solutions do not meet the standards necessary. The Navy needs an innovative process to automate installation, configuration, application deployment, auditing, and reporting of system status within a complex NCS. This process will need to align with the Navy's desire to deploy incremental capability improvements to ships at sea in a manner that maintains secure cyberspace posture and weapons safety. It is envisioned that the solution will include software and an architectural construct.

The current operator-intensive installation process can result in the introduction of cybersecurity vulnerabilities or misconfigurations that affect the performance and effectiveness of the NCS due to inadvertent operator error or the reduction of security controls during the execution of administrative tasks associated with installation. The possibility of operator error also introduces configuration uncertainty. This configuration uncertainty prohibits rapid introduction of modular capability updates.

Industry has demonstrated significant productivity improvements by migrating to automated tools such as Ansible [Ref. 1] to reduce complexity and enable DevOps initiatives. However, industry tools do not account for the rigor associated with weapons safety, with which the Navy must be concerned. Automated tools reduce the cybersecurity vulnerabilities associated with operator-intensive installation processes.

The desired innovation will be able to completely install and configure a tactical capability from a 'bare-metal' state while providing objective quality evidence (OQE) of the installation and periodic auditing of the configuration after installation. The desired innovation will utilize existing Navy-specified system and sub-system components to provide a fully functional operational capability with minimal operator involvement in an automated and repeatable process. The innovation desired should also demonstrate the capability to ingest a modular update to the NCS to allow agile deployment of capability improvements and bug fixes.

The correctness of the automated software deployment and auditing will be measured by objective assessment of proper operating systems configuration, configuration of software applications, and proper allocation of network device operating systems and configurations. By taking an 'infrastructure as code' approach [Refs. 2-5], the desired innovation will ensure the installed configuration is properly version controlled. The automated approach will reduce the need for operator-intensive interaction during installation and configuration, ensuring a repeatable process and reducing the opportunity to introduce cybersecurity vulnerabilities or misconfiguration.

The automated system will produce a logged record of the installation and therefore provide OQE of the installation results and auditing and reporting of current system configuration to permit identification of configuration drift. This will reduce costs associated with maintenance, manning, and operations associated with configuration management and cybersecurity.

The initial Naval Control System transition for this technology will be the AN/SQQ-89 Anti-Submarine Warfare Combat System Element, which fields with different Combat Systems on Cruisers, Destroyers, Frigates, and the Littoral Combat Ships. Testing of the automated system will take place under the cognizance of the Navy at the AN/SQQ-89 Prime Integrator site, currently LM RMS at Manassas, VA.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the

United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Define and develop a concept for innovative software and its associated architecture that will enable the automated installation and configuration of all components of an example NCS. Demonstrate the feasibility of the concept in meeting the parameters in the Description by modeling and simulation or analysis. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build the prototype in Phase II.

PHASE II: Develop and deliver a prototype of the software and its architecture for automated installation and configuration of NCS capabilities. Demonstrate the prototype performance through the required range of desired performance attributes given in the Description. Testing and demonstration will occur at a Government-specified facility.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology to Navy use. The prototype will provide support for Navy specified NCSs and the associated system engineering activities of the program.

The architecture developed has a high potential for dual use in systems that require a repeatable, automated installation and configuration process to reduce the introduction of potential cybersecurity vulnerabilities and misconfiguration in complex, critical systems, such as municipal infrastructure for power (nuclear, electrical) and connectivity. Automated installation and configuration that creates ‘infrastructure as code’ is of high interest to companies like Amazon and Google.

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1. “Ansible is IT Automation.” Ansible, 12 December 2018. https://www.ansible.com/

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3. Sitakange, Jafari. “Infrastructure as Code: A Reason to Smile.” ThoughtWorks. 14 March 2016. https://www.thoughtworks.com/insights/blog/infrastructure-code-reason-smile

4. “HashiCorp Packer.” HashiCorp, 12 December 2018. https://www.packer.io/

5. “HashiCorp Terraform.” HashiCorp, 12 December 2018. https://www.terraform.io/

KEYWORDS: Cybersecurity; Automated Software Deployment and Auditing; Agile Deployment; Naval Control Systems; Combat Systems; DevOps

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-031 TITLE: Digital Mission Planning Tools for Air Cushion Vehicles

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PMS 377, Amphibious Warfare Program Office, Ship-to-Shore Connector.

OBJECTIVE: Develop a mission-planning tool implementing Artificial Intelligence (AI) and machine learning (ML) for afloat mission data collection and analysis.

DESCRIPTION: The Ship-to-Shore Connector (SSC) is an Air Cushion Vehicle (ACV), or "hovercraft", providing amphibious transportation of equipment and personnel from ship-to-shore and shore-to-shore.

The ACV crews need a Mission Planning System (MPS) to support mission planning and post mission analysis for ACV operations that is integrated and synchronized with a lightweight and easy to use handheld tool for use onboard the craft. The LCAC Mission Assessment Tools (LMAT) along with Mission Planning Software (MPS)/Personal Digital Assistant (PDA) will give the Navy Landing Craft, Air Cushion (LCAC) crews the ability to adapt more quickly to requests by the United States Marine Corps (USMC) and accommodate rapidly changing mission parameters such as fuel burn rate and endurance with ease. The MPS will be able to develop and Integrate Mission Plans, Communication Plans, and selected navigation charts to the craft. The MPS should be able to process and display post mission data extracted from the craft. MPS will be a Windows10-based application that will provide mission planning, briefing, and debriefing support to LCAC operational crews and amphibious planning staffs. MPS will also support mission execution by generating electronic mission data packages for use in interfacing the craft's on-board navigation and communication systems. Mission data packages will include Digital Nautical Charts (DNC), operational, navigational and training overlays, mission navigation plans, engine performance and communication plans.

The capability to develop mission plans will support the gamut of Service Life Extension Program (SLEP) and LCAC 100 Class operations, ranging from single craft proficiency-training missions to complex multi-mission, multi-wave amphibious assault operations. This support will include proper route planning, environment-based predictive performance computations to ensure mission viability and conformance to approved operational envelopes, and post-mission analysis of executed missions through playback of recorded navigation, engineering, and communication data.

The system will provide a means to conduct off-craft mission planning and to perform post mission analysis of craft recorded data. Mission planning for ACVs currently takes over four hours and requires use of multiple volumes of manuals and data for implementation and years of training to do properly. Application of AI and ML to the solution will condense the mission planning to a single application based on a series of inputs, which include environmental conditions, cargo, distance, and crew day (calculated Main Engine start to Main Engine stop), greatly decreasing the amount of time needed to plan a mission and allow for greater flexibility when mission requirements change. There are unique sets of performance data for the SLEP LCAC with deep skirt as well as different power settings and engine performance tables for ETF40B engines which include fuel burn rate and endurance. This performance data will be contained within the software installed on each PDA and Land Based mission planning computer system. The MPS/LMAT will allow removal of the bulk of the performance data from the Safe Engineering and Operations (SEAOPS) Volumes and eliminate the complex iterative hand calculations within the planning process.

The MPS software will replace SLEP LCAC systems that are currently in fleet use and contains the following applications:
- Vehicle weight database
- LCAC Weight Allocation Calculator
- Crew Day Calculator
- Electronic Version of SEAOPS OCP Mission Planning Checklist
- LCAC Performance and Analysis System (LPAS)/MPS Computers

The LMAT will give the Navy LCAC crews the ability to adapt more quickly to requests by the USMC and accommodate rapidly changing mission parameters with ease. This is critical for an ACV, which has a defined balance of fuel and payload versus range.

Software developed must be executable on Government-approved Navy/Marine Corps Intranet (NMCI) compliant computing devices and integrated into standard NMCI software loads or software compatible with NMCI systems. Software must be adaptable by Navy System Subject Matter Experts to meet emerging needs and changes to mission priorities. The handheld tool will allow for greater flexibility by being able to be carried with the crew for on-the-fly mission changes. Prototype software is to be loaded on an ACV or appropriate test platform for human factors and regression testing at Naval Surface Warfare Center Panama City Division (NSWC-PCD).

PHASE I: Develop a concept for an MPS/LMAT for ACVs with an onboard handheld device that meets the requirements of mission planning tools for the unique sets of performance tables/data for the LCAC 100 Class with Advanced skirt, and SLEP LCAC with deep skirt as well as different power settings and engine performance tables for MT7 andETF40B engines. Ensure that the performance data will be contained within the software installed in a PDA-type device and the land-based desktop system, which will allow removal of the bulk of the performance data from the SEAOPS Volumes and eliminate the complex iterative hand calculations within the planning process. Incorporate latest data from all SEAOPS Volumes into PDA as described above. Demonstrate the feasibility of the concept in meeting Navy needs and demonstrate that the MPS concept can be readily and cost-effectively manufactured through standard industry practices by proof testing and analytical modeling. The Phase I Option, if exercised, should include the initial layout and capabilities to build the prototype in Phase II.

PHASE II: Develop and deliver a prototype MPS/LMAT with an onboard handheld device that meets the intent of the Description. Demonstrate the prototype on an ACV or appropriate test platform for human factors and regression testing at NSWC-PCD and support the testing. Evaluate the prototype to determine its compatibility with current craft layout and ability to perform to requirements. Use evaluation results to refine the prototype into a design that will meet the LCAC SLEP and LCAC 100 class Specifications. Prepare a Phase III development plan and cost analysis to transition the technology to Navy use. Provide detailed drawings, code and specifications in Navy-defined format.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the MPS for use on the Navy ACV program. Refine the design of the MPS, according to the PMS 377 Phase III SOW, for evaluation to determine its effectiveness in an operationally relevant environment.

The SSC MPS will have private sector commercial potential for craft of this scale operating in the near-shore or on-shore environment. Commercial applications include hovercrafts, airplanes, helicopters, ferries, the oil and mineral exploration/retrieval, automotive, and cold climate research and exploration.

REFERENCES:
1. Englander, Jacob A., Conway, Bruce A., and Williams, Trevor. “Automated Mission Planning via Evolutionary Algorithms.” Journal of Guidance, Control, and Dynamics, Vol. 35, No. 6, November-December 2012. https://arc.aiaa.org/doi/abs/10.2514/1.54101

2. Damilano, Luca, Guglieri, Giorgio, Quagliotti, Fulvia, Sale, Ilaria and Lunghi, Alessio. “Ground Control Station Embedded Mission Planning for UAS.” Journal of Intelligent & Robotic Systems, January 2013, Volume 69, Issue 1-4, pp. 241-256. https://link.springer.com/article/10.1007/s10846-012-9697-2

KEYWORDS: Ship-to-Shore Connector; Air Cushion Vehicle; Mission Planning Software; Machine Learning; Hovercraft; Artificial Intelligence; ACV; ML; AI

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-032 TITLE: High-Efficiency Wideband Linear Power Amplifier

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: Program Executive Office (PEO) Integrated Warfare Systems (IWS) 6.0; Command & Control (C2) Director

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a high-powered Radio Frequency (RF) linear power amplifier that enables efficient, linear operation with multiple simultaneous signals across a wide instantaneous bandwidth capable of operating in an active antenna array.

DESCRIPTION: Current Navy directional, tactical communication networks operate in a one beam at a time fashion with each message exchange assigned separate time slots. This limits network performance and spectral usage. The next generation of communication networks will use multiple simultaneous beams to leverage the spatial dimension in order to establish multiple communication links simultaneously in different directions. To achieve the major networking advantages of multi-beam operation (discussed below) enabled by digital array communications technology, power amplifiers will need to be developed that do not generate unacceptably high levels of interfering nonlinear effects when multiple communications signals are transmitted through them simultaneously. Current state-of-the-art amplifier designs are challenged to achieve acceptable levels of linearity performance without significant reductions in RF power, bandwidth, and power-added efficiency. Due to the reduced link ranges and allocated bandwidths of commercial communications, there is little investment to meet the metrics required for Navy operation.

Linearity together with power, bandwidth, and efficiency enables multichannel Transmit (Tx) capability. This, in turn, yields increased network throughput and decreased latency. High linearity also enables new, modern waveforms that further improve throughput. Improved throughput is needed to support the increasing network sizes; the growing emphasis on joint, cooperative, and net-centric technologies; as well as the proliferation of Unmanned Aerial Vehicles (UAVs) and other persistent surveillance platforms with their high throughput requirements. The resulting increased throughput will enable the flow of more data and growth in new mission areas such as Ballistic Missile Defense and Electronic Warfare. The decreased latency will enable new and compressed kill chains against advancing threats as well as larger networks. The Navy needs a technology that provides simultaneous, multichannel Tx operation. This will enable the warfighter to expand and refine the battlespace through improved and expanded network functionality.

A solution is needed in the area of high-powered RF linear power amplifier. Advanced techniques such as those described in [Refs. 1-3] will be needed to attain the targeted performance metrics. Current commercially available power amplifiers do not meet the combined power, bandwidth, linearity, and efficiency performance needed for military, multichannel operations.

The prototype amplifier solution must demonstrate the following performance metrics: (1) The amplifier will transmit M-ary Continuous Phase Frequency Shift Keying (CPFSK) and Orthogonal Frequency Division Multiplexing modulations and up to 4 simultaneous signals located in C-band (4 GHz to 8 GHz). The instantaneous bandwidth of these signals will be relatively narrow compared to the operational bandwidth of all C-band. 8 is a stretch goal for the number of simultaneous signals. (2) The peak power output by the power amplifier should be selectable from 36 dBm to 46 dBm in 2 dB steps. (3) The goal for the Error Vector Magnitude (EVM) is 2% or less. (4) The output third order intercept should be more than 55 dBm. (5) The goal for the power-added efficiency is 55% or more. (6) The goal for the power gain is 45 dB. All performance metrics should be met while operating with an output Voltage Standing Wave Ratio (VSWR) between 1:1 and 2:1 in the architecture.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Define and develop a concept for a high-efficiency wideband linear power amplifier. Demonstrate the concept can feasibly meet the Navy requirements as provided in the Description. Establish feasibility by a combination of initial analysis and modeling and if possible, through demonstration on existing hardware. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype in Phase II. Develop a Phase II plan that includes prototype testing, evaluation, and demonstration.

PHASE II: Develop and deliver a prototype power amplifier that demonstrates the performance parameters outlined in the Description. Validate the prototype through comparison of model predictions to measured performance.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. Further refine the prototype for evaluation to determine its effectiveness and reliability in an operationally relevant environment. Support the Navy in the system integration and qualification testing for the technology through platform integration and test events to transition the technology into PEO IWS 6 applications for simultaneous communications links to improve and expand tactical network functionality.

High-powered RF linear power amplifiers will have direct application to private sector industries that involve directional communications between many small nodes over large areas. These applications include transportation, air traffic control, and communication industries.

REFERENCES:
1. Cripps, Steve C. “Advanced Techniques in RF Power Amplifier Design.” Artech House Inc., Norwood, MA, 2002. http://file.yizimg.com/335677/2009090811191191.pdf

2. Colantonio, Paolo, Giannini, Franco, and Limiti, Ernesto. “High Efficiency RF and Microwave Solid State Power Amplifiers.” John Wiley & Sons Ltd., Chichester, West Sussex, United Kingdom, 2009. https://www.semanticscholar.org/paper/High-Efficiency-RF-and-Microwave-Solid-State-Power-Colantonio-Giannini/314063c2ba5bd5859aeec977d001b8a20e1e2372

3. Kenington, Peter B. “High-Linearity Amplifier Design.” Artech House, Inc., Norwood, MA, 2000. https://www.researchgate.net/publication/234790378_High_Linearity_RF_Amplifier_Design

KEYWORDS: Linear Power Amplifier; Power Added Efficiency; High-powered Radio Frequency; RF; Multibeam Operation; Digital Array Communications; Spatial Dimension

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-033 TITLE: Real-Time Adaptive Data Model and Dynamically Extensible Markup Language for Distributed Common Operational Picture

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS 1.0, AEGIS Combat System Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a real-time extensible and evolvable Distributed Common Operational Picture (DCOP) battlespace data model and associated descriptive battlespace data model markup language to improve command and control.

DESCRIPTION: The current AEGIS combat system implementation does not include a comprehensive distributed (i.e., multi-platform) capability for capturing the complete battlespace operational, environmental, and tactical picture in a coherent integrated manner. Currently available commercial systems and software that might be considered for adaptation to Navy needs (e.g., the FAA Air Traffic Control System hardware and software) are dated in their design, and lack the flexibility and track capacity required to adequately address Navy tactical needs. Specifically, currently available commercial technology is limited in that it lacks the capability to track, identify, and manage complex air, surface and subsurface entities and threats present in the DoD environment. A new capability is needed within AEGIS to present a common operational picture (COP) with complete situational awareness to the combat system watch standers. In order to support the development of such a COP subsystem, an innovative design is needed for a real-time adaptive data model of the battlespace, capable of supplying fire-control quality data to combat systems software applications. Development of such a data model will require achievement of dynamic on-the-fly run-time variation capability requirements critically necessary to successfully perform the mission within a rapidly changing combat scenario. The subsystem architecture should have the capability to provide engagement quality real-time track data to any combat systems application, which makes use of the services provided by the subsystem.

Sources of data may include identification data, estimated platform sensor and weapons capabilities, and observationally-derived behavioral data for entities within the battlespace. The subsystem must be modular in nature, and support sharing of the COP across all warfighting platforms within the battlegroup in a manner which insures the data coherence of the COP on every platform to the greatest extent possible.

The DCOP architectural model is needed and must have a common, expandable, and evolvable data model that supports the relevant metric set for any potential battlespace entity. An “evolvable” data model architecture should have the intrinsic capability to support any later addition, extension and/or modification without the requirement of extensively rewriting or scrapping previously developed code. The DCOP data model, including all its constituent software structures and component data elements, should, when taken in total, be capable of quantitatively and qualitatively describing the tactical and operational characteristics of all battlespace entities. This includes friendly, hostile, and neutral (i.e., non-combatants) within the host combatant’s Battlespace Area of Responsibility (AOR). It also includes any tactically relevant surface, subsurface, underwater, air and ground sensors, and weapons systems with their associated data and control streams capable of having an impact within the scope of the DCOP Battlespace AOR. The DCOP data model must also be capable of supporting data structure components and associated data fields enabling multi-platform data synchronization, access control, time tagging, and data senescence. Since it will not be possible to completely capture all relevant parameters for newly emerging combatant entities, sensors, or weapons systems, the data model must be dynamically evolvable and extensible (at run time) to provide for the emergence of previously unknown battlespace entities and their associated operational and tactical parameters. This combination of an overarching battlespace scope, a real-time non-disruptive data model, and structure content adaptability/evolvability, as well as multi-platform data synchronization support, are required for implementation of a DCOP capability within the fleet.

A Distributed Data Model Markup Language (DDML) will be developed to provide a software data structure design tool for DCOP, and a well-defined and concise documentation mechanism for all data structures making up the DCOP data model. The DDML will implement a dynamic, evolvable, and extensible descriptive linguistic construct capable of capturing the contents and structure of all DCOP data model constituent software structures and associated component elements as described above. The DDML must consist of a human-readable / machine-readable text-based (ASCII/Unicode compliant) descriptive language construct supporting linguistic components and structures roughly based on the Extensible Markup Language (XML) 1.0 Open Standard. The intent of developing the DDML is to provide both a software data-structure design tool for DCOP, as well as a well-defined and concise documentation mechanism for all data structures making up the DCOP data model as a whole. The DDML will provide a development tool, which will assist in both initial creation as well as any future maintenance, expansion, and adaptive evolution of the DCOP data model. This will enable the data model to capture operational and tactical characteristics of future battlespace entities not yet encountered or envisioned.

The DCOP architecture should be capable of supporting the ability to allow the successful modification of DCOP data structures within an operating software environment. It is also critical that any data model changes made within an operating software environment can be accomplished without significant negative impact on currently executing software accessing the DCOP data model. Specifically, run-time modification of the DCOP data structures should be possible without: (a) requiring the running software to be paused or cease operation; or (b) requiring the need to restart/reload the system.

Both the DCOP data model and its associated DDML descriptive language architecture shall be well documented and conform to open systems architectural principles and standards. Implementation attributes should include scalability and the ability to run within the computing resources available within the AEGIS combat systems BL10 or later environment.

The DCOP data model should initially include operational and tactical parameters, maneuvering capabilities, sensors, weapons, and off-board tactical and operational data sources (Unmanned vehicles, Satellite links, etc.). Focus will be on commonly encountered battlespace entities (air, surface, and subsurface platforms) and their respective associated parameters (radar, sonar, and EW track data).

The parsing application may be written in either C++ or Java and be capable of running in both 64-bit Windows (Version 10 or later) and Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) processing environments as a standalone application (i.e., no critical dependencies on network-based remotely hosted resources). The prototype DDML parser will demonstrate the following: (i) The ability to generate C++ data structure analogues to DDML linguistic components, and assemble them into overarching or composite data structures, each of which aligns to an associated battlespace entity; and (ii) The ability to non-destructively modify and update currently existing data structures within an operational DCOP environment.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design, develop, and deliver a concept for a real-time extensible and evolvable DCOP battlespace data model and associated descriptive battlespace data model markup language. Establish the concept through evaluation of the ability of the proposed model. Establish that it can successfully capture all tactical and operational battlespace parameters as detailed in the Description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype software DDML parsing application capable of generating data structures compatible with the C++ programming language and compliant with the requirements outlined in the Description. Use evaluation and test results to refine the prototype into a revised design that will meet Navy requirements. Develop and propose a Phase III Development Plan to transition the technology to Navy.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Implementation will include the integration of the DCOP data model for evaluation to determine its effectiveness in an operationally relevant environment at an AEGIS test site or test bed.

This technology has potential within the commercial Air Traffic Control system in future development of an air traffic "common operational picture" capable of handling complex traffic control patterns.

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KEYWORDS: Battle-space Data Model Markup Language; Extensible Markup Language; Distributed Common Operational Picture; Battlespace Data Model; Time-tagging and Data Senescence; Dynamically Evolvable and Extensible Data Model

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-034 TITLE: Low-cost, Expendable Surface Ship Threat Countermeasure

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PMS 415, Undersea Defensive Warfare Systems Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Design and develop a combined, compact, multi-function, lightweight, expendable, low-cost surface ship countermeasure capable of countering ever-increasing adversarial threats.

DESCRIPTION: All key U.S. Navy surface combatants require expendable countermeasure protection from adversarial torpedoes. The current Program of Record (PoR) uses submarine variant countermeasures for surface ship deployment, of which the submarine devices are overdesigned for surface ship requirements (i.e., temperature, shock, hydrostatic pressure). The Navy desires to tap into existing innovative form-factor reconfiguration and/or miniaturization capabilities and develop a lower-cost surface ship countermeasure that meets the surface ship environmental requirements while maintaining the notional acoustic and functional requirements of the current acoustic device countermeasure (ADC) Mk 2 Mod 6. Key surface ship environmental requirements that the device must withstand include, in general, resiliency to temperature shock, shipboard-launched water impact, and hydrostatic pressure up to 250 feet depth. Further testing details are listed below. It is expected this redesign of the existing submarine countermeasure adopted for surface ship use will reduce unit item cost while reducing overall lifecycle costs compared to the existing PoR. As a goal, a 20% to 25% reduction in unit cost, and a similar life-cycle cost reduction, is desired to facilitate installation aboard a wider range of surface platforms. As an added benefit to the warfighter, the devices ultimately resulting from a successful SBIR effort will not only provide the same mission capability and performance, but also have the potential of providing an innovative sailor-friendly form-factor.

In terms of test and evaluation throughout the Phases of this SBIR topic, Phase I is intended to develop a concept for an end-to-end design of a redesigned ADC Mk 2 Mod 6 that meets the operational requirements of the current device, but only meets the environmental requirements for over-the-side shipboard launch. Phase II is intended to evaluate three to five prototype systems and their abilities to acoustically perform both before and after exposure to primary environmental stress screening involving temperature shock (-54°C in air to 2°C in water, and +71°C in air to 15°C in water), shipboard-launched water impact of 80g radial acceleration and 25g axial acceleration, and hydrostatic testing to 250 feet depth. Environmental stress testing, including pre- and post-acoustic testing, will take place at facilities maintained by the Naval Undersea Warfare Center in Newport, Rhode Island. These Phase II tests will be the responsibility of the proposer with assistance and test facilities provided by the Navy. Phase III is intended to evaluate further matured devices against more formal environmental and operational tests, including storage temperature thermal cycling (-54°C to +71°C), lightweight shock testing (MIL-S-901D), vibration testing (MIL-STD-810, Section 528.1), in addition to operational in-water acoustic testing in a demonstration on a Navy instrumented test range. There is potential for some of this extended testing to occur in Phase II if the Phase II prototype design is a mature representation of a potential low-rate initial production design that is expected during Phase III.

Work produced in Phase II will likely become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for an end-to-end design of a redesigned ADC Mk 2 Mod 6 that meets the operational requirements of the current device, but only meets the environmental requirements for over-the-side shipboard launch, of which are noted in the description. Include, in the design, details of the modularized reconfiguration of the existing acoustic projector, electronics, and thermal lithium power supply, which notionally can be provided as Government Furnished Information (GFI). Establish the feasibility of the design through modeling and simulation pitted against known environmental requirements enabling surface ship launch capability. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and build three to five prototype devices for testing and evaluation. Further refine the prototype systems that can be transitioned to the Navy. Conduct evaluation and testing of the prototypes based on the environmental requirements for over-the-side shipboard launch, including but not limited to, temperature shock (-54°C in air to 2°C in water, and +71°C in air to 15°C in water), lightweight impact shock testing, and hydrostatic testing to 250 feet depth, as well as the performer’s low-level subassembly performance tests. Further details of the testing requirements are noted in the Description. Include acoustic evaluation, which will take place both before and after environmental stress testing at facilities maintained by the Naval Undersea Warfare Center Division Newport. Ensure final delivery of three (3) to five (5) prototypes. Perform initial testing with assistance and test facilities provided by the Navy. Assist the Navy with follow-on testing.

It is probable that the work under this effort will be classified under Phase II (see Description for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use in the form of follow-on Low-rate initial production (LRIP) units using any lessons learned from the Phase II prototyping and testing efforts. Provide engineering support for full environmental testing, which will expand on the testing that was performed within Phase II. The primary applicable NAVSEA program office is PMS 415, which resides within PEO SUBS. Some alternative Naval applications include active sonobuoys, training targets, and alternative acoustic sound sources. . Perform testing that includes long-duration storage temperature thermal cycling between -54°C and +71°C, lightweight shock testing in accordance with MIL-C-901D, vibration testing (shipboard and transportation in accordance with MIL-STD-810, Section 528.1), and all associated acoustic evaluation testing (source level, duration, and frequency content), both before and after environmental stress testing. (Note: There is potential for some of this extended testing to occur in Phase II if the Phase II prototype design is a mature representation of a potential low-rate initial production design.) Launch at least five LRIP units from a U.S. Navy surface ship to assist in the full circle environmental evaluation of the design.

Some commercial applications include marine mammal acoustic diversions and geological exploration.

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KEYWORDS: Surface Ship Torpedo Defense; Acoustic Countermeasure; Soft-kill Torpedo Countermeasure; Anti-submarine Warfare; Lightweight Shock Testing; Environmental Qualification Testing

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-035 TITLE: Advanced Compact Shipboard High Temperature Superconducting (HTS) Cable Terminations

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 320 Electric Ships Office

OBJECTIVE: Develop an innovative warm-to-cold high temperature superconducting power cable termination suitable for shipboard applications.

DESCRIPTION: The U.S. Navy is progressing toward increased electrification of ship systems and weapons requiring unprecedented levels of power distribution capabilities on ships. Electric propulsion motors are expected to demand 20-80MW per ship supported by multiple 10-40 MW generator sets. Additional high-power loads will include rail guns, lasers, electronic warfare systems, and high-power radar. These systems will be tied together through an integrated power system (IPS) that maximizes the utility and efficiency of installed power generation by routing power to loads on demand. A primary benefit of the IPS approach is an increase in overall power distribution density, electrical efficiency and fuel savings. Moving 10's to 100's of MW of power around a ship favors increased distribution voltages (greater than 450VAC and/or 6-18 KVDC) to minimize added cabling necessary to overcome the ampacity limits of traditional conductors. High Temperature Superconductors (HTS) are candidates for advanced conductor technology that can be used to increase the power distributed through a single lightweight cable without the necessity of going to higher voltage. Implementation of these technologies require HTS power cable termination suitable for shipboard applications. An additional benefit of a HTS cable system is the ability for co-axial or tri-axial cable designs that minimize externally emitted magnetic field thereby having no impact on ship magnetic signature. The compact cable termination will also enable center of gravity favorable power delivery to high elevation loads eliminating the negative weight impact using traditional copper conductors. Additionally, decoupling the cryogenic cooling system from the cable and termination would allow for additionally favorable placement of the heavier cryogenic system components lower in the ship.

HTS power cables have been successfully operated in several land-based demonstrations using liquid nitrogen as the cryogen. The primary benefit of HTS cables for in-grid land applications is the ability to utilize existing cableways, or right-of-way, originally intended for underground or overhead transmission cables to increase power distribution by 10. This is particularly useful in upgrading power distribution in cities with growing load demands where conventional approaches to expanded distribution is not feasible. While the HTS cable generally has an outer jacketing diameter in the range of 1.5 inches to 3 inches, the cable termination is usually several orders of magnitude larger. These terminations generally serve as the entry and exit point of the cryogen requisite to maintain the conductor's superconducting state. Minimizing the physical size and weight of terrestrial HTS cable terminations has not been a focus of the community. Existing terminations are unsuitable for the Navy shipboard environment since they impose a large footprint at each end of the cable.

The Navy has been developing superconducting cable technology using cryogenically cooled helium gas, which eliminates the logistic impact of handling a liquid cryogen and minimizes safety concerns related to the 700-time volumetric expansion of nitrogen from liquid to gas state. This gaseous helium cooling approach has been demonstrated in HTS degaussing cables as well as power cables. The cryogenic systems used in these cables have been optimized to provide gaseous helium at 50 K (-367°F) and up to 20 Bar (290 psi) charge pressure with mass flow rates up to 10 grams/sec.

Novel solutions are required to advance HTS cable technology through the development and testing of a compact cable termination to serve a wide range of naval power applications including shipboard power distribution and shore power. Proposed solutions should include flexibility to integrate with multiple HTS cable topologies including single and multiple-pole configuration of Conductor on Round Core cable (CORC®) or co-axial cable designs. The termination will enable the transition from the cryogenic superconducting cable to the ambient temperature environment and interface with conventional conductors or buss bar while also providing means for cryogen entry and exit. The termination should be scalable from 1kA-4kA, applicable for 450VAC and above and/or 12kVDC and above, for 2 MW to 100 MW of power while incorporating a McFee-based cryogenic current lead optimization approach. Proposed solutions shall include plans for verifying the design through testing within the Phase II effort. Cable termination concepts that include a compact termination, less than 6-in diameter by 12-in length at one end of the cable, and a requisite larger (24-inch diameter by 36-in) termination at the opposite end are acceptable under this topic. A successful termination product will enable the cost competitive acquisition of an affordable HTS system.

PHASE I: Develop a concept and demonstrate the economic, technical and manufacturing feasibility of a compact superconducting power cable termination design that meets the needs of the Navy as defined in the Description. Demonstrate the design and manufacturing concepts through modeling, analysis, and bench top experimentation where appropriate. Document the identification of the size, weight, and cryogenic thermal load vs current, along with ability and impact of scaling voltage and current ratings. Include, in the Phase I final report at a minimum, the technical and economic feasibility and the ability to complete more than one prototype termination iterations with the Phase II funding. The Phase I Option, if exercised, should include an initial detailed design and specifications to build a prototype with the Phase II effort.

PHASE II: Develop, fabricate, and test prototypes of compact HTS cable terminations of a quantity to fit within the scope of work and accomplish tasking. Perform testing activities that include demonstration and characterization of key parameters and objectives at the proposer's facility or other suitable testing facility identified by the offeror. Design the compact cable terminations for rated voltage and current, integrated with a HTS cable, and test them using a gaseous helium cryogen. Test the terminations to demonstrate the ability to meet the design characteristics. Deliver the Phase II prototypes consisting of HTS cables and terminations to the Navy for further testing. Submit the design and drawings of the tested superconducting compact cable termination prototypes to the Navy. In addition, submit to the Navy any updated designs, design changes, and related drawings that result from lessons learned discovered during prototype testing. Ensure that the final submitted design will pass Navy qualification testing (MIL-S-901D, MIL-STD-167-1, and others) once manufactured.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Perform market research, analysis, and identification of teaming opportunities with industry partners to establish production-level manufacturing capabilities and facilities that will produce and fully qualify a HTS cable and compact termination. Transition the compact superconducting cable termination to the Electric Ships Office for incorporation into shipboard power systems. Develop manufacturing plans to facilitate a smooth transition to the Navy.

This technology has potential high-value application in the commercial electric power industry, including the electric power transmission and distribution; and high-power-use industries (e.g., Data storage and Supercomputing centers). It is expected this technology will enable compact superconducting cables to serve high power loads without the traditional termination footprint requirement.

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KEYWORDS: High Temperature Superconducting Cable Termination; High Temperature Superconducting; Advanced Conductor; Power Distribution; Cryogenic Helium System; Cryocooler

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-036 TITLE: Dynamic Loadable Module Architecture and Applications Program Interface for a Distributed Common Operational Picture Subsystem

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS 1.0, AEGIS Combat System Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a real-time extensible and evolvable architectural model, software framework, and Applications Program Interface (API) for a modular software execution environment capable of supporting dynamic run-time installation and control of new capabilities via the use of dynamically installable and reconfigurable software modules.

DESCRIPTION: The Navy has a requirement to expand its sea-based advantage through increased capability. This need can be addressed by providing technology that has the potential to improve ship combat effectiveness and efficiency by significantly improving battlespace situational awareness, thus reducing the management complexity of the overall battlespace. This may allow for a reduction in the number of platforms needed in a specific tactical arena to provide an equivalent track engagement capability, and for reduced staffing or increased duty time. By reducing the potential stress and fatigue levels experienced by the operator while monitoring tracks in a sensor- or communications-compromised or denied environment, the Navy can potentially reduce shipboard manning requirements, and subsequently improve affordability.

The current AEGIS combat system implementation does not include a comprehensive distributed (i.e., multi-platform) capability for capturing the complete battlespace operational, environmental, and tactical picture in a coherent, integrated manner. Currently available commercial systems and software, which might be considered for adaptation to our needs (e.g., the FAA Air Traffic Control System hardware and software), are dated in their designs, and lack the flexibility and track capacity required to adequately address Navy tactical needs. Specifically, currently available commercial technology is limited in that it lacks the capability to track, identify, and manage complex air, surface and subsurface entities and threats present in the DoD environment. The Navy needs a modular software execution environment and API intended for integration into a Distributed Common Operational Picture (DCOP) software subsystem. This modular execution environment will provide the DCOP software subsystem with the ability to dynamically (on-the-fly) install, remove, or modify DCOP capabilities without disrupting the ongoing real-time performance of the DCOP subsystem, other currently executing combat systems applications, or the host combat systems performance as a whole. The capability is needed within AEGIS to present a common operational picture (COP) to the combat systems watch stander. The subsystem must be modular in nature, and support the sharing of COP data across all participating platforms within the battlegroup in a manner, which ensures the real-time multi-platform coherence and synchronization of COP data on every platform to the greatest extent possible.

The DCOP architectural model, software framework, and API should be considered in context with an appropriate DCOP data model (DM), DM markup language, and multi-platform data coherency and synchronization algorithm set. These components, when considered as a whole, should be capable of supporting the functional capabilities and requirements needed to provide a comprehensive real-time battlespace DCOP to each Navy or allied warfighting platform capable of hosting a DCOP subsystem.

The DCOP architectural model and software framework must be capable of providing both combat systems operators and combat systems software applications with real-time access to a distributed (i.e., multi-platform) COP. This COP represents a complete tactical view of the battlespace as well as all tactical and non-combatant entities present within the ship’s Area of Responsibility (AOR) and is characterized by a set of quantized parameters associated with each “entity” resident within the battlespace. The actual parameters for each entity will be defined by a DCOP real-time extensible and evolvable battlespace data model (and its associated markup language) which will constitute an associated modular component of the overall DCOP subsystem.

The DCOP architectural model and software framework must be capable of supporting “on-the-fly” addition and/or deletion of DCOP capabilities, with each capability implemented via a loadable software module. The installation, removal, activation, and deactivation of software modules within an executing DCOP implementation should have no adverse effect on the real-time performance of the DCOP system and/or the services it provides to the host platform and operator at the time those changes are implemented. An exemplar of this type of low/no impact behavior during runtime installation and removal of capabilities within an executing system can be observed in the kernel module control facilities of the Linux operating system (kernel 4.4 and above), such as the insmod, rmmod, depmod, lsmod, modinfo and modprobe commands [Refs. 2, 3]. The process of installing, removing, or otherwise controlling DCOP services and capabilities within an executing DCOP installation should be easily executed by combat systems watch personnel without the need to stand down, halt, or reload the currently running combat systems software instance and without the attention of specially trained software maintenance personnel.

The DCOP subsystem architecture and software framework must be capable of supporting battlespace common operational picture data access control and multi-platform DCOP data coherency and synchronization mechanisms as a modular replaceable or upgradable component of the overall DCOP architecture. To this end, the DCOP subsystem architecture will utilize a modular multi-platform high-reliability communications services capability provided by the host combat system, in conjunction with its own resident modular multi-platform data coherency/synchronization algorithm. This will ensure that the DCOP battlespace data model reflects the current real-time state of the battlespace, notwithstanding data update related multi-platform communications issues due to enemy electronic countermeasure action and problematic atmospheric radio frequency environment issues.

The DCOP API should provide a DCOP data access and subsystem control interface capable of supporting two major categories of DCOP-related software applications or modules. First, it must support the DCOP subsystem capabilities implementation modules, which add, remove, or control organic capabilities and services within the DCOP subsystem itself, with the purpose of enhancing the overall suite of capabilities and services, which DCOP provides to the platform’s combat system. Second, it must support the COP data access to combat systems hosted and console operator-initiated client applications or other software entities (e.g., software agents) resident within the combat systems suite, which require DCOP API-based real-time access to common operational picture data. The API architecture and software framework will provide an accessible data abstraction layer between any combat systems client software application and the actual DCOP data structure implementation maintaining common operational picture data, insuring that any combat systems applications remain independent of any implementation-specific changes, enhancements, etc. made to the DCOP data model and supporting data structures.

Both the DCOP architectural model and its API shall be well documented and conform to open systems architectural principals and standards [Ref. 4]. Implementation attributes should include scalability and the ability to run within the computing resources available within the AEGIS combat systems BL9 or later environment.

The software implementation of the DCOP prototype subsystem should be compatible with the C++ programming language and capable of running in a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) processing environment as a standalone application (i.e., no critical dependencies on network-based remotely hosted resources, save for sensor data emulators). The prototype DCOP subsystem implementation will demonstrate the following: (i) the ability to install, remove, and control various DCOP capability software modules in an executing system with minimal/no impact on system performance; (ii) the ability to support third party sourced C++ and Java applications requiring real-time access through the DCOP API to common operational picture data resident within the DCOP data model; and (iii) the ability to demonstrate real-time multi-platform sensor data updates, synchronization, and data coherency across multiple executing instances of the DCOP subsystem.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design, develop, and deliver a concept for an architectural model and software framework of a DCOP modular software execution environment and API capable of meeting the subsystem and API requirements and capabilities outlined in the Description. Establish the feasibility of the concept through evaluation of the ability of the proposed model to successfully capture all tactical and operational battlespace parameters as detailed in the Description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Ensure that the software implementation of the DCOP prototype subsystem is compatible with the C++ programming language and capable of running in a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) processing environment as a standalone application (i.e., no critical dependencies on network-based remotely hosted resources, save for sensor data emulators). Ensure that the prototype DCOP subsystem implementation will demonstrate the following: (i) the ability to install, remove, and control various DCOP capability software modules in an executing system with minimal/no impact on system performance; (ii) the ability to support third party sourced C++ and Java applications requiring real-time access through the DCOP API to common operational picture data resident within the DCOP data model; and (iii) the ability to demonstrate real-time multi-platform sensor data updates, synchronization, and data coherency across multiple executing instances of the DCOP subsystem.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the DCOP subsystem software for Navy use. Support implementation that will include the integration of the DCOP subsystem software into a prototype combat system implementation, consisting of one or more of the following: AEGIS BL9 or greater or Common Core Combat System (CCCS) experimental prototype and implemented on a virtualized hardware environment within an AEGIS compliant land-based testbed. This capability has potential for use within the commercial Air Traffic Control system in future development of an air traffic common operational picture, which would be capable of handling complex traffic control patterns.

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KEYWORDS: Real-time Extensible and Evolvable Battlespace Data Model; Resident Modular Multi-platform Data Coherency/Synchronization Algorithms; Current Real-time State of the Battlespace; Loadable Software Module; Run-time Installation and Removal of Capabilities; Common Operational Picture Data

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-037 TITLE: Multi-platform Real-time Synchronization and Coherency Algorithms and Architecture for a Distributed Common Operational Picture Subsystem

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS 1.0, AEGIS Combat System Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a set of real-time multi-platform data synchronization and coherency (DCS) algorithms to support an extensible and evolvable Distributed (i.e., multi-platform) Common Operational Picture (DCOP) subsystem.

DESCRIPTION: A Navy requirement exists to expand its sea-based advantage through increased capability. This need can be addressed by providing technology that has the potential to improve ship combat effectiveness and efficiency by significantly improving cross-platform data transfer and subsequent improvements in multi-platform situational awareness data coherence, thus reducing the management complexity of the overall battlespace. This reduction in battlespace management complexity may allow for a commensurate reduction in the number of platforms needed in a specific tactical arena, improved affordability, and an improvement in the overall tactical efficiency of the battle-group as a whole (i.e., the whole is greater than the sum of its parts). Such improvements to both ship and battle-group tactical efficiency may prove exceedingly cost-effective and lead directly to the “creation of a more lethal force by improving command, control and effectively delivering lethal force within a joint environment” (see 2018 National Defense Strategy [Ref. 1]).

The current AEGIS combat system implementation does not include a comprehensive distributed capability for capturing the complete battlespace operational, environmental, and tactical picture in a coherent integrated manner. Currently available commercial systems and software, which might be considered for adaptation to our needs (e.g., the FAA Air Traffic Control System hardware & software), are dated in their designs, and lack the flexibility and track capacity required to adequately address Navy tactical needs. Specifically, currently available commercial technology is limited in that it lacks the capability to track, identify, and manage complex air, surface and subsurface entities and threats present in the DoD environment.

Work has been done on distributed database system design over the years [Ref. 2]; however, the real-time performance parameters and constraints imposed by Navy tactical requirements on a viable common operational picture (COP) battlespace monitoring and data information subsystem contain a unique set of constraints (i.e., to provide consistent and synchronized fire control quality targeting data) mandating substantial innovation be applied in order to develop a workable solution. The DCOP DCS algorithm set and its associated architecture must be capable of supporting real-time battlespace COP data access control (to eliminate data access race conditions) and multi-platform DCOP data coherency and synchronization mechanisms as a modular part of the overall DCOP architecture. A new capability needs to be developed within AEGIS (as well as any future proposed combat system architecture) in order to present a COP to the combat systems watch stander, which provides that watch stander with complete situational awareness. The Navy needs an innovative method of ensuring real-time data synchronization and coherency across multiple ship- and shore-based platforms implementing a DCOP software subsystem. The focus of this topic is the development of a set of algorithms, and an associated software framework, capable of providing and maintaining real-time fire-control quality data for any and all combat systems applications utilizing the DCOP. Any subsystem which provides such a capability should include detailed engagement-quality track data, identification data from various sources, estimated platform sensor and weapons capabilities derived from organic and non-organic databases, and observationally derived behavioral data for each tactically relevant entity or non-combatant entity within the battlespace. The subsystem must be modular in nature and support the sharing of the COP across all participating platforms within the battlegroup in a manner that ensures the real-time data coherence of the COP on every platform.

The DCOP multi-platform data synchronization and coherency algorithm set should be considered in context with an appropriate DCOP software architectural model, data model (DM), and DM markup language. These components, when considered as a whole, should be capable of supporting the functional capabilities and requirements needed to provide a comprehensive real-time battlespace DCOP to each Navy or allied warfighting platform capable of hosting a DCOP subsystem.

The DCOP data synchronization and coherency algorithm set system model contains the following major components. First, it must contain the DCOP architectural model, software framework, and Applications Program Interface (API), which provides a mechanism for dynamically loading and managing software modules implementing DCOP capabilities and a DCOP API. This API provides various combat systems applications with a real-time mechanism for accessing battlespace COP data in a manner which is independent of the method by which such data is stored and maintained within the DCOP subsystem. Second, the DCOP Data Model, which defines the architecture of the actual DCOP software data structures, must be designed to reflect a parametric model of the actual battle-space and the various entities (friendly, hostile, or neutral platforms and their sensors, weapons, etc.) populating it. Lastly, the DCOP multi-platform data synchronization and coherency algorithm set and its requisite architecture, which has the responsibility of ensuring that each of the various executing DCOP instances and their associated data models residing on the participating DCOP platforms, must maintain a common synchronized and coherent picture of the overall battle-space. The technology sought focuses specifically on the development of this component, but it is important to recognize that the product of this topic is intended for integration with the other DCOP components described.

The DCS algorithms should be capable of monitoring the overall battlespace picture and the various elements and entities within that picture. The algorithms should also be capable of coordinating the real-time synchronization of the data model instances on each participating DCOP platform to ensure COP coherency across the entire DCOP network. In the event that real-time data coherency becomes compromised due to communications issues (e.g., adversary jamming, weather issues), the DCS algorithms must be capable of tagging the impacted non-organic (i.e., off-board) sensor-sourced data structure elements with appropriate coherence-focused “senescence and reliability” metrics. Metrics include, but are not limited to, data update delay in milliseconds, average delay jitters, and multi-source correlation. The algorithms must also be capable of synthesizing an overall Quality-of-Service (QOS) and reliability metric intended to give the operator and/or any combat systems applications an indicator as to the staleness or reliability of the data for any particular battle-space entity.

The DCS algorithms will also be capable of prioritizing and tagging battlespace entities with respect to a set of overarching operator- and Artificial Intelligence-based application-specified threat identification parameters. The algorithms must also be capable of utilizing that data to determine requisite cross-platform and sensor data update rates for each entity within the battlespace, with the intent of minimizing cross-platform data update bandwidth requirements by reducing update rates for non-threatening and slowly changing or moving battlespace entities.

Both the DCOP algorithms and their associated architectural models shall be well documented, and conform to open systems architectural principles and standards [Ref. 3]. Implementation attributes should include scalability and the ability to run within the computing resources available within the AEGIS combat systems BL9 or later environment. The algorithms, as well as any hosting system requirements, should be designed using modular principles with these goals: (i) eventual utilization of the DCOP Application Program Interface (API) for abstracted data structure access; and (ii) the eventual implementation via a dynamically installable software module within the DCOP dynamic loadable module software system architectural model.

Any developed software should be compatible with the C++ programming language and capable of installation within a prototype DCOP subsystem via the use of DCOP modular runtime loading mechanism. The DCOP host subsystem execution environment will be hosted on a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) processing environment as a standalone application (i.e., no critical dependencies on network-based remotely hosted resources, save for sensor data emulators or network-based connections to other running DCOP instances). The prototype DCOP multi-platform data synchronization and coherency algorithm suite implementation will demonstrate the following abilities. First, it must demonstrate the ability to successfully coordinate battlespace COP real-time data synchronization and maintain coherency across 10 or more executing DCOP instances hosted on separate computing platforms. Second, it must demonstrate the ability to successfully tag appropriate data elements within the DCOP data environment with QOS reliability metrics reflecting a loss of QOS when a DCOP communications channel between two or more DCOP instances is compromised or disabled. Third, it must demonstrate the ability to dynamically set DCOP data element update parameters based on operator specified threat identification parameters. Lastly, it must demonstrate the ability to successfully update the DCOP algorithm set software module within an executing DCOP subsystem implementation without impact to the performance of that executing instance.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design, develop, and deliver a concept outlining the algorithms needed to implement a DCOP multi-platform data synchronization and coherency capability meeting the requirements and capabilities as outlined in the Description. Establish feasibility of the concept through modeling and analysis. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Produce a prototype DCOP multi-platform data synchronization and coherency algorithm suite. Implement the prototype and demonstrate the following abilities. First, it must demonstrate the ability to successfully coordinate battlespace COP real-time data synchronization and maintain coherency across 10 or more executing DCOP instances hosted on separate computing platforms. Second, it must demonstrate the ability to successfully tag appropriate data elements within the DCOP data environment with QOS reliability metrics reflecting a loss of QOS when a DCOP communications channel between two or more DCOP instances is compromised or disabled. Third, it must demonstrate the ability to dynamically set DCOP data element update parameters based on operator specified threat identification parameters. Lastly, it must demonstrate the ability to successfully update the DCOP algorithm set software module within an executing DCOP subsystem implementation without impact to the performance of that executing instance.

Demonstrate the prototype capabilities outlined above during a functional test to be held at an AEGIS and/or Future Surface Combatant (FSC) prime integrator supported Land Based Test Site (LBTS) provided by the Government, representing an AEGIS BL9 or newer combat system environment.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the DCOP multi-platform data synchronization and coherence algorithm set prototype for Navy use. Integrate the algorithm set and DCOP subsystem software into a prototype combat system, consisting of one or more of the following: AEGIS BL9 (or greater) or Common Core Combat System (CCCS) experimental prototype implemented on a virtualized hardware environment within an AEGIS compliant land-based testbed.

This technology has potential for dual-use capability within the commercial Air Traffic Control system in future development of an air traffic “common operational picture” capable of handling complex traffic control patterns.

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KEYWORDS: Data Synchronization and Coherency Algorithm Set; Synchronized and Coherent Picture of the Overall Battlespace; Operational Picture Data Access Control; Real-time; DCOP; COP Synchronization of the Data; Resilient Multi-platform Distributed Common Operational Picture; Common Synchronized and Coherent Picture; COP; DCOP

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-038 TITLE: Multi-aperture Active Metrological Sensor for Submarines

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: NAVSEA 073, Advanced Submarine Systems Development

OBJECTIVE: Design an advanced Multi-aperture Differential Image Motion Analysis (MaDIMA) and monitoring system for marine wave boundary turbulence and atmosphere characterization in submarines.

DESCRIPTION: Design an advance metrological sensor based on multi beam and Multi-aperture Differential Image Motion Analysis (MaDIMA) system for the purpose of atmospheric turbulence by using MaDIMA and analysis and monitoring, marine wave boundary layer temperature, pressure, and atmospheric particle contents. The proposed technology shall be based on high-energy multiband short pulse (pico-second) laser, Light Detection and Ranging (LIDAR) technology in time domain, and focal plane array (FPA) for image and intensity mapping from a back-scattered laser. One of the key aspects of this system is that it is mono-static, meaning both laser and MaDIMA are collocated. The metrological system shall survive in a marine environment including temperatures from -40 °C to 60 °C, thermal shock (hot air at +66 °C to warm water at +20 °C and cold air at -54 °C to cold water at 0 °C), severe icing, and UV sunlight. The ultimate objective under the proposed concept shall incorporate pixel-by-pixel mapping of local optical turbulence parameter (Cn2), temperature, pressure, and evaporation fluctuation from periscope-to-target at far field. The MaDIMA system shall consist of short pulse lasers, known as transmitter and detector Focal plane arrays to detect image pulse, and is the receiver in the metrological system in the topic.

Current technology is based on single aperture differential image motion monitor (DIMM) technology. The disadvantage of the system is it requires distance source and it provides only the average marine turbulence parameter only.

This SBIR topic will increase mission capability, increase performance, and/or reduce lifecycle costs by providing advance awareness of Marine Wave boundary atmosphere by optimizing the sensor software and hardware.

PHASE I: Develop a concept to characterize marine wave boundary atmosphere based on MaDIMA and multiband pico second high-energy laser. Demonstrate the feasibility of the concept of multi-aperture differential image motion monitoring and analysis/characterization. Ensure that the proposed concept is able to measure 3-D temperature, pressure, humidity, evaporation, marine particle size (based on the mie scattering or Rayleigh scattering), etc., using active multiband Pico-second lasers integrated with FPA. Co-locate both the laser transmitter and receiver of the metrological system so any optical path of the scatter signal from the atmosphere or reflected signal from the target shall be detected. Ensure that the system operates in multiple mode, such as LIDAR and particle size. Describe and demonstrate the concepts and design of the proposed architecture of the system. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design and develop single lab prototype MaDIMA systems for testing and evaluation. Use this lab prototype to collect data and calibrate system performance. Use the prototype system to characterize marine wave boundary layer atmospheric parameters to show the technology has the potential to meet the performance as metrological instruments under all modes of operation. In the period of performance for the Phase II Option II, if exercised, the Navy shall provide the 3 band Pico-second Laser as Government Furnished Equipment (GFE) to build the integrated MaDIMA system and deliver the field prototype MaDIMA system to the Navy for further evaluation at a Navy Lab. Develop a Phase III transition plan.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Identify the final product and describe how the Navy expects to support transition to Phase III. (Note: The Government will identify the platform or program where the technology has the potential to be used and describe how the technology will meet critical Navy needs.) Assist the Navy with evaluation of the prototype product performance with a standard off-the shelf instrument to calibrate the product; and with validation, testing, qualification, and certification for Navy use as a metrological tool.

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KEYWORDS: Marine wave boundary layer (MWBL); Focal Plane Array (FPA); Differential image motion monitor (DIMM); Multi aperture differential image motion analysis(MaDIMA); Picosecond LIDAR

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-039 TITLE: Power Dense Single Core Three-Phase Transformer

TECHNOLOGY AREA(S): Electronics

ACQUISITION PROGRAM: PMS 400D, DDG 51 New Construction Program

OBJECTIVE: Reduce the size and weight of single-core three-phase transformers for use on Navy Shipboard power distribution systems.

DESCRIPTION: Isolation transformers are used on U.S. naval ships to provide galvanic and ground fault isolation between electrical components of the ship service electrical distribution system. This functionality is critical to the survivability of the ship's power distribution system, as transformers both prevent certain casualties from affecting other aspects of the system and suppress electrical interference and noise between devices.

The U.S. Navy is keenly interested in achieving space and weight savings within the DDG 51 design wherever possible. The three-phase isolation transformers currently in use are large and heavy. These transformers are widely used in many spaces throughout the ship. Space, maintenance, acquisition, and weight savings can all be achieved through new and innovative product development.

DDG 51 class ships currently utilize banks of three dry-type, single-phase 60 Hz transformers, rated at 37.5 kVA per transformer, to provide input isolation within vital loads of the ship service electrical power distribution system. Electrical power of this system is Type 1 60 Hz power, rated at 440 Vrms, three-phase, ungrounded, and is in accordance with the power requirements of MIL-STD-1399-300B Department of Defense Interface Standard: (Section 300b) Electric Power, Alternating Current. A single core three-phase transformer would need to replicate the electrical properties and tolerances, and meet the physical construction requirements of the current single-phase transformer bank design per phase. The transformer can be configured to be bulkhead or deck mounted, and able to be mounted horizontally or vertically. The Not To Exceed (NTE) dimensions and weight of the transformer shall be 95 in.x 71 in x 63 in and 1100lbs respectively. The combined power rating for the three-phase transformer design would be 194.85 kVA, to meet the power handling requirements of the existing transformer banks. The new transformer design would also be required to meet all Navy test and qualification standards including shock, vibration, airborne noise levels, and enclosure design.

Qualification shall be in accordance with Grade B shock of MIL-STD-901D Shock tests High Impact, Shipboard Machinery Equipment, MIL-STD-1310D Shipboard Bonding, Grounding, and other Techniques for Electromagnetic Compatibility and Safety, drip proof in accordance with IP 22, and in accordance with MIL-E-917E Electric Power Equipment Basic Requirements.

Single core three-phase transformers have been used in electric power distribution grids and to power larger electric motors. The commercial units used do not meet Military Standards and U.S. Navy shipboard requirements. Smaller units have been used onboard naval vessels but are not Navy-qualified and only used on non-vital loads. The development goal of this SBIR topic is to miniaturize and militarize this technology for implementation in a naval context. The design should incorporate innovative design aspects, such as novel material selection, to maximize the weight and space savings achieved by this project.

PHASE I: Develop a conceptual design for an affordable, compact, and durable single core three-phase transformer for application to naval ships. Present the salient features of the performance as well as the physical and functional characteristics of the proposed system(s). Using best practices, develop electrical models to predict system performance and provide justification for the model assumptions. Using the results from the modeling, assess the feasibility of the proposed solution to meet the performance goals and metrics. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop, fabricate, demonstrate, and deliver a prototype scaled to fit within the projected scope of the transformer as identified in the Description. Demonstrate that the same technology can support full-scale operation for shipboard power distribution. In a laboratory environment, demonstrate through test and validation that the prototype successfully powers a load and galvanic isolation of the source from the load. Ensure that Operational

Testing of the prototype mimics shipboard operation. Perform Standard Environmental Qualification Testing of the prototype. Perform all analyses and efforts required to refine the prototype into a useful technology for the Navy. Provide detailed drawings and specifications. Document the final product in a drawing package. Develop a Phase III installation plan.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the single core three-phase transformer to Navy use. Develop installation and maintenance manuals for the transformers to support the transition to the Fleet.

Isolation transformers within electrical distribution systems are used on Navy and civilian naval vessels and in commercial applications. Thus, the same potential demand exists in commercial shipping and cruise liners.

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KEYWORDS: Input Transformer; Electrical Power Distribution; Three-Phase Power; Isolation transformer; Galvanic Isolation; Miniaturization; Single Core

Questions may also be submitted through DOD SBIR/STTR SITIS website.

~~N201-040~~ [Navy has removed topic N201-040 from the 20.1 SBIR BAA]

N201-041 TITLE: Bridge-to-Bridge Radio for Unmanned Surface Vehicles

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 406, Unmanned Maritime Systems Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Create a system that converts VHF Bridge-to-Bridge radio transmissions from voice to text to meaning and integrates them into a COLREGS reasoning engine; and generates an intelligent reply to a proposed maneuver.

DESCRIPTION: The nautical rules of the road (COLREGS) provide clear guidance for encounters between two vessels, but they do not directly specify what should happen when three or more vessels come in close proximity to each other at nearly the same time. Mariners commonly deal with such situations by communicating via VHF Bridge-to-Bridge radio. Current Unmanned Surface Vehicles (USVs) have COLREGS reasoning engines, but they cannot incorporate information from Bridge-to-Bridge conversations, nor can they reply to simple maneuver proposals. Component technologies exist to convert voice signals to text, to convert text to meaning, and to maneuver unmanned vessels to avoid collisions while following COLREGS. The Navy seeks an integrated solution that will enable a USV to act much like a human mariner; in particular, the USV should be able to understand secure Bridge-to-Bridge radio transmissions, incorporate their meaning into its world model, develop appropriate maneuvering plans, and respond via voice on the Bridge-to-Bridge radio. Partial solutions to the problem may be acceptable, though preference will be given to approaches that are comprehensive and achievable.

PHASE I: Provide a concept to solve part of or the entire USV Bridge-to-Bridge radio problem stated in the Description. Demonstrate the feasibility of that concept. Ensure that, at a minimum, the proposed end product includes recognizing common call-ups such as “Sea Hunter, this is Sun Princess; propose a port-to-port passage.” Produce English language transmissions from native speakers. Integration with an actual VHF radio is not required in Phase I, but Phase I should include a plan to extend the product in Phase II and beyond, analysis showing viability of that plan, and a proposed approach to Phase II testing.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II that incorporates an actual VHF radio, extends functionality to mariners who speak English as a second language, and generates English replies to proposed maneuvers.

PHASE II: Build a prototype system for testing and evaluation. Incorporate into the prototype, at a minimum, an actual VHF radio, extend functionality to recognize English spoken by non-native speakers, and generate English replies to proposed maneuvers. Explore additional functionalities if feasible, such as integration with a COLREGS reasoning engine and world model. Ensure that the prototype is delivered at least three months prior to the end of Phase II to facilitate ashore testing followed by at-sea testing. (Note: Phase II testing may be accomplished on a manned surrogate vessel with a stand-alone autonomy system running on a laptop or other computer but not actually controlling the vessel’s movements. Phase II testing may also be accomplished on a USV that is temporarily manned for evaluation and safety reasons.) Ensure that the prototype complies with the Unmanned Maritime Autonomy Architecture (UMAA). The Navy will provide UMAA documentation at the beginning of Phase II.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Produce a final end-to-end system that enables a USV to perform like a human mariner, particularly in its use of the VHF Bridge-to-Bridge radio for negotiating maneuvers in situations involving three or more vessels. The Navy will provide a candidate COLREGS reasoning engine for integration along with an Interface Control Document (ICD) at the beginning of Phase III if needed by the proposer. The Navy expects proposers to support transition to Phase III by integrating into the ICD, supporting additional laboratory and at-sea testing, and developing any required intermediate hardware. This technology will be used in the Medium Unmanned Surface Vehicle (MUSV) program, the Large Unmanned Surface Vehicle (LUSV) program, and possibly other USV programs. This technology will meet critical Navy needs by helping to ensure safe USV navigation in compliance with COLREGS. The product will be validated and tested through extensive laboratory trials followed by more limited at-sea trials.

The civilian market for unmanned vessels appears poised for take-off, and such vessels will need to be able to function even when satellite links to remote oversight facilities ashore are inoperative. Additionally, this technology can be used on minimally manned vessels and pleasure craft as an aid to a human operator.

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KEYWORDS: Speech Recognition Software; Voice to Text; Text to Meaning; COLREGS; VHF Bridge-to-Bridge Radio; USV COLREGS Compliance; Natural Language Processing

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-042 TITLE: Rolling Shutter and Fast Panning Effects Mitigation

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: Integrated Submarine Imaging System, PMS 435, Submarine Sensor Systems Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a system to restore image degradation caused by a rolling shutter and correct for motion blur during fast periscope panning.

DESCRIPTION: Future submarine periscopes or future submarine off-board systems will employ Complementary Metal-oxide Semiconductor (CMOS)-based imaging systems operating at high resolution of 8 megapixel pixel density or greater, which pan across and image the scene. Some of these imaging systems will use rolling shutter-based imaging chips. Artifacts in rolling shutter imagery present challenges for many Navy maritime image-processing algorithms and severely affect Navy photogrammetry algorithms, which require highly accurate, geometrically correct measurements. In rolling shutter sensors, each row in the image is collected at a slightly different time, which results in scene distortion due to moving objects, platform motion, and panning. This makes single-frame image processing and multi-frame image registration difficult due to blur and pixel location errors. Approaches for mitigating rolling shutter effects include both video-processing algorithms and inertial measurement unit (IMU) data-processing algorithms. For image processing-based approaches to rolling shutter mitigation, the maritime environment presents a challenge due to the lack of consistent scene texture, as opposed to terrestrial imaging. For IMU-based approaches, raw IMU data may not be available, may have low fidelity, or may have time synchronization errors, which decrease the ability to accurately determine the camera's attitude during image collection. The Navy seeks to address these challenges and improve intelligence, surveillance, and reconnaissance (ISR) capabilities to detect, track, 3D model, and geo-locate targets using on-board or off-board low-cost sensors in maritime environment. The approach will reduce motion blur and correct pixel geolocation.

To modernize key capabilities for advance naval operations from the perspective of sensing and navigation, the Navy must manage the operational environment and develop advance capabilities that exploit novel principles to bring new affordable capabilities to the warfighter. The technology identified in this SBIR topic will enable faster situational awareness; enhance enemy, friendly, and neutral ship detection and classification; and improve safety of ship navigation.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for an algorithm to reduce motion blur and correct pixel geolocation in imaging data collected from a rolling shutter Complementary Metal-oxide Semiconductor (CMOS) camera systems as discussed in the Description. Demonstrate the feasibility of the concept via analysis or data collected with cameras provided by the vendor. The Phase I option, if exercised, will include the initial capability description to build a prototype for Phase II. Develop a Phase II plan.

PHASE II: Develop and deliver a prototype algorithm for testing and evaluation. Ensure that the algorithm runs in real time and demonstrates motion blur reduction by showing improvements in edge sharpness, edge spread function, or other quantitative metrics. Test the algorithm with data provided by the Government at the developer's facility and/or a government facility. Prepare a Phase II development plan to transition the technology for Navy and potential commercial use.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the algorithm for Navy use through the Technology-Insertion / Advanced Processing Build (TI/APB) process into the submarine combat system (across multiple classes of submarines). Support the TI/APB process, which includes several steps of testing, both laboratory and at-sea, using Government-provided data sets.

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KEYWORDS: Maritime Imaging; Periscope Imaging; Rolling Shutter; Image Enhancement; Complementary metal-oxide semiconductor; CMOS; Advanced Processing Build; Motion Blur

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-043 TITLE: Holistic Integration of Air Anti-Submarine Warfare Capability for Effective Theater Undersea Warfare

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS5: Undersea Systems Program Office, AN/UYQ-100 Undersea Warfare - Decision Support System (US

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a toolset to integrate aviation assets into Theater Undersea Warfare (USW) operations through data and information exchange and sharing between air platforms, ground support Command and Control (C2) nodes, and shore-based Theater USW C2 systems.

DESCRIPTION: Theater USW watch floor C2 planning currently contains limited information regarding Anti-submarine Warfare (ASW) mission planning and execution performance for Maritime Patrol and Reconnaissance Aircraft (MPRA), which conduct Air ASW, such as the P-3 [Ref. 1] and P-8 [Ref. 2] naval aircraft. The data available is often limited to the Area of Interest (AOI). The MPRA unit's mission is to search for planned locations for buoy fields.

The TacMobile Program provides expeditionary ground support for MPRA assets, but there are no data exchange requirements between TacMobile and Theater USW C2 systems. Therefore, in-situ information sharing is currently limited to chat, voice, and tracks passed via Link-16.

The Navy seeks innovative data sharing and information exchange technologies to achieve holistic integration of MRPA assets into Theater USW C2 decision making and execution tracking to support future Theater USW C2 operations. This decision making and execution tracking is performed using the AN/UYQ-100 USW Decision Support System (USW-DSS) [Ref. 3]. This integration will become increasingly critical as unmanned air vehicles (UAVs) performing ASW sensing missions [Refs. 4, 5] augment operated MPRA assets. While some commercial tracking capability exists, no available capabilities encompass the scope and breadth of data sharing and information exchange sought by this SBIR topic.

For this integration to be effective, all aspects of MPRA mission planning, communication of in-situ observation, and reporting, as well as post-mission replay and assessment, are necessary. Naval Air tactical operations centers (TOCs (shore based) and MTOCs (mobile)) will need to produce mission planning products that layer all sensor predictions, and then feed those models to the Theater USW operations center via USW-DSS.

Data to be exchanged or shared include the following:
1) Sensor performance predictions for all sensors. Example sensors include passive and active sonobuoys (SSQ-53, SSQ-62, SSQ-101, SSQ-125), radars, magnetic anomaly detection (MAD), electro-optical and infrared (EO/IR), and electronic support measures (ESM).

2) Mission planning data. Data to be shared include routes, search areas, and predicted cumulative detection probabilities (CDPs) for sensors employed during a planned search over time.

3) Mission execution data. Data to be shared include calculated CDPs during mission execution based on in-situ environmental measurements and actual execution parameters.

4) Contact and track data. This data includes information such as lines of bearing, positional information, and tracks passed via Link-16.

5) Mission readiness data. This includes information regarding aircraft sensors available for use, availability of flight crews, fuel stores, available weapons, and remaining stores of expendables (e.g., sonobuoys).

6) Common tactical picture (CTP) data. This would include area search performance for individual air assets and fused information across multiple sorties.

7) Environmental measurements. This would include measurements of atmospheric conditions, bathymetric measurements to infer sound speed profiles, and ambient noise measurements.

8) Intelligence data. This includes acoustic intelligence (ACINT) and signal intelligence (SIGINT).

9) Geographic plot and air tasking order (ATO) or flying program (FLYPRO) data. These data include search areas, routes, Weapon System Manager (WSM) acknowledgements, and geographic overlays.

Integration of MPRA data into USW-DSS will produce a fully informed USW common tactical picture to enable effective decision making when planning and executing employment of MPRA and ASW UAVs in a Theater or Operational Level of War environment. This addition to a more fully informed USW tactical picture will reduce acquisition costs to develop similar technologies with a lower level of confidence. Unit and individual sortie-level data across all applicable sorties will be needed to build a comprehensive MPRA picture to integrate with tactical pictures produced by surface combatants, submarines, surveillance systems, and unmanned assets when confronting a peer adversary. The result of this integration effort will reduce the level of effort required for coordination between Theater USW watch floors and TOC/MTOC sites.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for a module for the holistic integration of MPRA planning, execution, and state data with the USW-DSS system. Use modeling and simulation to demonstrate the feasibility of the concept to convey all the categories of data listed in the Description. The Phase I Option, if exercised, will include the initial system specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype of the Air ASW module. Demonstrate prototype performance through the required range of parameters given in the Description. If needed, coordinate with the Government to conduct testing at a Government- or company-provided facility to validate the prototype capability.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to an integrated element of USW-DSS. Demonstrate and report on performance during laboratory testing or at-sea trials.

Commercial use could be in industries involving vehicle tracking and status. Tracking vehicles on a site-specific map, level of readiness for deployment, and the preventative maintenance each vehicle may need would provide situational awareness to reduce costs and provide safe vehicles for the customer (e.g., rental cars, school bus systems).

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KEYWORDS: Anti-submarine Warfare; Air ASW; Theater USW Command and Control; Maritime Patrol and Reconnaissance Aircraft (MPRA); MPRA Mission Planning; Post-mission Replay and Assessment

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-044 TITLE: 2 micron Wavelength Kilowatt Class High Energy Laser/Amplifier

TECHNOLOGY AREA(S): Weapons

ACQUISITION PROGRAM: NAVSEA 073, Advanced Submarine Systems Development

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a high-energy laser operating at 2 µm (micron) wavelength, kilowatt (kW) class amplifier design for Next Generation Submarine Warfare and Battle Space supremacy using non kinetic energy.

DESCRIPTION: The Navy is evaluating how it uses the Electro-magnetic (EM) Spectrum with an objective of gaining military advantages and achieving freedom of action across all Navy missions in support of nearwater warfare. This effort is driven by both new threats and available and emerging technologies. These technologies have the potential to vastly improve the agility and flexibility of the Navy systems by utilizing high-energy lasers for Battle Space Supremacy and Water Space Management as envisioned by the Chief of Naval Operations (CNO). The current technology for High Energy Laser (HEL) at this wavelength for kW class amplifiers is in early development. A major challenge exists for this technology to be viable for development of doped fiber for the 2 µm kW class amplifier systems. The Navy seeks to address the manufacturability, electrical-to-optical (EO) efficiency and technology risk assessment and reduction of this class of laser amplifier design.

The major advantage of this spectrum for HEL class amplifier should lead to an increase in engagement range at marine atmospheric conditions, such as scattering, thermal blooming etc., when compared to the scenario where the same power at 1 µm wavelength is used. Another advantage of this wavelength spectrum is providing operation in the eye-safe spectrum from the optical scattering from the marine wave boundary layer (MWBL) when compared to the 1 µm wavelength laser, which has higher scattering properties from MWBL. The third consideration of 2 ?m laser is the less detectability compare to current standard 1 ?m HEL system.

A major challenge to develop this technology is the development of thulium based doped double clad optical fiber design for the 2 ?m kw class amplifier system. The second challenge is to demonstrate an EO efficient > 40% with high beam quality (M2 < 2) > 2 kW class laser module prototype system for test and evaluation at Navy lab.

The current state-of-the-art technology in the commercial or DoD arena is based on 1 µm wavelength high-energy, weapon-grade laser. The challenges of current laser technology at marine atmosphere levels are its detectability by adversaries due to its higher scattering property and that it is not an eye-safe operation in a clutter condition where friendly force or bystanders are present. The EO efficiency of the 2 µm kW laser amplifier module shall be greater than 30%. The technology shall be demonstrated through the Spectral Beam Combining (SBC) of the individual module to combine power to achieve 30 kW continuous wave output power with higher beam quality M2<2. Both the power specifications and wavelength of operation and EO efficiency will be tested at a NSWC Dahlgren, Navy HEL test facility.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept of 2 µm operating wavelength fiber laser/amplifier products for Navy application. Consider the Size, Weight, and Power-Cooling (SWaP-C) aspect of the amplifier for the design of the kW class amplifier. Ensure that the EO efficiency of the amplifier is greater than 30%. In Phase I company shall provide a feasibility study of the kw class 2 um amplifier design based on Model Based Engineering. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution based on by modelling and simulation. Develop a Phase II plan.

PHASE II: Develop, demonstrate, and deliver an efficient, high beam quality (M2 <2) 2kW class prototype laser module system for testing and evaluation. Evaluate the prototype laser kW class module by testing. Provide test results and analysis. Demonstrate the SBC of the individual module to combine power to achieve 30 kW output power with higher beam quality M2<2. Deliver the prototype to the NSWC Dahlgren Navy lab to evaluate the performance of the system in terms of power specifications, wavelength, beam quality and EO efficiency for a HEL prototype system that can meet Navy performance goals.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. For this purpose, show the scalability of power to 100kW class and beyond. The laser system will be deployed ultimately in a submarine or other Navy platform to advance the future Navy warfighting capability. Both the power specifications and wavelength of operation and electrical to optical (EO) efficiency will be tested at a NSWC Dahlgren, Navy High energy laser (HEL) test facility.

There is a potential for dual use of this system for cutting/welding, optical communication and use in space or airborne platforms. One of the most important characteristics of this wavelength is that it will be less affected by the atmospheric operation near marine wave boundary layer (MWBL) and its eye-safe operation from scattered light.

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KEYWORDS: HEL; High Energy Laser; Optical Amplifier; Optical Efficiency; Spectral Beam Combining; SBC; Electro Magnetic Spectrum; Marine Wave Boundary Layer; MWBL

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-045 TITLE: Development of a Debris Prediction Method for Hardened Structures

TECHNOLOGY AREA(S): Materials/Processes

ACQUISITION PROGRAM: Naval Ordnance Safety and Security Activity (NOSSA)

OBJECTIVE: Develop a fast running model (FRM) for hardened structure debris prediction by using reliability analysis and adopting a stochastic procedure that can provide practical fundamentals for site planning of the hardened structures such as the magazine.

DESCRIPTION: Analysis of reinforced concrete and other forms of structural component cementations affected by weapons effects have been performed using a variety of deterministic analysis tools/methods, such as finite element methods, FRMs, pressure-impulse (PI) curves, and single-degree-of-freedom models. Such analyses have a critical limitation related to the manner in which such tools handle the inherent stochastic nature of the weapons effects problem. The modeling and simulation (M&S) technology is not standardized, thus no reliable procedure for evaluation has been developed. Currently the required time and effort for the evaluation is a measurement taking weeks or months for just one specific case. A new FRM will provide reliable and accurate predictions in the scale of minutes for all the magazine and related hardened structures.

The present approach to weapons effects analysis should be revised to improve its consideration of the actual uncertainties presented by targeting problems and weapons effects responses. The methodology was developed in 1943 and since then it has not been changed or improved seriously. The only advantage of the methodology is that it is a simple hand calculation process, and because of this advantage, it is traceable to check validity. The analysis method far beyond finite element method is being used as a proven technology. However, the non-traceable nature, huge Computer Processing Unit (CPU) time and technical complicacy prevents the use of advanced methods such as mesh-free analysis, even though it is the most reliable method. The proposed R&D pursuing the development of FRM can solve three problems to keep the reliability and accuracy: no need to be traced for validation because it is already validated by this proposed R&D; week-level CPU time can be reduced to minute level thanks to FRM nature; and easy access by user-friendly Graphical User Interface (GUI).

More reliable prediction of the structural damage due to fragment and secondary debris in case of detonation shall specify required resistance of the structural components of a specific area to enhance the structural soundness evaluation, and eventually to reduce cost and efforts for the maintenance of the magazine structures. Generally, maintenance of the structure is conducted by three levels: visual inspection; non-destructive test (NDT); and computer simulation or test for validation by acquired inspection data and NDT data. More reliable prediction of the structural damage due to fragment and secondary debris in case of detonation can specify required resistance of the structural components of specific area. It can enhance the efficiency of the structural health monitoring and eventually can reduce cost and efforts for the maintenance of the magazine structures.

Functional change of the ammunition structures requires stopping all the operations related to the designated structure. The development shall pursue accurate and reliable prediction of the structural response to expedite the evaluation process, which drives the minimization of the operational discontinuity. Functional change of the ammunition structures requires stopping all the operations related to the designated structure. Accurate and reliable prediction of the structural response can expedite the evaluation process, which drives the minimization of the operational discontinuity.

The statistical characteristics of the debris or fragmentation prediction cause two major difficulties in the application of deterministic analysis procedures for analysis: the high statistical variance of the loading and the variance in response that it engenders. For example, mesh size is not sufficiently considered in performing an analysis concerning the influence of smaller particle fragments on the results. The influence of the small size fragment (e.g., one smaller than the mesh size) cannot be adequately predicted by a conventional finite element or mesh-free analysis method. Cracks and break-up simulation requires the mesh to be as small as possible. Even tenth of an inch is not sufficiently small enough to simulate discontinuity. Normally, analysis should accept the error from the mesh size, which cannot be ignored.

Since the physical reduction of mesh size in the model is limited based on the response information computed during the analysis, less physical analysis techniques or indirect analysis methods, such as FRM or database concepts, should be incorporated in the analysis procedure. For example, multi-layer analysis schemes could be applied to get the behaviors caused by smaller size fragments into standard size meshes. Non-structural analysis techniques are needed to capture these multi-scale stochastic features of weapons effects analyses. A combination of structural, non-structural, and intermediate approaches is needed to capture such characteristics of the fragment loading, and similar features would be needed for other aspects of such response predictions. For example, response to contact and embedded munitions, where the standard analysis methodologies cannot effectively operate even by high-fidelity physics-based (HFPB) analyses methodologies. This research would result in a new form of analysis method, such as a hybrid method combining HFPB modeling with reliability modeling. This combination will address problems where refinement alone is inadequate for considering the intense environment generated by many forms of weapons effects and the corresponding extreme distortions introduced in the structural component struck.

PHASE I: Provide a concept for new forms of analytic models that incorporates hybrid HFPB and reliability-based on formulations that are intended for very intense weapons effects analyses. Identify the viable candidates for such a hybrid approach and the feasibility of their development. Highlight the limitations of conventional weapon effects analyses using HFPB models to identify the problems to be addressed and how the proposer recommends mitigating these problems.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop, and validate theoretically, analysis methods for both structural and weapons effects characterizations. Ensure that one or more of these analysis methods is realized sufficiently to perform some weapons effects analysis for validation against test data. The test results from the Navy ESKIMO series are available to use for the validation. Produce a final report of findings of all the issues described above and a prototype form of FRM software that has the capability to analyze a structure developed to display the technology. For example, the software should comprehensively incorporate the physics-based and stochastic-based modeling of the weapons effects and, in particular, modeling the casing fragment characterization and structural response induced by fragment impacts/perforation. Normally FRM is composed by scientific computing software such as MATLab or Python for standalone program or linked to the integration software. Scope of this development is to setup theoretical approaches and compose standalone program for current use and future integration, if it is required.

Ensure that the developed FRM shall have functions of magazine structure debris prediction under the given conditions such as construction materials, design facts, or surrounding structures.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the FRM for Navy use in improving design regulations and standard designs for hardened structures. In the new design or when the modification or new design is required, predict the response for the safety estimation of the surrounding structures. Support the approval procedure conducted with interagency cooperation including Naval Ordnance Safety and Security Activity (NOSSA) and the Department of Defense Explosive Safety Board (DDESB). Validate the results of this effort by full scale tests whether simplified or full scale to be used as a part of the approval procedure.

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KEYWORDS: Debris and Fragmentation; Hardened Structure; Magazine Structure; Meshfree Method; Stochastic Analysis; Fast Running Model

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-046 TITLE: Through-Hull Underwater Submarine Communications

TECHNOLOGY AREA(S): Electronics

ACQUISITION PROGRAM: PMS391, Submarine Escape and Survivability

OBJECTIVE: Develop external means to provide real-time externally mounted communications through the hull of a distressed submarine (DISSUB) to provide digital communications and/or external measurement of internal DISSUB conditions.

DESCRIPTION: To successfully rescue a DISSUB, and minimize risks to rescue forces, it is necessary to quickly and efficiently determine the status of the DISSUB survivors. Current procedures utilize available onboard communications, such as underwater telephones and globally recognized tap codes, to assist rescue forces in determining status and risk. However, in the event the DISSUB is unresponsive, no method exists to determine the status of the survivors in real time. U.S. Navy rescue protocols dictate that in this instance, rescue will not be attempted because of the unknown risks to rescue forces.

While an unresponsive DISSUB may be because there are no survivors, there are other reasons why the DISSUB survivors may not be able to effectively communicate with rescue forces: loss of underwater telephone capability, location of survivors within the DISSUB, and atmospheric conditions that limit and/or prevent consciousness – such as high internal pressures or higher than normal atmospheric contaminants. In these instances, it is necessary for rescue forces to be capable of externally determining the status of survivors in real time to effectively determine the risks associated with a rescue attempt prior to the rescue vehicle mating with the DISSUB. Current technology using external communications equipment requires the transmission to be recorded and then the equipment to be removed for future download. Due to the necessity for rapid assimilation of all available information to support rescue of a submarine, the ability to receive and transmit DISSUB information in situ is paramount.

To provide all necessary information to rescue forces to be able to accurately determine risks associated with a rescue attempt, the Program Office desires communications that are capable of providing digital transmission and receipt, determining the internal pressure of the submarine compartments, and determining the levels of atmospheric contaminants within the compartments. These communications should not rely on DISSUB survivor inputs, should not require permanent onboard installation of equipment, and should minimize power requirements as much as practical. The proposed solutions should be capable of the following: (1) Externally mountable to a submarine hull via Remotely Operated Vehicle (ROV) or Unmanned Undersea Vehicle (UUV); (2) Implosion- and explosion-proof to a minimum of 3000 feet of sea water (fsw); (3) Transmit and receipt of digital data to the surface via relay station onboard an ROV or UUV; (External measurement of internal submarine pressure up to 6 atmospheres absolute (ATA) [Note that the use of available thru-hull penetrators is acceptable, but establishing new penetrators is not desired]); and (4) External measurement of internal atmospheric contaminant levels up to 8 ATA. It is well known that the accuracy of currently available technology to assess atmospheric contaminants under pressure is widely disparate. The solution proposed should take this into account and either provide a scalable correlation or a means of determining tolerances of data provided. At a minimum the solution should be capable of measuring the following contaminants: Carbon Dioxide (CO_2) up to 5 parts per million (ppm), Oxygen (O_2) 13 to 30 %, Carbon Monoxide (CO) up to 50 ppm, Hydrogen Cyanide (HCN) up to 50 ppm, Ammonia (NH_3) up to 300 ppm, Chlorine (Cl_2) up to 10 ppm, Hydrogen Chloride (HCl) up to 50 ppm, and Sulfur Dioxide (SO_2) up to 100 ppm. In terms of technology development effort priority, the proposed solution threshold is the development of digital communications and the objective is the ability to measure atmospheric contaminants.

In addition to being a safety and duty of care issue, continued advancement and modernization of the USN Submarine Escape and Rescue Program is considered an Assistant Secretary of the Navy core field in support of the larger Undersea Warfare effort and directly aligns to both the National Defense Strategy and the Submarine Commander's Intent by defending the homeland, enabling interagency counterparts to advance U.S. influence and national security interests, ensuring USN submarine warfighting readiness and survivability, strengthening alliances, and attracting new partners. The latter was highlighted in the geopolitical outcome following the USN Submarine Escape and Rescue response to the ARA SAN JUAN incident in November 2017.

PHASE I: Develop a conceptual solution that defines the methods and identify the major components required to meet the Nay needs. Determine feasibility by using modeling and simulation to demonstrate the proposed solution. The Phase I Option, if exercised, will include refinement of the proposed solution to support Phase II breadboard and prototype development.

PHASE II: Develop a breadboard design based upon the conceptual solution, including the major components identified, to provide a representative simulation of the proposed solution. Following breadboard testing, refine, as necessary, the design to build and deliver a reduced scale prototype for testing. Depending on schedule and asset availability, test the reduced scale prototype at sea on a submarine platform, but at a minimum via bench-testing in a simulated environment comparable to the anticipated operational environment at NSWC Philadelphia and/or NUWC Rhode Island. Include, in testing, verification of the ability to meet implodability and explodability in accordance with SS800-AG-MAN-010/P-9290 Revision A. Develop the concept of operations for utilizing ROV and/or UUV to support delivery and attachment of the equipment. Develop a Phase III plan.

PHASE III DUAL USE APPLICATIONS: Assist the Government in transitioning the technology for Navy use. Develop, build, and deliver a full-scale through-hull communications system based on the proposed design for use in the support of the USN submarine rescue mission. Test the system(s) at sea in a representative operating environment before transition to a program of record and procurement to support submarine rescue mission needs. Support the development of any required training manuals, technology refresh considerations, and other applicable lifecycle sustainment requirements.

The ability to provide real-time digital communications through various obstructions and monitor and/or externally measure atmospheric conditions of confined spaces is a technology requirement that extends beyond the submarine rescue mission, both in other military and commercial applications. Confined space rescue and the ability to assess the risks associated with that rescue are also mission needs within organizations such as the National Aeronautics and Space Administration (NASA), Mine Safety and Health Administration (MSHA), and National Institute for Occupational Health and Safety. While the program office’s intent is to develop technology that addresses the unique needs associated with a submarine rescue event, potential exists to leverage that technology to address similar needs across these other organizations.

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KEYWORDS: Underwater Communications; Atmosphere Control; Atmosphere Monitoring; Submarine Rescue; Digital Communications; Disabled Submarine Assessment; DISSUB

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-047 TITLE: Modular Architecture Framework Model and Application Program Interface for Common Core Combat System

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS 1.0, AEGIS Combat System Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a Common Core Combat System (CCCS) modular architecture framework and software component Application Program Interface (API) capable of serving as (i) a core combat system architectural upgrade within the current AEGIS system and (ii) the basis for a new platform-agnostic combat system core implementation for Future Surface Combatant (FSC) platforms.

DESCRIPTION: The Navy needs to expand its sea-based advantage through increased capability. This need can be addressed by providing technology that has the potential to improve ship combat effectiveness and efficiency by providing an updated 21st century combat system implementation capable of handling the increased complexity of today's battlespace environment. Such a combat system will provide increased task automation utilizing Artificial Intelligence (AI) technology and Autonomous software concepts, thus reducing the management complexity of the overall battlespace as presented to the combat systems operator. This may allow for potential reduced shipboard manning requirements, increased duty time productivity by reducing the potential stress and fatigue levels experienced by the combat systems operator while performing his duties, and improved affordability.

The current implementation of the AEGIS Combat System has fundamental architectural limitations deriving from its initial hardware and software design constraints. These architectural limitations have forced the use of inefficient "bolt-on" style modernization modifications and enhancements to meet evolving 21st century threats. Currently available commercial systems and software, which might be considered for adaptation to partially address the Navy's ever-growing needs for advanced situational awareness (e.g., the FAA Air Traffic Control System hardware and software), are dated in their designs. They lack the flexibility and track capacity required to adequately address tactical requirements. Specifically, the currently available commercial technology mentioned above is limited in that it lacks the capability to track, identify, and manage complex air, surface and subsurface entities and threats present in a combat environment. Additionally, such commercial systems have no intrinsic ability to provide the other critical weapon and sensor coordination services provided by an effective combat system implementation. Since no viable commercial alternatives exist or can be adapted, it becomes necessary for the Navy to pursue a different avenue of exploration.

A fundamental redesign of the core architecture of the current AEGIS combat systems is needed to enable the efficient, rapid, and cost-effective addition of new capabilities, such as multi-platform sensor and weapons coordination, off-board and organic on-the-fly sensor and weapons integration, built-in cyber resilience, and real-time fault recovery. The Navy needs a software execution framework and API capable of supporting the real-time addition, removal, and control of the major software components constituting a CCCS implementation. The framework and API must also be capable of the real-time dynamic installation, removal, and control of any software modules supporting multiple on-board and off-board sensor and weapons capabilities, as well as any requisite multi-platform integration packages, all without disrupting the real-time performance of the currently executing combat system. Due to the severe tactical real-time constraints placed on the performance of combat-system related software, such as the need for real-time fire-control quality engagement tracking data, target de-confliction data, and identify, friend, or foe (IFF) verification data all synchronized across multiple platforms, the development of a suitable software framework and API capable of meeting the requirements outlined above will demand the application of innovative software architectural design techniques and concepts. To address this critical need, a new CCCS architecture is currently in the planning stage with the intent of providing a modular set of platform-agnostic common combat system services. This CCCS implementation, when supplemented by platform-specific sets of weapon, sensor, and communications capabilities modules, will constitute a new, modular, and dynamically adaptable CCCS design that can evolve to meet future emerging threats in a rapid and cost-effective manner. The innovative technology sought will improve the reliability and efficiency of the re-designed AEGIS Combat System, improving multi-platform tactical coordination, as well as significantly improving battlespace situational awareness, thus reducing the management complexity of the overall battlespace. This allows for a reduction in the number of platforms needed in a specific tactical arena by improving the overall tactical efficiency of the battle group as a whole.

Development of a CCCS combat system modular architectural framework and software component API is critical to the future needs of the Navy. The architectural framework and software component API will be combined with: (i) an appropriate CCCS Ecosystem software execution model and software application/component API; (ii) an appropriate CCCS multi-platform coordination architecture and inter-platform data exchange algorithm set; and (iii) an appropriate multi-platform coordinated/synchronized Distributed Common Operational Picture (DCOP) subsystem to provide a comprehensive architectural model for a complete, versatile platform-agnostic "core" combat system implementation. The term "core" means this system implementation will provide combat system services and capabilities that are considered necessary to satisfy common tactical warfighting requirements, which span various and diverse surface combatants. This core combat system implementation, when configured with the appropriate surface warfighting platform-specific sensor and weapons capability software modules, will be capable of fulfilling the functional warfighting capabilities and requirements needed to support current U.S. Navy surface platforms well into the future.

The CCCS core architectural model and software framework must first and foremost be capable of supporting underlying CCCS functions (i.e., those combat systems capabilities and functions that are common across the vast majority of major surface combatant platforms, such as track management and weapons engagement planning). The required capabilities and functionality are currently outlined in the PEO IWS1 Combat Systems Top Level Requirements (TLR) documentation suite (currently in draft form). This documentation will be made available on request from NAVSEA PEO IWS 1SP for any Phase II efforts. The intent of this SBIR topic is on the design and prototype of an overarching software architectural framework for a CCCS capable of supporting "on-the-fly" addition, deletion, or upgrade of the modular software capabilities within any arbitrary CCCS implementation (hereafter referred to as an "instance"). The solution will allow for the retention of the real-time response capabilities needed to support modern weapons and sensors control and data linkages in a modular manner and within a modular software architecture with native run-time "on-the-fly" no impact combat systems new capability installation.

Commonly used combat systems services will be implemented within the CCCS via the use of software capability modules. The intent is to support all combat systems capabilities, which would benefit from frequent or periodic updates or upgrades (in order to address our rapidly changing threat environment) through the use of such software capability modules. Those modules, which provide common capabilities across multiple platforms (such as Anti-Aircraft Warfare (AAW), Anti-submarine Warfare (ASW), Anti-Surface Warfare (ASuW), and Ballistic Missile Defense (BMD) track management, weapons assignment, scheduling and control.), as well as modules providing platform-specific weapons and sensor capabilities, will be dynamically upgradable at run-time. This allows for rapid capability upgrade via a capability software module run-time installation or removal management facilities supported by the CCCS. Design of an overarching CCCS architecture and software framework capable of supporting "on-the-fly" addition, deletion, upgrade, and control of such capabilities within any arbitrary CCCS instance, with each capability implemented through the dynamic (i.e., run-time) installation of a loadable software "capability" module is the focus. Installation, removal, activation, and deactivation of such software modules within an executing CCCS implementation should have no adverse effect on the real-time performance of the CCCS system or the services it provides to the host platform and operator at the time those changes are implemented. An exemplar of this type of no-impact behavior during runtime installation and removal of capabilities within an executing system can be observed in the Linux operating system kernel module control facilities (kernel 4.4 and above), such as the insmod, rmmod, depmod, lsmod, modinfo, and modprobe commands [Ref. 2&3]. The process of installing, removing, or otherwise controlling CCCS services and capabilities within an executing CCCS installation should be easily executed by combat systems watch personnel without the need for specially trained software maintenance personnel.

The CCCS system architecture shall incorporate a native suite of inter-module and inter-combat-system (CS)-

application data exchange and communications services (IM/ICS service suite). The IM/ICS service suite is intended to support real-time data exchange between capability modules internal to a specific CCCS instance (such as a ship CCCS instance), as well as across multiple CCCS instances (like CCCS instances hosted on multiple warfighting platforms). Access to this suite of data exchange services shall be using a well-defined and documented IM/ICS API, which provides a level of software abstraction between the client capability module software and the CCCS service provision layer and associated software capability modules. This allows the potential future upgrade of core CCCS services without affecting existing compiled CCCS capability modules. When supporting data exchange and communications services between ship and non-organic (such as off-board) CCCS instances, the IM/ICS API shall internally utilize a set of services provided by a modular multi-platform coordination and data exchange (MPC/DEX) services capability subsystem intended to provide such services within a CCCS instance.

One example of a potential software capability module for use within the CCCS is a Multi-platform DCOP support module, which would provide real-time access to a battlespace-wide distributed (multi-platform) common operational picture. Access to such a battlespace common operational picture (COP) will supply critically needed situational awareness (SA) to the combat systems watch stander. The CCCS would support the dynamic run-time installation of such a DCOP capability via the use of a CCCS dynamically loadable DCOP subsystem module. This DCOP capability module will make use of the IM/ICS API and service suite provided by CCCS to achieve COP coherency across multiple warfighting platforms.

Both the CCCS architectural model and its associated APIs shall be well documented and conform to open systems architectural principles and standards [Ref. 4]. Implementation attributes should include scalability and the ability to run within the computing resources available within the AEGIS Combat Systems BL9 or hardware later environment.

Any delivered software prototypes will be compatible with the C++ programming language and capable of running in a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) software execution environment as a standalone application (that is, no critical dependencies on network-based remotely hosted resources, save for sensor data emulators). The prototype CCCS implementation will demonstrate the following abilities: (i) the ability to install, remove, and control (i.e., start and stop) various CCCS capability software modules in an executing system with no impact on system performance; (ii) the ability to demonstrate real-time performance when executing various data exchange operations between organic capability software modules; and (iii) the ability to demonstrate real-time performance when executing various data exchange operations between organic and non-organic CCCS-hosted capability software modules.

The Government will furnish AEGIS BL9 or later combat systems design or architecture documentation, draft Common Core Combat Systems TLR documentation, and any other appropriate material needed to assist in the development of the design effort.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design, develop, and deliver an initial concept design for a CCCS architectural model and software framework capable of meeting the subsystem and API requirements and capabilities outlined in the Description. Establish feasibility to accomplish the requirements through modeling and analysis. Develop a Phase II plan. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Produce a software prototype that is compatible with the C++ programming language and capable of running in a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) software execution environment as a standalone application (i.e., no critical dependencies on network-based remotely hosted resources, save for sensor data emulators). Demonstrate that the prototype CCCS implementation has the following abilities: (i) the ability to install, remove, and control (i.e., start and stop) various CCCS capability software modules in an executing system with no impact on system performance; (ii) the ability to demonstrate real-time performance when executing various data exchange operations between organic capability software modules; and (iii) the ability to demonstrate real-time performance when executing various data exchange operations between organic and non-organic CCCS-hosted capability software modules. Ensure that the prototype meets the capabilities outlined in the Description during a functional test to be held at an AEGIS or Future Surface Combatant (FSC) prime integrator-supported Land Based Test Site (LBTS) provided by the Government, representing an AEGIS BL9 or newer combat system hardware environment.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the CCCS system software for Navy use. Integrate the CCCS system software along with other CCCS compliant capability software modules into a prototype combat system implementation on a virtualized hardware environment within an AEGIS-compliant land-based testbed.

This capability has potential for dual-use capability within the commercial Air Traffic Control system in future development of an air traffic control system capable of rapid upgrade to handle increasingly complex traffic control patterns.

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KEYWORDS: Software Execution Environment; Platform-agnostic Combat System Core Implementation; Application Data Exchange and Communications Services; Tactical Warfighting Requirements which Span Various and Diverse Surface Combatants; Platform-specific Sensor and Weapons Capability Software Modules; Software Module Run-time Installation or Removal Management Facilities

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-048 TITLE: MK 48 Torpedo Composite Fuel Tank

TECHNOLOGY AREA(S): Weapons

ACQUISITION PROGRAM: PMS 404, Undersea Weapons Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a composite fuel tank that meets the MK 48 torpedo system requirements and increases torpedo in-water performance.

DESCRIPTION: The current MK 48 torpedo fuel tank is manufactured primarily from aluminum. Due to the material properties of aluminum and the resulting product, the current fuel tank has a number of limitations: higher than ideal weight, internal reinforcing structures required for strength reducing internal volume that could otherwise be used for fuel, and a high susceptibility to corrosion.

Due to numerous weapon system requirements, no current commercial off-the-shelf (COTS) solution is available for immediate use by the MK 48 torpedo. Any COTS approach would need to be adapted for MK 48 use and be designed to survive at the maximum operating depth of the torpedo (>1200') and significant torsional loads when putting a composite structure in the middle of a metal torpedo. Additionally, there are high load stresses due to the rapid depth changes, high speed and high turn rates inherent to a torpedo dynamic that other COTS ocean products would not experience.

The Navy is interested in improving the MK 48 torpedoes' performance through an objective of a 20% increase in range and better utilization of more of the Otto fuel in the tank by decreasing or eliminating seawater/Otto fuel mixing during high-speed maneuvers. A secondary goal is to decrease the opportunity for corrosion in the tank, and reducing maintenance and life cycle costs of the fuel storage solution for the weapon. This upgrade for the MK 48 torpedo is important in furthering the Strategic Approach to 'Build A More Lethal Force'. Additionally, topics for improvement include:

Decreased weight: The total weight of the MK 48 torpedo has an effect on the buoyancy of the weapon that affects the torpedo's performance. By utilizing materials with high strength to weight ratios, the weight of the fuel tank can be decreased. The goal for weight reduction is 10% for the fuel tank section. This allows additional fuel or hardware to be installed inside the MK 48 torpedo without affecting the torpedo's performance.

Increased fuel tank internal volume: The current fuel tank has internal ribs and separators that allow the fuel tank to survive the pressure requirements of the torpedo (NAVSEA Drawing 5893767) as well as decreasing the current designs Otto Fuel/Seawater mixing during high-speed maneuvers. By utilizing stronger materials, these ribs can be removed, which would allow for additional fuel storage. Other innovative methods and solutions for creating additional internal volume inside the fuel tank without impacting system requirements are of interest as well. The goal is to increase the usable fuel by 15% or more, which would yield a tactical significant improvement to the weapon.

Better separation of Otto fuel and seawater: Otto Fuel II is the propellant used in the MK 48 torpedo. It has a density greater than water and is immiscible with water, which allows the fuel delivery system to displace consumed fuel with seawater during operation. This reduces the sidewall differential pressure requirement that would be significantly higher if required to operate at the full operational depth of the weapon. However, the seawater displacement system creates the opportunity for mixing during high-speed maneuvers and the ingestion of seawater into the torpedo power plant during operation, which results in shutdowns before fuel exhaustion. The current fuel tank has internal structures to mitigate this potential. However, fuel and seawater separation can be improved by designing improved separation or a better fuel management scheme. This would allow additional fuel to be consumed prior to seawater ingestion. The goal is to increase fuel utilization by 10% by increased Otto fuel/seawater separation.

Reduced fuel tank corrosion: The current fuel tank and internal components are inherently subject to corrosive materials (reactants and seawater), which can cause extensive corrosion damage to high replacement cost items. By increasing the utilization of corrosion-inert materials and decreasing areas that are hard to flush or clean, corrosion damage can be reduced or eliminated along with associated hardware repair and replacement cost. The goal is to reduce fuel tank maintenance between runs and the maintenance required between storage turns by 30%. It is also a goal to reduce the need for replacement of the fuel tanks by 15% over the normal 20-year or greater life of the weapon.

The awardee will have to apply research in the field of composites to design and manufacture a composite pressure vessel that meets all of the MK 48 fuel tank requirements. Additionally, the awardee will have to determine a method to ensure adequate bonding at the interfaces between a composite fuel tank and existing MK 48 torpedo metal components. Fuel tank requirements include pressure loads; axial and radial force loading; temperature, vibration, shock, impact, and corrosion resistance; atmospheric control requirements; and hazards to electromagnetic radiation on ordnance requirements. The awardee will need to demonstrate that the design approach will withstand the maximum differential pressure that the fuel tank is expected to experience, which is the design test depth of the submarine plus the launch from a torpedo tube. The exact numbers are classified but it is >1200 feet of Seawater. Once these requirements are satisfactorily met, the application of composite pressure vessels can be applied to other cases where pressure vessels are required by the Navy or industry in Undersea Unmanned Vehicles, Naval Mines, and potentially manned submersibles. Fuel separation systems improvements will also require research and development and can be applicable to other fuel handling systems that are seawater compensated.

In order to qualify the design for Navy use, qualification testing will occur during Phase II. The Government will furnish test services for all testing required specific to qualification of the design for the Torpedo (i.e., hydrostatic, land-based propulsion testing with the fuel tank, in-water testing, shock, vibration, thermal). Contractor testing may include bond testing of the composite to metal interface and coupon testing. Government testing will take place primarily at Naval Undersea Warfare Center Division Newport (NAVUNSEAWARCENDIVNPT), Naval Undersea Warfare Center Division Keyport (NAVUNSEAWARCENDIVKPT), or other sites where the Government has unique test capability.

Full Rate Production of the existing aluminum fuel tank begins in FY21 and is projected to go through FY30. Once this new composite fuel tank design is qualified and determined to have cost benefits and/or performance improvement, the Navy anticipates the new tank will be phased into production for replacing the aluminum fuel tank. Replacement of the current inventory of aluminum fuel tanks will also be considered as the MK 48 torpedo is expected to remain in service for at least 30 more years. 700 new fuel tank procurements are planned for the MK 48 Production program and for insertion into a large number active inventories of the U.S. Navy, and/or to be sold through foreign military sales.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Determine the technical concept and feasibility of manufacturing and fielding composite fuel tanks that meet the current requirements including deployment life. Work with the Government to ensure applicable requirements are understood, so that the awardee can develop a design proposal that will address all requirements. Address areas of weight reduction; improved fuel separation/management; technology improvements; and risk reduction of the metal to composite interfaces. Perform analysis on the concept to determine the ability of the concept to meet requirements, including exposure to environments from the stockpile to the target sequence and long-term exposure to Otto fuel. Assess the durability of the composite material to the shipboard handling and storage environment, and damage inspection techniques. Investigate manufacturing processes required to manufacture a prototype fuel tank. Perform a cost analysis to estimate the procurement costs and maintenance cost per 5-year period. Assess the improvements of the MK 48 torpedo's tactical use. The Phase I Option, if exercised, will include the initial design concepts and plan to build a prototype in Phase II.

PHASE II: Design prototype fuel tanks with a minimum of one prototype manufactured to evaluate the proposed design approach. Evaluate the prototypes to determine if the design approach will accomplish the goals of this project concerning cost reduction, increased performance and decreased maintenance as well as the final design's ability to meet the weapon's environmental requirements. Conduct testing with the Navy to evaluate the increased fuel volume and fuel separation. When Navy specific assets are required for testing, the Navy will provide the assets or conduct the test for the performer. Refine the prototype until it can successfully transition to the Navy. Upon successful validation of a prototype, deliver the prototype(s) to the Government for the completion of MK 48 torpedo integration testing and in-water testing.

It is probable that the work under this effort will be classified (see Description section for details). If the Phase II Option is exercised, the performer will produce production representative prototypes (minimum of 6) that will be used to validate the design requirements against the MK48 torpedo's design.

PHASE III DUAL USE APPLICATIONS: Phase III will finalize the design and manufacturing processes into final products and production drawings. The production of fuel tanks or license the technology to produce operational fuel tanks for the Navy will also be awarded in this Phase. The Phase III awardee will provide production drawings to the Government for configuration management and maintenance of the fuel tanks. The Phase III awardee will document and provide the Government assembly and disassembly procedures, inspection procedures, maintenance procedures, and repair procedures that will be used to support composite fuel tanks for the duration of their service life.

Technology and manufacturing methods developed on this SBIR topic could be transitioned to other military and commercial submersibles and industry for manned or unmanned applications. Commercial application include oil and gas exploration; deep-sea salvage and recovery operations; and deep-sea exploration, as examples.

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KEYWORDS: Composite Fuel Tank; Composite Pressure Vessel; High Strength Material Use in Fuel Tanks; Seawater Ingestion; Displacement of Fuel with Seawater; Corrosion in Fuel Systems

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-049 TITLE: Towed Array Position Estimation System

TECHNOLOGY AREA(S): Battlespace, Electronics, Sensors

ACQUISITION PROGRAM: PEO IWS 5, PMS 401: Submarine Acoustic Systems Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a system for determining the position of the headline of the towed array relative to some fixed point on the towing platform for incorporation into future towed arrays.

DESCRIPTION: The Navy uses towed acoustic sensor arrays and hull-mounted acoustic sensors to detect submerged and surface vessels. Each type of sensor provides unique capabilities [Ref. 1]. In order to take advantage of capability overlap, it is critical to know key parameters about both systems, including physical location of towed acoustic sensors relative to each other. However, the ability to combine these capabilities is limited because state-of-the-art technology cannot accurately locate the towed array relative to the hull array.

Co-processing sensors provides two main benefits: increasing gain by increasing the number of channels and aperture at the design frequency; and allowing for target ranging and localization (triangulating). The required accuracy is a function of the design frequency of the array. Two (2) wavelengths are sufficient accuracy for position measurement for co-processing purposes [Ref. 2].

The Navy seeks an innovative solution to determine the relative positions of the towed and hull arrays to support coherent processing of the combined arrays. This capability will assist the Navy in maintaining or increasing its tactical advantage in the undersea warfare (USW) domain. While the Navy currently has many capable hull-mounted and towed sensors, there is currently no means to process the towed and hull sensors coherently with each other in order to provide increased awareness of the battlespace and overall performance improvement. The solution sought will provide, in three dimensions, accurate (relative to the wavelength correlating to the design frequency of the array in question), near real-time (less than one sample delay relative to the array sample rate) position data of the towed array headline relative to some fixed point on the towing platform. The array headline position is the most important position, but fully locating the entire array would be of additional interest to the Navy. The desired capability must also permit the desirable capabilities in currently fielded technologies (such as the capability some multi-line towed array systems use to report relative positions of each of several towed lines to each other) [Ref. 3].

The proposed solution must be suitable for packaging within towed arrays (no more than 5.1” long, 0.75” in diameter) and must not cause elevated signatures (e.g., acoustic or electro-magnetic) in a manner that makes the towing platform more detectable. Specifically, the system shall not generate any detectable signals above ambient conditions at a range of 100 yards. While modeling solutions may be part of the solution, it is anticipated that sensor-based elements will be required to achieve sufficient accuracy to attain the desired coherent processing.

Sensor elements associated with the proposed solution must survive extreme environments (as described below) during deployment and must maintain their accuracy within 10% of nominal (inclusive of drift) over the requirements described below. The sensor element(s) must suffer no degradation over a fifteen-year span from time of first use while operating at pressures up to 1200 psi, temperatures over a range of -28°C to 50°C, and accelerations up to 100 Hz over a range of 0.0 g to 25.0 g. The reliability of the sensor element(s) will need to support a Mean Time between Failure (MTBF) of at least 7,000 hours. Testing to validate the technology meets these requirements will be performed at the Naval Undersea Warfare Center in Newport, RI, or at the contractor’s facility if deemed sufficient by the Government.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for determining the position of the headline of the towed array relative to a fixed point on the towing platform. Demonstrate that the concept can feasibly meet all requirements in the Description. Establish feasibility through modeling and analysis. The Phase I Option, if exercised, will include the initial system specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype system for testing. (Note: The Government will provide support for packaging the system within the towed array.) Validate the prototype through testing. Demonstrate that the position of the headline of the towed array does not negatively affect the detectability of the towing platform. Perform testing and validation at a Government-provided facility.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Assist the Government in transitioning the technology for Navy use. Conduct experimentation and refinement to qualify the technology for use on towed arrays within the Advanced Processing Build process. (Note: The Government will provide the performer access to a Navy ship where the final system validation and performance verification will be conducted.) Support installation and removal from an at-sea test platform and assist in data recovery and processing. Use the resulting data to verify the measurements and accuracy of the system.

This technology would prove useful for oceanographic research, oil and gas exploration, congested area traffic monitoring, and other applications where data from multiple disparate sensors are fused to provide a more holistic awareness of the volume being monitored by sensors, especially where sensors are not in fixed locations.

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KEYWORDS: Towed Array; Sensor Fusion; Position Measurement; Acoustic Detectability; Measurement Certainty

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-050 TITLE: Real-time Insights for Combat System Integration and Testing

TECHNOLOGY AREA(S): Battlespace, Electronics, Sensors

ACQUISITION PROGRAM: PEO IWS 5.0: Undersea Systems, Surface ASW Combat System Integration, Surface ASW System Improvement

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative, rapid, iterative capability to monitor, visualize, and assess combat system interface traffic in real-time during integration and testing of combat systems.

DESCRIPTION: Surface ship combat systems represent complex systems of systems, such as the SSQ-89 Anti-Submarine Warfare (ASW) combat system element [Ref. 1], that must adapt to rapidly evolving threats. Integration, testing, and certification of the SQQ-89 are required prior to fielding production systems. These activities are time consuming and costly, throttling the rate of improvement to warfighting capability. Migration to automated testing [Ref. 2] alone for external interfaces has been insufficient to eliminate this throttling effect. The Navy desires to adopt rapid, iterative approaches to capability development and reduce costs, technological obsolescence, and acquisition risk.

A key challenge to the time and cost associated with integration is the testing time spent by engineers and coders during integration and test events trying to gain insight into the cause of errors related to internal interfaces between systems or modules of systems. An ability to monitor, visualize and assess combat system interface traffic in real time during integration and test events would allow real-time root cause analysis and reaction in place of the current time lag, duplicative, and labor-intensive processes.

Development, integration, and element testing is performed at the AN/SQQ-89 prime integrator site. Combat system integration testing of the AN/SQQ-89 with associated combat system elements is performed in conjunction with the appropriate Combat System Engineering Development Site (CSEDS), such as the AEGIS CSEDS at Moorestown, NJ. Real-time insight during integration and testing of combat system elements - both stand-alone and when connected via Ethernet and legacy Naval Tactical Data Systems (NTDS) - facilitates Navy migration to a DEVOPS approach to modular capability fielding. To serve as this enabler for DEVOPS, the real-time analysis must be able to support automated development and test environments with rigorous datagram packet inspection for root cause analysis [Refs. 3, 4].

This capability will have utility for a range of complex interconnected systems that are safety critical, such as military systems, utility systems, and information technology systems.

A real-time integration analysis tool must be developed to test the specific combat system applications and their interactions through the interface. It must conduct deep packet datagram inspection to assess the specific data fields for the application messages sent between the systems. The system must compare the data to government-furnished information (GFI) interface design specifications in order to determine if the message is in error. It must assess specific data fields within the datagram to find these potential problems; and must assess if the data is out of bounds; and must determine if an older incorrect weapon specification is being used. Testing of the technology sought will take place either at Navy facilities (e.g., Naval Undersea Warfare Center, Newport, RI) or at Navy Prime Integrator sites (e.g., LM RMS at Manassas, VA or LM RMS at Moorestown, NJ).

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for a software tool that provides the test team the ability to conduct real-time monitoring, visualization, and assessment of combat system interface traffic. Demonstrate the concept can feasibly support interface traffic in development, integration, and test environments, including automated testing described in the Description. Establish feasibility through modeling and analysis of the tool.

The Phase I Option, if exercised, will involve initial system specification of the performer's solution with associated capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype of the software tool that will focus on supporting SSQ-89 development, integration, and testing. Validate the prototype through testing to demonstrate it achieves the metrics defined in the Description. (Note: The Government will provide access to the facility at LMCO, Manassas, for testing using the prototype software and run-time environment on the interface between the SQQ-89 and the AEGIS VTWIN. The A Government representative will witness a system performance test to verify that it satisfactorily meets the requirements. The test will utilize the Automated Combat System of System Integration Test for Certification tool to run automated operator kill chain actions to fully vet the IDSs.)

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use through the prototype's successful ability to produce a real-time monitoring and assessment capability to support system of systems development, integration, and testing for modular capability improvements using DEVOPS in the SQQ-89 Advanced Capability Build development process.

Commercial applications are possible for software developers, where complex code integration and testing can currently only be assessed after testing or which requires duplicative re-testing to validate fixes could benefit from an approach to achieve real-time insights into integration and testing of information technology infrastructure.

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KEYWORDS: AN/SSQ-89; Errors Related to Internal Interfaces; Assess Combat System Interface Traffic in Real-time; DEVOPS Approach to Modular Capability Fielding; Integration and Test Events; Rigorous Datagram Packet Inspection for Root Cause Analysis

Questions may also be submitted through DOD SBIR/STTR SITIS website.

~~N201-051~~ [Navy has removed topic N201-051 from the 20.1 SBIR BAA]

N201-052 TITLE: Wide Band Large Aperture Beam Director Head Window

TECHNOLOGY AREA(S): Materials/Processes

ACQUISITION PROGRAM: NAVSEA 073, Advanced Submarine Systems Development

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a new, environment-friendly, wide spectral band (from visible to mid wave infrared (IR)), high optical transmission (> 99.9% near IR) band, and high strength hydrophobic, greater than 12-inch diameter) submarine beam director head window materials.

DESCRIPTION: The Navy requires an innovative material solution for new large aperture (greater than 12 inch in diameter) and wide spectral band (broadband) optical development for High Energy Laser (HEL) beam director head window with anti-reflection coating (ARC) and water shedding or hydrophobicity ability. At present, there is no large aperture broad spectral band commercially available for a high strength, extreme low loss head window is available. The head window shall be broadband (0.5 to 5 µm) and high strength with a greater than 99.9% transmission at near IR wavelength. The bandwidth of the material shall be within greater than 80% - both in visible and MWIR band. The head window shall also have near broadband (visible to MWIR) ARC, water-shedding (hydrophobicity), non-fouling and service life performance of the HEL beam director head windows (or imaging windows).

Residual water (seawater, rain) on a small craft operation near the marine wave boundary layer head window will lead to the delivery of the HEL optical power at greater than 100 kW with less than 0.1 percent total loss at HEL pass band. The proposed head window shall withstand static pressure equal or greater than the current fused silica window (thickness 3 inch), the head window material used in submarine imaging system window. Removing or shedding water fully and completely is critical to the successful operation of the beam director system. In addition, HEL beam director head windows are affected by micro fouling, which is currently one of the prime causes of reduced water shedding performance or hydrophobicity of the head window material.

The Navy needs an innovative approach to develop broadband large aperture window materials. The proposed window shall have broadband anti reflection (AR) coating and hydrophobicity, with a contact angle greater than 130°, with a goal of greater than 150°. The optical transmission of the window at near IR wavelength shall be greater than 99.9 percent, at visible and at 0.5- µm wavelength with 90% transmission, including any absorption and scattering from the optical surface. The window random anti reflection (RAR) coating shall be able to withstand HEL power greater than 100kW. The proposed HEL window material shall have superior hydrophobicity and micro fouling or performance against salt sedimentation, which are major causes of any degradation, by no more than 10 percent during 15-year life of the head window. In addition, the window materials should be capable of being cleaned using normal maintenance and cleaning procedures without causing damage to the hydrophobicity of the surface or AR coating. The window materials shall survive in an environment including temperatures from -40°C to 60°C, thermal shock (hot air at +80°C to warm water at +50°C and cold air at -54°C to cold water at 10°C), severe icing, and ultra violet (UV) sunlight. The broadband large aperture beam director head should have RAR and IR coating and hydrophobicity technology that meets the above requirements and can, in addition, be applied to other types of HEL beam director head window materials such as sapphire, spinel, and aluminum oxynitride (referred to as ALON).

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for new and innovative materials for wide spectral band large aperture beam director head windows. Conduct a feasibility study to demonstrate the viability of the proposed broadband high transmission materials with RAR coating through modeling and simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop the window material, ensuring that the materials will support RAR, hydrophobic, non-fouling technology. Develop large aperture window materials for HEL application. Document the results and demonstrate the feasibility of the manufacturing concepts. Identify suitable candidate materials (e.g., sapphire, spinel, and ALON), low transmission loss (less than 0.1%) processes at 1 µm, and transmission higher than 90% (both in 0.5 and 5 µm spectral band). Ensure that the concept highlights process techniques to improve HEL beam director head window hydrophobicity and RAR. Propose the selection of a final material for window materials and AR coating and hydrophobicity technology candidate(s). Develop and deliver a large aperture (12 inches diameter) low transmission loss (at 1 µm, > 99.9%), hydrophobicity and AR coating window material test coupon to the Navy lab to carry laser power (less than 100kW), environmental and stress test. Characterize the head window service life and determine service life protocols (e.g., service life, in-service maintenance) for the developed AR coating on actual head window materials. Develop a Phase III plan.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for operational use. Manufacture the successful materials, hydrophobicity, and coating based on the mechanical and environmental constraints of the HEL beam director.

This technology can be used in commercial airlines and satellite imaging systems.

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KEYWORDS: Electro-Optics; Hydrophobic; Hydrophobicity; Non-Fouling; Non-Hazardous; Marine Wave Boundary Layer; MWBL; High-energy Laser Beam Director; HEL

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-053 TITLE: Development of New Generation Earth Covered Magazine (ECM) Structure Design using Composite Materials

TECHNOLOGY AREA(S): Materials/Processes

ACQUISITION PROGRAM: Naval Ordnance Safety and Security Activity (NOSSA)

OBJECTIVE: Develop lightweight materials and associated structural components to produce a more efficient means to construct Earth Covered Magazines (ECMs) while keeping the same or higher level of protection capability, making it easier to maintain and upgrade them, and enabling the military to fabricate the munition structure under field conditions.

DESCRIPTION: The defense technology based on the weapons effect phenomenology can increase the functions of weapon storage structures by adopting new generation structural members with improved energy absorption. The design of ECM storage facilities has been standardized by developing several typical models. The primary components of the ECM structure are concrete walls, concrete roof, basement, blast door, and earth cover. Design details very typical of hardened structure design before 1945 are employed. Few changes to this design concept have been made, and the standard design is still being used, even though there have been important technical developments in blast resistant structure design concepts.

The Navy seeks innovative, advanced materials specifically found advantageous for enhancing blast resistance, which will be considered to replace the standardized heavy concrete structures of the past and will afford for deployment of much more lightweight and easily constructed ECMs. This new approach to the design of ECMs is to employ modular components fabricated from composite structural components, which has many advantages for various types of munitions storage facilities both at a base and in the field. The material or structural members will be developed to maximize blast effect resistance and then, three types of structures will be designed to show the applicability, efficiency and feasibility of the developed material/component to ECM design and construction. Various ECM standard designs are currently being used. The general dimension of the ECM in rough measure is in the range of 30 ft. X 30 ft. X 30 ft. to 100 ft. X 100 ft. X 30 ft., with normal concrete thickness of more than three ft. Tunnel and standalone ECM module type have totally different measurements. Cost and function shall be evaluated by comparison with Navy standard design of concrete structures to show efficiency.

The development is planned in three steps – composite material development, module development, and module application to the ECM. Based on selected or developed composite material, a structural module will be developed. A Lego-type module integration, which will be assembled to the ECM, will be designed by computer simulation and validated by full-scale testing. Full-scale structural testing, assembled by developed modules, can hardly be conducted in this project due to limited cost. Instead, the construction procedure can be precisely reviewed by using building modeling information (BMI) techniques to acquire preliminary information about construction procedure and detail cost.

PHASE I: Identify the blast resistant capacity through energy absorption mechanism of the various materials followed by a study of the participation of the identified foams in composite members. The developments in Phase I shall include:
- Efficient blast resistant composite components based on high-fidelity physics-based (HFPB) analytic simulations shall be generated.
- Lab tests for dynamic material characteristics of the materials for energy absorption function shall be conducted.
- Materials shall be identified by using test results to show the contribution of each material in composite action.
- HFPB analysis shall be conducted to show efficiency of the identified material model against the frequency and magnitude range of the blast load. The results of Phase I research shall give solid insight about the practical applicability of the members when it is applied to the magazine or related hardened structures in extensive and comprehensive research in Phase II.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to design a prototype solution in Phase II.

PHASE II: Based on the results of the Phase I, with sufficient and convincible insight of the application of composite materials to the magazine and related hardened structures, practical design and validation through integrated member testing. Develop a comprehensive new generation design of ECMs. Ensure that the components and modules can be deployed for the construction of different ECM structures requiring hardened capacity or a high level of blast resistance. Include:
- Development of a module design suitable for fabrication from the results of HFPB analysis for materials and structural components.
- Development of structural designs in accordance with the design guidelines specified by UFC (Unified Facility Criteria) and DDESB (Department of Defense Explosives Safety Board) technical notes.
- Testing of optimal designs of the composite material with three different levels of blast resistant capability according to the applied blast loadings in reference to the ECM design guideline.
- Consideration of a modular concept of the ECM structures to control the local damage and make the maintenance effective and efficient.
- Full scale detonation testing of integrated modules with the boundary conditions and connection conditions for validation of the development, which is the basic module to the structural assembly.
- Production of standard drawings of the three structures with the modular concepts in the same format as the conventional design. Provide the construction and fabrication simulation with BMI technology.

PHASE III DUAL USE APPLICATIONS: The developed design of the practical structures will be extended to more standard designs those were established before 1980's. Also, the developed and validated structural members and integrated modules will be assembled by modeling and simulation (M&S) and BMI to check any remaining practical problems to be solved.

The developed design of the practical structures can be extended to more standard designs those were established before 1980's. Also, the developed and validated structural members and integrated modules will be assembled by modeling and simulation (M&S) and BMI to check any remaining practical problems to be solved. It can be applied not only the new construction of the new generation magazine structures but for the pure protection of the commercial structures. According to the protection level adjustment, enhancement of the magazine storage capacity can be pursued by the developed design.

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KEYWORDS: Magazine Structure; Blast Loading; Energy Absorption: Composite Material; ECM Modular Design; ECM Modeling and Simulation; Full Scale Detonation test; Earth Covered Magazine; ECM

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-054 TITLE: Coordinated, Layered Defense Capabilities of Multiple Torpedo Countermeasures

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PMS 415, Undersea Defensive Warfare Systems Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a capability for acoustic torpedo countermeasures to coordinate focused layered defense strategies against incoming advanced threat torpedoes.

DESCRIPTION: All submarines are currently protected by 6-inch and 3-inch diameter expendable torpedo countermeasures that, upon launch, act autonomously and independently to thwart adversarial weapons. Adversarial weapons are becoming more and more sophisticated requiring the Fleet to develop smarter and more capable countermeasure devices. It is the intention of this effort to develop additional capabilities that can be incorporated into current and future torpedo countermeasures to provide increased platform protection. As such, the innovation sought by the execution of this effort is to develop the ability for multiple acoustic countermeasures to coordinate a layered defense against adversarial torpedoes. The countermeasures, which are based either on the existing three-inch diameter Acoustic Device Countermeasure (ADC) Mk 2 Mod 7 and/or the existing six-inch diameter ADC Mk 3 Mod 1, would have the ability to identify the incoming direction of a threat torpedo through an onboard receiver(s) or other devices/platforms in the engagement. Additionally, the solution will use its relative positions to provide spatial, temporal, and spectral defensive protection for the host platform. The ability to detect the threat, identify threat localization, and implement appropriate threat acoustic responses amongst a potentially highly cluttered acoustic environment will be evaluated. The specific acoustic response would be based on the existing acoustic modes of the current ADC, depending upon the chosen form factor for the design. The innovation challenges involved in this topic execution are twofold: first, coordination of the communication capabilities amongst multiple torpedo countermeasures and with the host submarine platform need to be robust in what is anticipated to be an acoustically cluttered environment; second, technology advancements are needed to provide this coordinated capability (on-board receiver and identify friend or foe (IFF) and communication logic) without driving significant increase (less than 25%) in unit cost and not significantly changing the form factor of the baseline device (either 6-

inch diameter, 100-inch long, 120 pounds or 3-inch diameter, 39.5-inch long, 10 pounds). By providing these additional features, these advanced countermeasures will possess the ability to reduce the number of devices needed to thwart adversarial threats with a reduced number of devices, thus offsetting the anticipated increased unit cost per device. The Technical Point of Contact will provide Testing and evaluation criteria on an as needed basis.

Environmental stress testing will take place at facilities maintained by the Naval Undersea Warfare Center in Newport, Rhode Island. Initial baseline testing (acoustic and coordinated capabilities) will be the responsibility of the executing company, while any follow-on testing will be the responsibility of the Navy, with the company's anticipated assistance. .

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop an end-to-end design and implementation concept for a coordinated countermeasure using acoustic or non-acoustic technologies, including (1) receiver technologies and (2) on-board electronics that are powered by the same power supplies currently in use by the legacy devices: either thermal lithium like the ADC MK 2 MOD 7, or silver chloride seawater activated battery like the ADC MK 3 MOD 1 ,to provide the capability to identify incoming threat torpedoes and send the appropriate signals to the existing acoustic projector to thwart the threat. Consider a device solution that is based on the existing legacy devices: ADC MK 2 MOD 7, and/or ADC MK 3 MOD 1. Establish feasibility of the proposed concept. Evaluate the operational ability of the device design will be evaluated per the requirements in the Description. The Phase I Option, if exercised, will include the initial system specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and build three to five prototype systems for testing and evaluation. Conduct evaluation and testing of the prototypes based on the anticipated inter-countermeasure and countermeasure from/to host platform communication links, which are expected to be simplistic, yet robust, and have the ability to avoid host-platform "beaconing." Ensure that the specific acoustic response would be based on the existing acoustic modes of the current ADC Mk 2 Mod 7 and/or ADC Mk 3 Mod 1, depending upon the chosen form factor for the design. Evaluate the robustness of the communications technology. Subject the prototype devices to limited environmental testing and design risk reduction evaluations. Focus testing primarily on the evaluation of the communications implementation, with environmental stress testing, as noted in the Description, folded in to mitigate operational design risks. Develop a Phase III plan.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Deliver five to six follow-on prototypes (incorporating any lessons learned from the Phase II prototyping and testing efforts) and engineering support for full environmental testing. Conduct the following testing: storage temperature thermal cycling (-54°C to +71°C) testing; shock testing (MIL-S-901D), hydrostatic testing to submarine operational depths, internal countermeasure launcher acceleration testing (via the Naval Undersea Warfare Center Division Newport's internal countermeasure launcher facility), and any additional evaluation testing for the newly developed communications technology, including, in-water acoustic testing in a demonstration on an instrumented Navy test range. (Note: Some of this testing may occur in Phase II if the Phase II prototype design is a mature representation of a potential low-rate initial production design.) Depending on platform availability, it is anticipated that some, or all, of the prototypes will be evaluated through real-world range operations with active torpedoes or with a host submarine. Ultimately, the primary focus within a Phase III effort will be on evaluating the ability of the devices to coordinate collectively for effective host platform protection, while showing resiliency against applicable environmental stressors.

Alternative naval applications include sonobuoys (launched on the surface whereas the intended innovation product is launched from submarines), training targets, and alternative acoustic devices launched from various platforms. Some commercial applications include marine mammal acoustic diversions and geological exploration.

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KEYWORDS: Torpedo Defense; Acoustic countermeasure; External Countermeasure Launcher; Internal Countermeasure Launcher; Anti-submarine Warfare; Detection and Tracking

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-055 TITLE: Coaxial Insulated Bus Pipe for High Energy Application

TECHNOLOGY AREA(S): Electronics

ACQUISITION PROGRAM: PMS 407, Surface Ship Modernization; Robust Combat Power Control FNC

OBJECTIVE: Develop a Medium Voltage Direct Current (MVDC) coaxial Insulated Bus Pipe (IBP) conductor and associated components for integration onto U.S. Navy ships.

DESCRIPTION: A MVDC coaxial IBP conductor with the associated connectors, bulkhead penetrations, and shock excursion mounts for transmission of MVDC with voltages in the range of 6 kV to 12 kV and ampacity from 2000 to 4000 amperes is required to mitigate the challenges associated with cabling of available IBP technologies. Existing cables are limited in ampacity to approximately 400-700 amps per conductor, which requires multiple paralleled cables and terminations. Multiple paralleled copper cable conductors are difficult to install, heavy, and require more of the ship's internal volume to meet the needs of future surface combatants. As such, higher conductor capacities are desired to support higher power distribution without the need to install and maintain multiple parallel cables and the associated terminations.

The Navy, as well as shipyards, are seeking an innovative MVDC IBP conductor to improve power transmission and modular ship construction. Prior developments resulted in single phase IBP design appropriate only for Medium Voltage Alternating Current (MVAC) Navy distribution systems. Magnetic fields in MVDC IBP must be limited so as not to disrupt other systems nor increase the ship's magnetic signature. To mitigate the magnetic fields of high power parallel MVDC conductors, a coaxial IBP configuration with the associated connectors, bulkhead penetrations, and shock excursion mounts are required.

This effort will require finding innovative solutions to enable bus pipe technology to meet Naval traditional operating environment requirements These requirements are in accordance to the Navy's MIL-STD-1399. The proposed design must be able to support a range of voltages from 6kVDC to 12kVDC and currents from 2000 to 4000Amperes. 3000Amperes at 12kVDC provides 36MW, which will allow a single coaxial MVDC IBP to support most loads. The design must also address shock excursions of bulkhead penetrations and mounts.

Cost impacts will be evaluated for both the replacement of conventional cabling with IBP and tradecraft manpower reductions due to the configuration changes to preformed modular sections rather than pulling multiple long lengths of heavy cable throughout the ship during construction.

In modular Navy ship construction, connection tubes and terminations must be maintenance free to reduce the risk of loose-connections and associated arc-faults. IBP must also meet US Naval application specification and standards to include Shock Tests (MIL-S-901); Cables, Electric, Low Smoke Halogen-Free (MIL-DTL-24643); Electromagnetic Interference Characteristics Requirements for Equipment (MIL-STD-461); Electromagnetic Environmental Effects Requirements (MIL-STD-464); 1399-MVDC interface specification; and IEEE 1580.1. A MVDC bus pipe specification does not currently exist; however, the MVDC IBP system is expected to comply with applicable Military standards and specifications, such as shock, fire and Electromagnetic Interference (EMI). Electric and magnetic fields must be managed and comply with Navy EMI requirements.

PHASE I: Develop a concept for MVDC coaxial IBP conductor and associated connectors, bulkhead penetrations, and shock excursion mounts for transmission of 6 kVDC to 12 kVDC to support high power loads in Navy high power systems.

Demonstrate the feasibility of a MVDC coaxial Insulated Bus Pipe design concept that meets the needs of the Navy as defined in the Description. Identify the technical feasibility of the proposed concept, and demonstrate the concept through modeling, analysis, and/or bench top experimentation where appropriate. Capture the technical feasibility and estimated production costs for the proposed concept in the Phase I Final Report. During a Phase I Option, if exercised, awardees will provide for initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design and build prototype IBP sections in straight and complex configurations. Design and manufacture connectors necessary for testing. Provide viable design of bulkhead penetrations and mounts allowing for shock excursions.

Develop a test plan to validate IBP to proposed Navy IBP standards. Test IBP prototypes to U.S. naval application specifications and standards to include: MIL-S-901, MIL-DTL-24643, MIL-STD-461, MIL-STD-464, 1399-MVDC interface specification, and IEEE 1580.1.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. The use of Insulated Bus Pipe in Navy construction will allow for modular installation and enable optimized workflow of high-power distribution systems installation in ship construction.

Power distribution systems in all commercial Medium Voltage high current applications will benefit with reductions in size, weight and cost of cabling. Current commercial applications are in cruise ship design and urban underground power distribution in constrained environments.

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KEYWORDS: Insulated Bus Pipe; IBP; Solid Conductor; Coaxial DC Power; Modular Ship Construction; Bulkhead Penetration; MVDC Distribution; Medium Voltage Direct Current

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-056 TITLE: Data Exchange Subsystem Architectural Framework, Algorithm Set and Applications Program Interface for Common Core Combat System

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS 1.0, AEGIS Combat System Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an architectural framework, algorithm set, and Applications Program Interface for a Common Core Combat System (CCCS) Modular Multi-platform integration and coordination Data Exchange (MPDEX) subsystem capable of providing data synchronization and common operational picture coherency across multiple coordinating warfighting platforms.

DESCRIPTION: The current implementation of the AEGIS Combat System has fundamental architectural limitations deriving from its initial hardware and software design constraints. These architectural limitations have forced the use of inefficient "bolt-on" style modernization modifications and enhancements to meet evolving 21st century threats. Currently available commercial systems and software that might be considered for adaptation to partially address the Navy's ever-growing needs for advanced situational awareness (SA) (e.g., the FAA Air Traffic Control System hardware and software) are dated in their design. They lack the flexibility and track capacity required to adequately address tactical requirements. Specifically, the currently available commercial technology mentioned above is limited in that it lacks the capability to track, identify, and manage complex air, surface and subsurface entities and threats present in a combat environment. Additionally, such commercial systems have no intrinsic abilities to provide the other critical weapon and sensor coordination services provided by an effective combat system implementation. Since no viable commercial alternatives exist or can be adapted, it becomes necessary for the Navy to pursue a different avenue of exploration.

A fundamental architectural redesign of the combat system's core is needed to enable efficient, rapid, and cost-effective addition of new capabilities, such as multi-platform sensor and weapons coordination, off-board or organic on-the-fly sensor and weapons integration, built-in cyber resilience, and real-time fault recovery. To address these critical needs, a new CCCS architecture is currently in the planning stage, with the intent of providing a modular set of platform-agnostic common combat system services.

This CCCS implementation, when supplemented by platform-specific sets of weapon, sensor, and communications capabilities modules, will constitute a new modular and dynamically adaptable combat system design that can evolve to meet future emerging threats in a rapid and cost-effective manner. An innovative virtual communications channel, a data exchange architectural model, and a software framework that utilizes all available physical data communications pathways in an opportunistic manner are needed to insure real-time communications responses. Each virtual channel supported by this subsystem shall be fully characterized, and that characterization must be maintained dynamically throughout the effective lifetime that the channel is needed. The virtual channel subsystem developed will be utilized within the CCCS architecture currently under development in PEO IWS 1 to provide redundant, resilient, and radio frequency (RF) environment-adaptive real-time tactical data communications across multiple warfighting platforms within a battlegroup.

The innovative technology will improve the reliability and bandwidth of cross-platform combat systems data exchange services, thus improving multi-platform tactical coordination. In addition, this technology will significantly improve battlespace SA, thus reducing the management complexity of the overall battlespace. This allows for a reduction in the number of platforms needed in a specific tactical arena by improving the overall tactical efficiency of the battlegroup as a whole.

Development of an MPDEX architectural framework, algorithm set and Applications Program Interface (API) for use within the CCCS architecture, or as a modernization enhancement for future AEGIS baselines, is needed. MPDEX should, when taken in conjunction with (i) an appropriate CCCS core combat system modular architectural framework and software component API, (ii) an appropriate CCCS Ecosystem software execution model and software application or component API, and (iii) an appropriate multi-platform coordinated and synchronized Distributed Common Operational Picture (DCOP) subsystem, provide a comprehensive “core” architectural model for a complete, versatile platform-agnostic combat system implementation. “Core” means this system implementation will provide combat system services and capabilities satisfying common tactical warfighting requirements that span various and diverse surface combatants. This core combat system implementation, when configured with the appropriate surface warfighting platform-specific sensor and weapons capability software modules, should be capable of fulfilling the functional warfighting capabilities and requirements needed to support current U.S. Navy surface platforms well into the future.

The CCCS MPDEX will provide a CCCS modular cross-platform data exchange mechanism and synchronization capability through utilization of current shipboard communications services. MPDEX will make maximum use of currently available hardware-based communications facilities or other high-level communications capabilities in a manner intended to satisfy the following design criteria. First, it will need to increase the overall reliable/guaranteed bandwidth. Second, it will need to improve connection reliability and anti-jam resistance. Lastly, it will need to provide automatic hardware-connection “fail-over” capability in the event of loss of a hardware-based connection pathway. One method to achieve this goal is by utilizing the concept of “dynamic hardware channel bonding and aggregation”, in which a set of “virtual communications channels” are created and managed by the MPDEX algorithms and architecture resident within combat system host platform implementations operating at both communications endpoints. Each virtual communications channel will be associated with a “virtual” communications transceiver (or “node”) instance, capable of supporting the combat system’s network application layer. From the point of view of the combat system and its underlying network application layer, a “virtual” communications channel will appear and function as a “generic” physical communication interface and matching transceiver, supporting the same capabilities as other physical shipboard wireless transceiver suites. Software modules (and other client applications within the combat system) requesting the creation and/or assignment of a MPDEX virtual channel will be able to specify a set of minimum performance parameters for that channel, including minimum acceptable data up/down transfer bandwidth, data senescence/delay, maximum acceptable jitter, etc. during channel creation. Virtual channel Quality of Service (QOS) performance parameters (based on the metrics provided by the client application during channel creation and instantiation) will also be maintained in real time for each executing virtual channel instance and be made available to the client application by the MPDEX API. Client applications could qualify their requests for communications services through the MPDEX API by specifying minimum QOS parameters (e.g., data senescence, jitter, maximum and minimum bandwidth) needed for the task at hand. The potential parametric ranges for the requirements above will be wholly dependent on the requirements of any potential combat system client applications, but any prospective MPDEX implementation should be able to satisfy parametric requirements that range from single-digit millisecond to minutes (for data delay and jitter), and from kilobytes/sec to gigabits/sec (for bandwidth). It is important to note that there may also be other design approaches that achieve the capabilities described; however, any successful technological implementation must be capable of meeting the three design criteria outlined above.

MPDEX will provide a well-defined and documented API, which will allow combat systems software modules (and other client applications) to access MPDEX services. These services will include the ability to request the creation, deletion, reassignment and release of a virtual channel, the ability to specify or modify the minimum performance parameters for that channel, the ability to monitor the performance of that channel, and the ability to support a multi-platform channel endpoint discovery service.

The MPDEX subsystem and its associated API shall be well-documented and conform to open systems architectural principles and standards [Ref. 4]. Implementation attributes should include scalability and the ability to run within the computing resources available within the AEGIS Combat systems BL10. It will run in a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) environment. The MPDEX technology will demonstrate the following: first, the ability to create, manage, and destroy virtual communications channels based on the aggregation of a number of available physical communications channels, effectively bonding the data streams from those multiple physical channels into a single virtual data stream of higher reliability and bandwidth; second, the ability to dynamically reallocate physical channels at run-time across a virtual channel suite with minimal or no degradation in current system performance in order to maintain specified performance parameters for each virtual channel; and, lastly, the ability to monitor and report on the real-time performance of each virtual channel.

The development of the technology proposed in this topic will significantly improve the reliability and bandwidth of cross-platform Combat Systems data exchange services, thus improving multi-platform tactical coordination and having the potential to significantly improve battlespace SA, thus reducing the management complexity of the overall battlespace, which may allow for a reduction in the number of platforms needed in a specific tactical arena by improving the overall tactical efficiency of the battlegroup as a whole, with an associated overall improvement in affordability.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop an initial concept design for an MPDEX architectural model and algorithm set capable of meeting the subsystem and API requirements and capabilities outlined in the Description. (Note: The Government will furnish AEGIS BL9 or later combat systems design/architecture documentation, draft Common Core Combat Systems TLR documentation, and other appropriate material needed to assist in the development of the Phase I design effort.) Determine the feasibility of the concept by modeling and simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop a prototype MPDEX architectural model and algorithm set that meets the parameters detailed in the Description. Evaluate the prototype to ensure it meets an MPDEX design commensurate with the requirements outlined in the Description. Ensure that the prototype demonstrates the capabilities outlined in the Description during a functional test that will be held at an AEGIS and/or Future Surface Combatant (FSC) prime integrator supported Land Based Test Site (LBTS) capable of providing simulated physical communications hardware supporting multiple modalities and representing an AEGIS BL9 or newer combat system hardware environment. Provide a Phase III plan to transition the technology to Navy use.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the MPDEX subsystem software to Navy use. Integrate the MPDEX subsystem software along with other CCCS compliant capability software modules into a prototype combat system implementation, consisting of a CCCS experimental prototype, implemented on a virtualized hardware environment within an AEGIS compliant land-based testbed. (Please note that the CCCS concept is currently being developed by PEO IWS 1SP as a potential AEGIS Combat System future replacement, as well as an initial combat system implementation for the planned FSC program currently envisioned by OPNAV N96.)

This capability has potential for dual-use capability within the commercial Air Traffic Control system in future development of an air traffic control system capable of rapid upgrade to handle increasingly complex traffic control patterns.

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KEYWORDS: Virtual Communications Channel; Coordination Data Exchange Subsystem; Real-time Communications; Multi-platform Sensor and Weapons Coordination; Sensor and Weapons Capability Software Modules; Virtual Channel Performance Parameters

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-057 TITLE: Software Ecosystem Architectural Model and Application Program Interface for Common Core Combat System

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: PEO IWS 1.0, AEGIS Combat System Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a Common Core Combat System (CCCS) software application execution and cross-application coordination environment (ecosystem) and associated Application Program Interface (API) capable of supporting various DoD- or 3rd-party-sourced dynamically loadable real-time tactical combat systems client applications.

DESCRIPTION: The Navy requires expansion of its sea-based advantage through increased capability. This need is addressed by providing technology that has the potential to improve Combat Systems client applications real-time performance (and the overall tactical performance and effectiveness of the host surface platform), as well as enabling multi-platform software re-utilization and commonality. This may allow for a reduction in the number of platforms needed in a specific tactical arena by improving the overall tactical efficiency of the battlegroup as a whole, resulting in a subsequent improvement in overall affordability.

The current implementation of the AEGIS Combat System has fundamental architectural limitations deriving from its initial hardware and software design constraints. These architectural limitations have forced the use of inefficient “bolt-on” style modernization modifications and enhancements to meet evolving 21st century threats. Currently available commercial systems and software that might be considered for adaptation to partially address the Navy’s combat systems requirement for advanced situational awareness (SA) (e.g., the FAA Air Traffic Control System hardware and software) are dated in their designs. They lack the software flexibility and track monitoring capacity required to adequately address tactical requirements. Specifically, the currently available commercial technology mentioned above is limited in that it lacks the capability to track, identify, and manage complex air, surface and subsurface entities and threats present in a combat environment. Additionally, such commercial systems have no intrinsic ability to provide a real-time-response-capable software execution environment for DoD- or 3rd-party-sourced combat systems client applications. Since no viable commercial alternatives exist or thus cannot be adapted to address these needs, it becomes necessary for the Navy to pursue a different avenue of exploration.

The Navy needs a combat systems application software execution environment (i.e., software “ecosystem”) for use within a host CCCS (or AEGIS) environment. This software ecosystem will support various DoD- or 3rd-party-sourced dynamically loadable real-time tactical combat systems client applications, all potentially executing simultaneously within the software ecosystem. Here “dynamically loadable” means that a client application can be loaded and started at operator discretion within a currently executing combat system instance, without the need to reload, restart, or otherwise interfere with the current running status of the combat system. The software ecosystem must also provide these client applications with a common API enabling access to combat systems weapon, sensor, and Common Operational Picture data in a real-time manner. The innovative challenge in this design task derives from providing these services without jeopardizing or degrading the overall real-time performance of the other simultaneously executing client applications or the host combat system itself. A fundamental architectural redesign of the combat systems core is needed to enable the efficient, rapid, and cost-effective addition of new capabilities, such as multi-platform sensor and weapons coordination, off-board/organic on-the-fly sensor and weapons integration, built-in cyber resilience, and real-time fault recovery. To address this critical need, a new CCCS architecture is currently in the planning stage, with the intent of providing a modular set of platform-agnostic common combat system services. This CCCS implementation, when supplemented by platform-specific sets of weapon, sensor, and communications capabilities modules, will constitute a new, modular, dynamically adaptable combat system design that can evolve to meet future emerging threats in a rapid and cost-effective manner.

Development of a CCCS software application execution and cross-application coordination environment (ecosystem) and associated API is critical to the future needs of the Navy. Such a capability will allow for the rapid integration of new tactical capabilities within a currently installed and running combat system instance. This software ecosystem is intended to serve as: (i) a core combat system architectural enhancement within the current AEGIS system; or (ii) a primary modular component within the newly proposed CCCS platform-agnostic combat system, intended for implementation on Future Surface Combatant (FSC) and other appropriate Navy platforms.

The CCCS modular ecosystem architectural framework and software component API should provide a comprehensive architectural model for a complete, versatile platform-agnostic “core” combat system, when taken in conjunction with: (i) an appropriate CCCS core combat system modular architectural framework and software component API; (ii) an appropriate CCCS multi-platform coordination architecture and inter-platform data exchange algorithm set; and (iii) an appropriate multi-platform coordinated/synchronized Distributed Common Operational Picture (DCOP) subsystem implementation. The term, “core” implies that this system architecture and implementation will provide those combat system services and capabilities that are considered necessary to satisfy common tactical warfighting requirements spanning various and diverse surface combatants. This core combat system implementation, when configured with the appropriate surface warfighting platform-specific sensor and weapons capability software modules, should be capable of fulfilling the functional warfighting capabilities and requirements needed to support the vast majority of U.S. Navy surface platforms well into the future. The CCCS modular applications program execution and cross-applications data exchange and coordination environment (hereafter referred to as the "ecosystem") will provide a software execution environment supporting multiple dynamically loadable (i.e., run-time loadable) combat systems operator controlled and/or autonomous applications. The ecosystem will support application performance monitoring and control services as well as inter-application (ship and cross-platform or battlegroup) coordination and data exchange services, all provided via a well-defined and documented ecosystem API. The architecture of the API will provide a layer of software abstraction hiding any implementation-specific details of CCCS provided lower-level software communications and control services.

The CCCS ecosystem architectural model and software framework will support a software execution environment and API capable of supporting a scalable number of independently executing combat systems applications and autonomous AI-based software agents or entities, such as tactical and engagement planning tools, multi-platform weapons control and assignment tools, and AI-based situational awareness autonomous agents. Within the ecosystem, each application or entity will be capable (when granted the appropriate access permissions) of accessing: (i) ship- or battlegroup-hosted weapons and sensor system control elements system status and sensor data; (ii) DCOP data; (iii) inter-application cross-platform data exchange and messaging services; and (iv) host combat system (i.e., CCCS) ecosystem software management performance monitoring metrics and applications execution controls.

With respect to ship-based ecosystem applications accessing organic-hosted (such as ship)capabilities, all four of the access categories listed above should support real-time access and control. With respect to ship-based ecosystem applications accessing non-organic-hosted (such as battlegroup) capabilities, near real-time performance should be the goal. The ecosystem architecture and its API will support a Quality-of-Service (QOS) application and local and remote capabilities performance monitoring subsystem. This subsystem should be capable of providing QOS metrics for each off-board capability to any application granted access to that capability. The QOS metrics for any capability should be based on appropriate weapons communications control-loop delay and sensor data delay measurements derived from periodic automated communications-loop access senescence and jitter testing of off-board capabilities.

The ecosystem subsystem software architecture and API framework should be modular in nature. The installation, removal, activation, and deactivation of the ecosystem modular software within an executing CCCS implementation (or other host combat system) should have no adverse effect on the real-time performance of the CCCS system or the services it provides to the host platform and operator at the time those changes are implemented. An exemplar of this type of no impact behavior during runtime installation and removal of capabilities within an executing system can be observed in the Linux operating system kernel module control facilities (kernel 4.4 and above), e.g., the insmod, rmmod, depmod, lsmod, modinfo, and modprobe commands [Refs. 2, 3]. The process of installing, removing, upgrading, or otherwise controlling the ecosystem software implementation module within an executing CCCS installation should be easily executed by combat systems watch personnel, without the need for specially trained software maintenance personnel.

The CCCS ecosystem API architecture and software framework will provide a native suite of Ecosystem cross-application and cross-platform data exchange and message services. The API will provide a level of software abstraction, masking the underlying implementation details of the communications services framework of the CCCS (or host combat systems) that it utilizes. The ecosystem API will also provide ecosystem resident software applications and entities with an access-controlled combat system weapons and sensor-system data real-time- or near real-time-capable interface. This API will be architected to provide a platform-agnostic abstracted weapons and sensor access mechanism capable of providing access to both organic and non-organic weapons and sensors utilizing common well-defined and documented data and control software structures, and access to the QOS metric subsystem described previously to quantify performance when accessing near real-time non-organic capabilities. The ecosystem API architecture will also implement a software applications access control subsystem, which will utilize a hierarchically structured set of privilege levels to control access to both organic and non-organic weapons and sensor systems data and interfaces.

Both the CCCS ecosystem architectural model and its associated APIs will be well-documented and conform to open systems architectural principles and standards [Ref. 4]. Implementation attributes should include scalability and the ability to run within the computing resources available within the AEGIS combat systems BL9 or later hardware environment.

The technology will be compatible with the C++ programming language and capable of running in a Linux (Redhat RHEL 7.5/Fedora 29/Ubuntu 18.4.1 or later) processing environment as a standalone application (i.e., no critical dependencies on network-based remotely hosted resources, save for sensor data emulators). The prototype CCCS implementation will demonstrate the following: first, the ability to start, stop, and control multiple operator-driven or autonomous combat systems applications or software agent entities; second, the ability of real-time performance when executing various data exchange operations between ecosystems-hosted applications and entities; and lastly, the ability of real-time performance when executing various data exchange operations between organic and non-organic ecosystem-hosted software applications and entities, and real-time or near real-time access and control of organic and non-organic sensor and weapons system emulators.

Any prototype produced during Phase II shall demonstrate that it meets the capabilities described above during a functional test to be held at an AEGIS or FSC prime integrator supported Land Based Test Site (LBTS) identified by the Government and capable of simulating an AEGIS BL9 compatible or newer combat system hardware test environment.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Design a concept for a CCCS software application execution and cross-application coordination environment (ecosystem) and associated API. Establish feasibility through modeling and analysis to show the concept will meet the required parameters in the Description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design, develop, and deliver a prototype software implementation of the CCCS ecosystem. Demonstrate that the prototype meets the capabilities detailed in the Description during a functional test that will be held at an AEGIS or FSC prime integrator-supported LBTS provided by the Government, representing an AEGIS BL9 or newer combat system hardware environment.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Integrate the CCCS ecosystem software along with other CCCS compliant core capability and platform-specific capability software modules into a prototype combat system implementation, consisting of a Common CCCS experimental prototype, implemented on a virtualized hardware environment within an AEGIS compliant land-based testbed.

This capability has potential for dual-use capability within the commercial Air Traffic Control system in future development of an air traffic control system capable of rapid upgrade to handle increasingly complex traffic control patterns.

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KEYWORDS: Common Core Combat System; Modular Applications Program Execution and Cross-applications Data exchange and Coordination Environment; Rapid and Cost-effective Addition of New Capabilities; Cross-applications Data Exchange and Coordination Environment; Communications Services Framework; Dynamically Loadable Real-time Tactical Combat Systems Client Applications

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-058 TITLE: Affordable and Efficient High-Power Long Wavelength Infrared Quantum Cascade Lasers

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PEO IWS 2: Surface Electronic Warfare Improvement Program (SEWIP) Block 4

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate an affordable, high-power, highly efficient, quantum cascade laser technology for operation in the long wavelength infrared spectrum.

DESCRIPTION: Solid-state laser systems have a wealth of military applications, including target designators, illuminators, secure communications, countermeasures, and directed energy weapons. Providing effectiveness in diverse environments and flexibility in the face of rapidly changing operational demands, and addressing the range of enemy threats require lasers operating across wide parts of the electro-optic/infrared (EO/IR) spectra. As with all military systems, issues of efficiency, size, weight, and power (SWaP) and especially cost, are paramount concerns. No single laser system can address all operational requirements, and no single laser technology can operate equally well across the wide span of the visible and infrared bands.

To date, a great deal of effort has been invested in developing compact, affordable, and efficient laser diode technology in the visible, short-wave infrared (SWIR), and mid-wave infrared (MWIR) bands, especially in the area of quantum cascade lasers (QCLs) for the MWIR. QCL-based laser modules have been demonstrated in these bands. They are compact (approximately a few hundred cubic centimeters), lightweight (less than a kilogram), and flexible in application. Alternate laser technologies of comparable performance would necessitate at least an order of magnitude increase in size and weight. The long-wave infrared (LWIR) band, especially the atmospheric transmission window of 8-10.5 microns (µm), has received less attention. This is not to suggest that the LWIR band is less important. Indeed, the LWIR band possesses characteristics that make it particularly attractive for many application – but progress in the area is slowed by the difficulty of fabricating suitable device structures.

Recent QCL research in the 9-11 µm wavelength band has demonstrated single device continuous wave (CW) output powers of 2-3 W with corresponding “wall plug” efficiencies (WPE) of around 12% (WPE is defined as the ratio of total optical output power to the input electrical power). Commercially available devices (what few exist) produce far less power (typically less than 1 W), exhibit efficiencies (WPE) around 5%, and cost in excess of $5000 in small quantities. Granted, wide scale application of LWIR QCLs in Navy systems would create the demand necessary to somewhat reduce device cost. However, before this can happen, a viable technical path must be shown toward achieving both the required performance and reliable, repeatable manufacture. A per-device cost reduction of at least one order of magnitude is needed.

The Navy needs a high-power, high-efficiency, and affordable LWIR QCL technology. Specifically, a QCL technology that operates over the wavelengths 8-10.5 µm is required. For a single device (a single QCL emitter, not an optically combined array of emitters), the goals for optical output power and WPE are 4 W and 16%, respectively, at room temperature. These power and efficiency goals are understood to apply over the entire 8-10.5 µm band. That is, a single QCL technology is desired such that the entire band of interest can be covered by the same basic device design through parametric design changes (e.g., emitter length, optical waveguide width). Approaches that use different device structures to cover separate parts of the band are not of interest. Prototype devices produced under this effort need not cover the entire band of interest (or even substantial portions of it). However, prototype devices should be demonstrated at representative wavelengths sufficient to show applicability of the technology across the full band of interest. As the combining of output from multiple devices is envisioned for some applications, the output beam should be CW and nearly diffraction limited with M2 of 2.0 or less.

Fundamental to this effort is development of a path toward affordable manufacture of the proposed QCL technology. Therefore, this effort should not only deliver prototype devices, but should also establish and mature the essential fabrication process such that (upon validation of the process) the devices can be reliably manufactured with high batch-to-batch repeatability and yield. Full validation of a semiconductor fabrication process is beyond the scope of Phase I and II of this effort and is left to Phase III. As device design and process development typically require an iterative and incremental approach, it is expected that multiple prototype devices will be fabricated and tested during this effort. Therefore, at least two individual devices shall be tested and delivered to the Naval Research Laboratory.

PHASE I: Propose a concept for an affordable, efficient, and high-power QCL technology as described above. Demonstrate the feasibility of the proposed approach and predict the ability of the concept to achieve the required parameters in the Description. Demonstrate feasibility by some combination of analysis, modelling, and simulation. Address affordability initially by identification of the key manufacturing steps and processes anticipated for manufacture of the device in Phase II, their maturity and availability in the industry, and their projected cost. The Phase I Option, if exercised, will include a device specification, initial process description, and test plan in preparation for device prototype development and demonstration in Phase II.

PHASE II: Develop and demonstrate a prototype QCL technology as detailed in the Description. Demonstrate that the technology (including the nascent manufacturing process) meets the requirements in the Description. Demonstrate the technology in two progressive parts: a demonstration that a prototype QCL meets the power and WPE requirements in the Description; and a demonstration that multiple (at least four) prototype (packaged and ready to use) CW QCLs meet the performance requirements of the Description such that manufacturing repeatability and the ability of the devices to operate at more than one wavelength within the LWIR band is shown. After electrical performance testing, deliver the prototype devices to the Naval Research Laboratory. Make available the prototype manufacturing process, as documented by initial process control specifications, process definitions, calibration instructions, in-process quality protocols, etc., for review by Naval Research Laboratory personnel or their authorized representatives. Deliver an analysis of production cost based on the resulting manufacturing process and an assessment of the MRL achieved at the end of the effort.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Government use and Low Rate Initial Production (LRIP). Assist in applying the design to (and maturing the process for) specific QCL devices (specific wavelength devices, packaging, etc.) since the prototype devices and initial manufacturing process resulting from Phase II are a generic demonstration of the technology. Mature and validate the prototype manufacturing process developed in Phase II for production at qualified foundries.

The technology resulting from this effort will have application in the fields of laser spectroscopy and communications.

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KEYWORDS: Solid-State Laser; Quantum Cascade Laser; QCL; Long Wave Infrared; LWIR; Semiconductor Fabrication; Laser Diode; Laser Systems

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-059 TITLE: Automated Management of Maritime Navigation Safety

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 406, Unmanned Maritime Systems Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop software or a combination of software and hardware that enable an Unmanned Surface Vehicle (USV) to tailor its navigation safety active emissions and passive signatures to the current situation based on broad guidance given days earlier by a distant controlling station.

DESCRIPTION: Unmanned Vessels should be able to present an appearance that is appropriate to the current local situation. For example, a USV transiting through pirate-infested waters may seek to minimize its signatures to avoid attracting unwanted attention and a potential boarding. At the other extreme, a USV with a relatively low signature may want to increase its visibility in a high-traffic area to give other vessels more time to react to its presence. The USV may only be in intermittent communications with a distant oversight station, or communications may be completely severed. Therefore, the USV must be able to take the most recent broad guidance received and use it to adapt to the current local situation without real-time human assistance. The signature management may be limited to controlling radiofrequency (RF) emissions, but it may also include installing and operating hardware such as a hoisted radar reflector. Current manned vessels can and do manage their signatures, but the decision-making is done by people on those vessels. Research, development, and innovation are required to enable unmanned vessels to perform this function. The concept can be a novel way to reduce or enhance a particular signature, or it can be software for a USV to manage the signature that it presents, or both. Signature enhancement or reduction could be focused in one direction from the USV, or it could be an overall enhancement/reduction. Companies must include the expected scope of the Phase II effort in their Phase I proposals. Performance and technical requirements will be based on the solution that is proposed.

The Phase II effort will likely require secure access, and NAVSEA will process the DD254 to support the contractor for personnel and facility certification for secure access. The Phase I effort will not require access to classified information. If need be, data of the same level of complexity as secured data will be provided to support Phase I work.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Provide a concept to solve the stated Navy problem and demonstrate the feasibility of that concept. At the end of Phase I, deliver a technical report including analysis showing how the concept would work and documenting its expected effectiveness. If the concept is for signature enhancement/reduction, its effectiveness should be measured in terms of expected percentage or dB enhancement/reduction as well as radians of coverage (2D case) or steradians of coverage (3D case) for the signature change. If the concept is for signature management software, its effectiveness should be measured in terms of expected probability of matching a desired signature and expected time latency in changing the vessel's signature. If practical and advantageous, conduct limited sub-scale prototyping and testing ashore or on a surrogate vessel.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Produce two prototype systems for testing and evaluation. If the solution is entirely a software product, integrate it with two different USVs using an Interface Control Document (ICD) supplied by Navy at the beginning of Phase II. Finish prototypes within three months prior to the end of Phase II, with the last three months of Phase II devoted to testing and demonstration of the prototypes. If the prototype includes any software, ensure that it complies with the Unmanned Maritime Autonomy Architecture (UMAA), which the Navy will provide at the beginning of Phase II.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Ensure that, at the end, the Medium Unmanned Surface Vehicle (MUSV) and/or the Large Unmanned Surface Vehicle (LUSV) will have better control of its signatures even though the final product will vary based on the proposed solution. Deliver an integrated and tested hardware and software solution. (Note: Navy will provide ICDs in a timely fashion to support software integration.) Validate the product in a series of in-port tests followed by at-sea testing in a variety of conditions, depending on the nature of the solution. For example, if the solution changes the vessel's appearance to an Electro-Optical sensor, then testing would occur in day and night conditions, clear visibility, haze, and fog.

Signature management tools for Navy USVs may be useful for unmanned or minimally manned commercial vessels. Such tools would allow a commercial vessel to make itself easier to detect for safety purposes, or harder to detect to avoid pirates.

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2. Thompson, J., Vaitekunas, D. and Brooking, B. "Signature management-The pursuit of stealth lowering warship signatures: Electromagnetic and infrared." Proceedings of Signature Management-The Pursuit of Stealth Conference, 2000. http://www.wrdavis.com/docs/papers/lowering_warship_signatures.pdf

KEYWORDS: Vessel Signature Management; Vessel Radar Cross-Section; Vessel Infrared Signature; Vessel Radiated Noise; Vessel Electromagnetic Signature; USV Autonomy

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-060 TITLE: Unmanned Passive Navigation without GPS

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PMS 406, Unmanned Maritime Systems Program Office.

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a passive device or system that allows an unmanned vehicles/vessels to develop and maintain awareness of its location on the earth’s surface without using the Global Positioning System (GPS).

DESCRIPTION: This topic stands at the intersection of three needs: unmanned navigation, passive sensing, and mitigation of GPS vulnerability. First, unmanned surface vehicles/vessels (USVs) are being developed both by global navies and by commercial shipbuilders. While underway, a USV must determine its position on the earth’s surface to get to its destination while avoiding shoal waters, charted obstacles, and prohibited areas. Second, military vessels need to have the capability to operate without revealing their locations to potential adversaries. Radio frequency (RF) transmissions, including use of a surface search or navigation radar, can disclose a vessel’s location, Commercial vessels may also find that staying silent can aid in avoiding being targeted by warships during hostilities or by pirates. Third, the GPS has become the primary means for navigation for most ocean-going vessels. However, this system is susceptible to interruption or spoofing, especially during times of hostilities between nation-states. Therefore, the U.S. Navy seeks a device that allows an unmanned vessel to develop and maintain awareness of its location on the earth’s surface without using GPS or revealing the vessel’s location while meeting the accuracy requirements for restricted piloting as well as coastal and open water navigation (As described in CNSP/CNSLINST 3530.4F).

Passive navigation techniques such as celestial navigation with a sextant have been used for centuries, but the navigational fix accuracy is not sufficient for operation of modern Navy systems. Older electronic navigation systems such as Omega and Loran-C have also been retired. Other satellite-based systems such as Russia's GLONASS and the European Union's Galileo have the same disadvantages as GPS. Additionally, there are legislative and policy limitations on use of the Global Navigation Satellite Systems (GNSS) of other nations by the US Navy (Public Law 114-328 and DoD instruction 4650.08). Use of satellite constellations as part of the proposed solution is not prohibited, but cannot be the only means of navigation fixing. This topic seeks a novel system, an improvement over existing methods, and/or a combination of methods to achieve the stated accuracy goals. Solutions only relying on GNSS or using active RF transmission will not be accepted. Use of a fathometer and AIS is discouraged but not prohibited. The final product is a fully integrated system that interfaces with the USV's autonomy by passing a stream of latitude, longitude, time, and confidence fields. The final product should be able to take an input from an onboard inertial navigation system that provides a "dead reckoning" solution to previous fixes and that gives a ship's heading information.

This system will meet critical Navy needs by allowing Medium Unmanned Surface Vehicle (MUSV) and Large Unmanned Surface Vehicle (LUSV) to safely navigate without revealing their location to adversary forces. The product meeting stated goals without operator input or assistance (unmanned or autonomous) will be validated and tested ashore for compliance with the Navy-provided Initial Capabilities Document (ICD). Additionally, the product will be evaluated for ease of integration with the unmanned vehicles/vessels with respect to Hardware (Size, Weight, Power, and Cooling) and Software Integration. Once validated ashore by the Navy, it will be qualified and certified for Navy use through sea trials in at least three different geographical locations (e.g., Atlantic Ocean, Gulf of Mexico, and Pacific Ocean) and in a variety of conditions. These conditions will include near-shore and open ocean conditions, daytime and nighttime, clear visibility and fog. Depending on the technology used, tests will be selected that provide a diversity of conditions having an impact on the solution.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Provide a concept to solve the Navy's problem as detailed in the Description. Demonstrate feasibility with modeling and or simulation. Provide any preliminary analysis and/or testing supporting the viability of the approach at the end of Phase I.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop two prototype systems for testing and evaluation. Support Government evaluation of the prototype systems at sea in both near-shore and open-ocean conditions to verify navigation accuracy on existing MUSV and LUSV prototypes. Integrate the prototypes into Navy-provided autonomy systems ashore using a Navy-specified Interface Control Document (ICD) that will be provided by the Government after award. After integration, test the prototypes ashore in a laboratory environment to verify that they meet the ICD standards and that they can send navigation messages to the autonomy systems. Develop a Phase III plan.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the passive navigation technology for Navy use by supplying hardware, software, and technical documentation for installation and repair. Provide assistance, if required, for the first several installations, required on the MUSV and the LUSV.

This technology could be used on manned and unmanned commercial vessels of many different types. In particular, it could be used as a complement to and backup for unmanned navigation systems that rely on GPS, GLONASS, and/or Galileo.

REFERENCES:
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2. Cozman, F. and Krotkov, E. "Robot Localization using a Computer Vision Sextant." Proceedings of 1995 IEEE International Conference on Robotics and Automation, Vol. 1, pp.106:111. https://www.researchgate.net/profile/Eric_Krotkov/publication/2593290_Robot_Localization_using_a_Computer_Vision_Sextant/links/5506d5f30cf26ff55fb010b/Robot-Localization-using-a-Computer-Vision-Sextant.pdf

KEYWORDS: Unmanned Navigation; Non-GPS Navigation; Passive Sensing; Celestial Navigation; Visual Navigation; Magnetic Navigation

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-061 TITLE: Mine Countermeasures Unmanned Surface Vehicle Common Deploy and Retrieve System

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 406, Unmanned Maritime Systems Program Office, MCM USV

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Currently, a common deploy and retrieve system does not exist for towed systems; existing deploy and retrieve systems are specific to the towed body. This SBIR effort aims to develop a common, robust, maintainable, and reliable deploy and retrieve system for Mine Countermeasures Unmanned Surface Vehicle (MCM USV) to deploy, stream, tow, retrieve, and stow similarly sized (diameter 10.29" to 15.5") towed systems that may be towed by connection at the nose of mid-body.

DESCRIPTION: The Mine Countermeasures (MCM) Mission Package (MP) has a requirement to conduct minehunting (MH), which is being executed through a capability to tow either the AN/AQS-20C or AN/AQS-24B sonar system. However, towing of each of the tow-bodies current requires different deploy and retrieve systems, due to the different locations of the tow points. Because of this, the AN/AQS-20C and AN/AQS-24B sonar systems have different tow cables; handling requirements, hydrodynamic requirements, and interfaces. The Navy is seeking innovative approaches to develop a common deploy and retrieve system for a variety of towed sonar systems and platforms, including the AN/AQS-20C and AN/AQS-24B sonar systems. These payloads will be the first two sonar systems to be integrated into a common deploy and retrieve system for the MCM USV.

A common deploy and retrieve system will provide additional flexibility in towed sonar choices and procurement options, and lower life cycle costs to the Navy. The goal is to provide the Fleet with a modular capability to launch and recover towed sensors at a competitive cost. Upon successful demonstration of the deploy, retrieve, and tow capability from an MCM USV, the deploy and retrieve system will be procured as part of the program of record for the MCM USV MH configuration.

PHASE I: Develop a concept for a common deploy and retrieve system that will interface with the nose and the mid body of a towed sonar, per the AN/AQS-20C and AN/AQS-24B Interface Control Document requirements. Demonstrate the feasibility of the concept through modeling, simulation, and analysis.

The Phase I Option, if exercised, will include the development of the initial design specifications and capabilities description for common deploy and retrieve system requirements. The Option will complete with a Preliminary Design Review (PDR) package for delivery to the Navy. Develop a Phase II plan.

PHASE II: Develop a Critical Design Review (CDR) package for the common deploy and retrieve system. Build an operational common deploy and retrieve system prototype to be used to test functionality and validate the physical and logical interfaces. Perform operational testing on the prototype, per AN/AQS-20C and AN/AQS-24B System Requirements Document. Coordinate testing with the Navy to evaluate the system in an at-sea environment. Prepare a Phase III development plan to transition the technology to the Navy and potentially for commercial use.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use on the MCM USV program. Further refine the software and hardware to ensure compatibility with existing interfaces and workstations for evaluation to determine their effectiveness in an operationally relevant environment. Support the Navy for test and validation to certify and qualify the system for Navy use. Similar sized sonars are manually deployed from larger boats and are used for sea exploration and other research and development purposes. This deploy and retrieve assembly would allow for use by smaller boats and would enable unmanned, semi-autonomous, operations.

REFERENCES:
1. "Mine Countermeasures Unmanned Surface Vehicle (MCM USV)." The US Navy – Fact File, 02 January 2019. https://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=1400&ct=2

2. "AN/AQS-20A Mine Hunting Sonar System." PEO LCS Fact Sheet, 26 September 2011. https://www.secnav.navy.mil/rda/Documents/AQS-20+20110826+V2.pdf

3. "AN/AQS24B Minehunting Sonar System." The US Navy – Fact File, 08 November 2013. (Uploaded to SITIS 12/10/2019)

KEYWORDS: MCM USV; Detection of Ocean Mines; AN/AQS-20; Moored Mines; AN/AQS-24; Towed Array

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-062 TITLE: Hydrophone Incorporating Open Architecture Telemetry

TECHNOLOGY AREA(S): Battlespace, Electronics, Sensors

ACQUISITION PROGRAM: PEO IWS 5/PMS 401, Submarine Acoustic Systems Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on

this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a hydrophone (Acoustic Channel Assembly (ACA)) with embedded electronics that comply with the Open Architecture Telemetry (OAT) standard to support receive arrays with increased numbers of hydrophones and telemetry channels per unit length and reduced ACA cost.

DESCRIPTION: Currently, the acoustic channels in towed arrays deployed from surface ships and submarines consist of an acoustic section (hydrophones) and separate telemetry connected via micro-miniature connectors to exfiltrate acoustic information from the array. There are many Acoustic Channel Assemblies (ACAs) in a typical array [Ref. 1]. Innovation is sought to integrate telemetry electronics with acoustic channel assemblies to permit enhanced coherent processing.
Multiple towed array systems, both surface ship, surveillance, and submarine, could utilize the new ACA's technology and performance. By integrating hydrophones with telemetry electronics as an acoustic channel assembly, towed array designers can achieve higher sensor density with increased coverage overlaps. This will enable processing enhancements of the towed array data.

Present commercial technology and hydrophones focus on single element hydrophone sensors. The designs are typically for stationary sensing and do not incorporate multiple elements or meet the required form factor.

The cost of the present channel assemblies and the associated electronics (telemetry) account for approximately 20 percent of the overall cost of a towed array. The development of an ACA with incorporated telemetry would allow a 5-10% reduction in the overall system cost by eliminating the separate assemblies and the touch labor associated with the wiring and connectors.

The performance of towed arrays improves when there are more ACAs and telemetry channels per unit length [Ref. 2]. Array performance and processing can significantly increase when single paired hydrophone telemetry channels with separate telemetry are replaced with improved acoustic sensors with embedded electronics to support data exfiltration. Integration of hydrophones with key telemetry electronics will provide for inherent redundancy and graceful degradation in the event of a sensor failure.

The Navy needs an innovative technology that combines the acoustic channel performance with an increased number of ACAs and telemetry channels per unit length. This capability will assist the Navy in maintaining or increasing its tactical advantage in the undersea Anti-Submarine Warfare (ASW) domain. The solution will consist of an acoustic sensing section and the associated electronics to acquire the acoustic information, convert signals to a digital format, and then transmit the data to the second-level telemetry backbone. The entire assembly will be packaged as a single unit. The Navy will provide an Interface Control Document (ICD) that defines the incoming power (estimated 100 milli-watts per ACA), channel performance requirements, and the digital output format, which complies with the Department of Justice Interface Control Document standard [Ref. 3]. The ACA acoustic improvement goal is to measurably improve noise rejection (e.g., improve noise rejection greater than 3 dB) of the turbulent boundary layer noise typical for acoustic sensor towed inside a towed array.

ACAs experience extreme environments; therefore, the system and/or sensors must be capable of functioning without damage or degradation in pressures (depth) up to 1200 psi, temperatures over a range of -28°C to 50°C, and accelerations up to 100 Hz over a range of 0.0 g to 25.0 g. The reliability of the ACA must support a Mean Time Between Failure (MTBF) of at least 7000 hours.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for an improved ACA that integrates the hydrophone with telemetry electronics identified in the Description. Demonstrate feasibility through modeling, development, and analysis. The Phase I Option, if exercised, will include the initial system specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design, develop, produce, and deliver two dozen of the Improved Acoustic Channel Assembly prototypes. (Note: The Government will provide support for packaging the assemblies within a towed array as well as environmental testing as required.) Demonstrate the prototypes at a Government- or performer-provided facility. Provide technical support to the Government to conduct environmental testing at NUWCDIVNPT, Middleton, RI and performance testing at NSWC Acoustic Research Detachment, Bayview, ID.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Assist the government in transitioning the technology for Navy use. Conduct experimentation and refinement to qualify the system for use on towed arrays. (Note: The Government will provide the performer access to a Navy ship for validation and performance verification of the final system.) Support installation and removal from an at-sea test platform and assist in data recovery and processing using the system for towed arrays.

This system would prove useful for oceanographic research, oil and gas exploration, congested-area traffic monitoring, and other applications where data from multiple disparate sensors are fused to provide a more holistic awareness of the volume being monitored by said sensors, especially where said sensors are not in fixed locations.

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1. Lemon, S. G. "Towed-Array History, 1917-2003." IEEE Journal of Oceanic Engineering, Vol. 29, No. 2, April 2004, pp. 365-373. http://ieeexplore.ieee.org/abstract/document/1315726/

2. Burdic, William S. “Underwater Acoustic System Analysis.” Prentice-Hall, Inc.: New Jersey, 2002. https://www.worldcat.org/title/underwater-acoustic-system-analysis/oclc/70580566

3. “Interface Control Document, The Department of Justice Systems Development Life Cycle Guidance Document, Appendix C-16, January 2003.” https://www.justice.gov/archive/jmd/irm/lifecycle/appendixc16.htm

KEYWORDS: Towed Array; Acoustic Channel Assemblies; Turbulent Boundary Layer; Telemetry; Hydrophone; Embedded Electronics in Towed Arrays

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-063 TITLE: SUBSAFE Electrical Hull Penetrator Connectors for Directed Energy (DE) Weapon Systems

TECHNOLOGY AREA(S): Electronics

ACQUISITION PROGRAM: NAVSEA 073, Advanced Submarine Systems Development

OBJECTIVE: Develop submarine SUBSAFE electrical hull penetrators and connectors that can transfer high currents or high voltages in the order of 100’s of kW through the submarine's pressure hull.

DESCRIPTION: The Navy seeks technologies for transmitting high electrical power required for operating Directed Energy (DE) weapon systems from inboard the submarine to an outboard DE system, submersible platform, special operation, etc. The technology must address the capability to transfer high electrical power safely from inboard submarine to a DE subsystem or beam director located on an outboard platform through the hull-penetrating path. In the case of all electrical hull penetrators, the solution needs to address high-power electrical cables and appropriate connectors that can carry high electrical power (greater than 500kW of electrical power) over long distances (greater than 30 ft.) with low ohmic or impedance loss. The electrical cable shall also include additional shielding to minimize EMI. Consideration must be given to the overall system approach and operational aspects of the systems. Ideally, DE systems would require hull penetrations for the high electrical power required for operating a High Energy Laser (HEL) subsystem and low electrical power required for operating a beam director or other auxiliary subsystems within a DE system. The guideline for total electrical power is approximately 300 kW with potential roadmap to greater than 500 kW potential growth.

The solution of the electrical hull penetrator shall be based on current hull penetrator configurations (3 hull penetrators per Universal Modular Mass (UMM)), where one or all three current hull penetrators are used for off board high-power DE systems operation or for other submersible platform and any sensor connection, as required. The electrical hull penetrator shall address affordability because it is a very cost-effective way to get high power outboard from inboard submarine electrical systems. Currently, the Navy needs to tow the generator to support a similar system.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for a hull penetrator to transmit kW class of electrical power from the inboard DE system to an outboard HEL subsystem or high energy DE to beam director system. Ensure that the concept includes electrical feed technology in the marine environment that provide realistic energy levels from 300 kW to 600 kW electrical energy required in order to operate an approximately 100 kW to 200kW class outboard high energy HEL system with >30% electrical to optical efficiency. Ensure that the hull penetrator design meets Navy SUBSAFE qualification requirements and uses Model Base Engineering (MBE) approach. Demonstrate feasibility by some combination of analysis, modelling and simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities in preparation for prototype development and demonstration in Phase II.

PHASE II: Design and develop a lab prototype that incorporates power-transmitting capability from inboard to outboard Navy systems and can be tested in a representative undersea environment. Include in the design the maintainability and workability of the Hull Penetrator Insert under a marine environment. Conduct a demonstration of the design and a verification test at a Navy facility to verify that key system performance specifications are met. Outline the plan to fabricate an initial field prototype system using model base engineering (MBE) that can be easily integrated and tested on a representative submarine environment. Develop a Phase III plan.

It is probable that the work under this effort will be ITA restricted under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: In Phase III, the company support the Navy or DoD contractor in transitioning the technology for manufacturing of Electrical insert for Hull Penetrator.

As a dual application, this technology can be also be used in commercial industry for oil platform, under water high electrical power to perform number of innovative commercial and academic research. This technology can also be very useful to use safely high electrical power in humid or wet condition for dual use applications.

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KEYWORDS: Submarine Systems; Hull Penetrator; High Energy Laser (HEL); Submarine Safety; SUBSAFE; Universal Modular Mass (UMM); Model Base Engineering (MBE)

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-064 TITLE: Digital Theater-level System Model for Cyber Security Analysis

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: EO-IWS5: Surface ASW Combat System Integration, Surface ASW System Improvement

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a digital model that can assess the communications-related cybersecurity posture of geographically distributed sensors, weapons, and combat systems supporting theater-level mission tasking.

DESCRIPTION: For the Theater Undersea Warfare (USW) mission, the Theater commander’s tool is the AN/UYQ-100 Undersea Warfare Decision Support System (USW-DSS) [Ref. 1]. USW-DSS produces plans that optimize USW capability across the entire theater. However, cybersecurity has not traditionally been a part of mission planning at the theater level. The theater-wide system of systems contains distributed networks of disparate systems at varying levels of cyber resiliency, which communicate through physical environments that vary as a function of time, season, commercial and military interference, and other factors [Refs. 2, 3].

Cybersecurity posture of individual systems are monitored in accordance with the Risk Management Framework (RMF) [Ref. 4]. However, RMF is not sufficient to support modeling of the cybersecurity of geographically distributed systems communicating through atmospheric and acoustic environments with variable properties. Commercial infrastructure with similar needs operate on networks specifically designed to be robust, but are not adequate for military needs. Military combat systems in conflict with a peer competitor cannot count on dedicated intra-system communication network infrastructure and must adapt to transmissions through the available environment (e.g., acoustic transmission, electronic transmission through the atmosphere).

The Navy needs a software architecture and digital system model capable of providing USW planners a comprehensive assessment of the cybersecurity posture of a geographically distributed network of disparate sensors communicating through paths fundamentally dependent on environmental factors. The successful technology will be used as a stand-alone product in support of new system design and will be incorporated into USW-DSS in support of theater ASW operations.

The needed digital system model will provide modeling of actual and planned theater assets and allow designers to assess the cybersecurity implications of distributed and unmanned systems as they communicate and operate in the physical environment. Incorporation of this model into USW-DSS will also allow theater commanders to include cybersecurity in mission planning, mission execution, and post-mission analysis.

The digital system model must be able to represent the cybersecurity posture of each category of USW sensor and platform, including surface combatants, unmanned vehicles, submarines, air vehicles, surveillance assets, and expendables associated with these platforms. The digital system model must also be capable of modeling the communication pathways between these geographically dispersed sensors and platforms, including modeling of environmental factors and their effect on the communication between the sensors and platforms. This technology will reduce engineering efforts to provide Objective Quality Evidence (OQE) for the system cybersecurity resiliency in operational environments.

The digital system model must have a useful instantiation that can run as an element of USW-DSS without increasing processing hardware requirements. USW-DSS is hosted on shipboard computational assets such as the Consolidated Afloat Networks and Enterprise Services (CANES). Mission execution monitoring must be able to support real-time execution. Post-mission analysis must be able to support 4X real-time analysis. The USW-DSS system-operating environment will be defined in greater detail by the Government, but will consist of RedHat Security-Enhanced Linux as the base operating system.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Define and develop a concept for a software architecture that would support assessment of the cybersecurity posture of a geographically distributed network of sensors and platforms. Demonstrate feasibility through analytical modeling and development that address the requirements discussed in the Description. The Phase I Option, if exercised, will include the initial system specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype of the software and its architecture for digitally modeling a theater-wide system of systems to assess cybersecurity posture. Demonstrate performance through the required range of parameters given in the Description, including the ability to conduct robust options analysis in varying locations in support of system design as well as an ability to support real-time assessments by human operators of ongoing operations in the theater. Demonstrate, at a Government- or company-provided facility, utilization of existing Navy-specified system or sub-system components to provide a fully functional operational capability within USW-DSS; and the capability to ingest real-time data representative of operational conditions.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology for Navy use and complete further experimentation and refinement to ensure that the technology provides support for USW-DSS and other Navy specified systems and the associated system engineering activities of the Program.

The technology should have high potential for dual use for industries with geographically distributed systems, such as utilities related to power generation, water distribution, information networks, and border surveillance. This is particularly useful for industries where reliability of the communication networks impacts performance and cybersecurity.

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KEYWORDS: Theater Undersea Warfare; USW; Undersea Warfare Decision Support System; USW-DSS; Cybersecurity Implications of Distributed and Unmanned Systems; Combat Systems; Cybersecurity of Geographically Distributed Systems; Modeling of Environmental Factors

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-065 TITLE: Element-Level Digital Communications Array

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: PEO Integrated Warfare Systems (IWS) 6.0 Command & Control (C2) Directorate

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a digital, C-Band Transmit (Tx) and Receive (Rx) array antenna that transmits and receives multiple spatially and spectrally diverse narrowband signals.

DESCRIPTION: Expanded mission areas and the implementation of additional data routing resulting from future warfighting capabilities place more demand on data distribution services in the form of higher data bandwidths and reduced latencies. These demands require improvements in Radio Frequency (RF) spectrum utilization and advances in antenna technologies. Digital array antenna technology promises to enable these improvements by dramatically increasing operational flexibility. Digital arrays are not off the shelf available; but rather, industry contractors develop digital arrays in response to acquisition efforts. The commercial development of multi-beam 5G networks will focus on small picocells. Lower power levels and reduced linearity challenge leave a significant gap preventing commercial technology from being useful in Navy applications. Defense Advanced Research Projects Agency (DARPA) efforts have made digital arrays a more off the shelf technology. Notable among these is the Arrays at Commercial Time Scales (ACT) and Millimeter-wave Digital Arrays (MIDAS) program. These programs focus on the transceiver and beamforming functionality of the array as opposed to the aperture. However, this technology is still not off the shelf and integration work would be required to meet the digital array needs even using this technology. The Navy must overcome some technology risks with a critical one being the development of digital array technology that can operate at the necessary bandwidths and frequencies while in complex RF environments.

The Navy seeks to expand and refine the battlespace by improving and expanding tactical network functionality. Increased data throughput is needed to enable the flow of more data and support of new mission areas. Decreased latency is needed to enable new and compressed kill chains against advancing threats as well as larger networks. Increased network throughput and decreased latency will be attained by developing 4-channel Transmit (Tx) and Receive (Rx) capability for digital communications arrays. The level of improvement in the fielded system will depend on the topology, size, and operation of the network. For large, half-duplex (i.e., cannot transmit and receive simultaneously) networks of four-beam nodes having all nodes connected along a line, the level of throughput improvement will approach a factor of 2. For large, half-duplex networks of four-beam nodes having topologies where all the nodes are connected to each other, the throughput improvement will approach a factor of 4. For other networks, the improvement will be somewhere in between. Of course, the fielded system may have a different number of beams per node. Four was chosen based on engineering judgement as a compromise between complexity, technical challenge, and capability improvement.

The Navy needs a digital communications array to realize simultaneous, multichannel Tx and Rx capability. The digital communications array is a key enabler for higher data throughputs and reduced latency needed to engage evolving threats and enabling significant improvement in utilization of spectrum. This must be done while pushing the boundaries of signal integrity, dynamic range, isolation of signals and resistance to interference to maximize link performance. No technology currently meets all these requirements.

An innovative digital antenna subarray architecture is sought to attain the previously stated requirements. More specific antenna system goals include a 1 x 4 linear configuration and element level signal generation and digitization. Beam steering in azimuth should be ±60º. The subarray should transmit and receive 4 simultaneous beams in half duplex mode. The operational bandwidth is C-band (4 GHz to 8 GHz). Compared to the operational bandwidth, the instantaneous bandwidth is relatively narrow. The element level Equivalent Isotropic Radiated Power (EIRP) should be 0 dBW over the scan volume. The output Error Vector Magnitude (EVM) should be less than 3%. The antenna should be able to receive an incident signal with incident power density measured at the free-space-to-antenna interface ranging from -134 dBW to -53 dBW and output a digital signal with 20 dB signal to interference plus noise ratio. The goal for the spur free dynamic range is 80 dB. 32 dBm is the goal for the input third order intercept. The polarization should be selectable, with four options. These options should be horizontal, vertical, right hand circular and left hand circular. The polarization loss factor should be less than 0.25 dB. The antenna will be capable of null steering with a null depth goal of 80 dB relative to the mainlobe.

The subarray must be capable of processing 4 narrowband signals located arbitrarily within a contiguous operational bandwidth within C-band. The design should permit any two 1 x 4 subarrays to be connected in any configuration and beam-steered. A two-dimensional array must be capable of having its beam steered in both dimensions. The design should permit connecting 1 x 4 or 4 x 1 subarrays into a contiguous rectangular array of arbitrary size. For example, three 1 x 4 subarrays must be able to be configured to form a 1 x 12 and then reconfigured to form a 3 x 4; without re-flashing firmware. Moreover, both configurations must demonstrate vertical, horizontal, right-hand circular, and left-hand circular polarizations while attaining 0.25 dB of polarization loss factor for each of these four polarizations. The design should include built-in testing to indicate failures that occur. The interface to the digital array on the transceiver side will use a standard format to send digits of data, such as Ethernet. Beam steering commands sent to the array will contain azimuth and elevation angles relative to the array face, frequency and Tx or Rx identification.

Testing, evaluation, and demonstration should include configuring and measuring antenna patterns for a 1 x 12 and 3 x 4 array using the same three (3) 1 x 4 subarrays. Moreover, vertical, horizontal, right-hand circular, and left-hand circular polarizations should be demonstrated. Validation of the prototype will be through comparison of model predictions to measured performance. The location for the demonstration may occur at the small business's facility or at a Government-identified location.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Define and develop a concept for a digital C-Band Tx and Rx array antenna. Demonstrate that the concept can feasibly meet the Navy requirements as provided in the Description. Establish feasibility by a combination of initial analysis and modeling. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype in Phase II.

PHASE II: Develop and deliver a prototype digital C-Band Tx and Rx array antenna that demonstrates the performance parameters outlined in the Description. Conduct prototype testing, evaluation, and demonstration (at the small business's facility or at a Government-identified location). Provide an interface control document guide for developing the signal and control interface for the array. Include configuring and measuring antenna patterns for a 1 x 12 and 3 x 4 array using the same three (3) 1 x 4 subarrays in the demonstration plus vertical, horizontal, right-hand circular, and left-hand circular polarizations. Validate the prototype through comparison of model predictions to measured performance.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Further refine the prototype for evaluation to determine its effectiveness and reliability in an operationally relevant environment. Support the Navy in the system integration and qualification testing for the technology through platform integration and test events to transition the technology into PEO IWS 6 applications for simultaneous communications links to improve and expand tactical network functionality.

Digital, high-performance antennas will have direct application to private sector industries that involve directional communications between many small nodes over large areas. These applications include transportation, air traffic control, and communication industries.

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KEYWORDS: Digital Array; Communications Array; Multichannel Tx and Rx; Digital Antenna Subarray Architecture; Narrowband Signals; Digital Antenna Subarray Architecture

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-066 TITLE: Acoustically Transparent Mid-Frequency SONAR Projector

TECHNOLOGY AREA(S): Battlespace, Electronics, Sensors

ACQUISITION PROGRAM: PEO IWS-5A: Integrated Warfare Undersea Systems, Advanced Development Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative acoustically transparent mid-frequency SONAR projector to add active capability to traditionally passive sensor arrays and reduce life-cycle costs.

DESCRIPTION: U.S. Navy nuclear attack submarines (SSNs) have traditionally relied on acoustic receive arrays to sense their environment, including sensing of enemy submarines [Refs. 1-2]. Evolving conditions such as increased shipping traffic have degraded the effectiveness of sensing the underwater regime solely using passive acoustic sensors. Mid-frequency active sonar is used extensively by surface combatants and could meet the environmental sensing needs of submarines; however, current projector technology incorporated into submarine arrays would degrade the passive capability that submarines depend on when covert.

Current Navy and commercial state-of-the-art SONAR projectors are physically large and heavy, and require specialty-mounting structures. In addition, such projectors must be mounted at a distance from receive sensors and arrays so as not to interfere acoustically. To add mid-frequency active capability to traditionally passive sensor arrays without degrading passive performance, the Navy requires R&D for an acoustically transparent projector that can be located between or in front of receive sensors and/or arrays. Lifecycle costs will be reduced by eliminating specialty structural and mounting requirements and reducing material, manufacturing, and packaging costs.

Advancements in projector technologies involving meta-materials or non-traditional acoustic signal generation, together with lightweight (such as neutrally buoyant) elements make it feasible to envision acoustically transparent mid-frequency SONAR projector arrays that achieve useful acoustic source levels (SLs) with conventional power amplifiers. The projector and projector cable requirement for acoustic transparency is less than 0.1 dB insertion loss and less than 0.5 degrees phase error induced in individual receive array pressure or velocity sensors. The requirement for mounting location is in front of or in-between receive array elements. Current SONAR projector technologies cannot meet these requirements. Finally, the goal for the associated projector power amplifier is to use existing Navy units such as the Modular Power Amplifier (MPA) or High Density Power Amplifier (HDPA) or ruggedized commercial-off-the-shelf (COTS) devices such as Class D or Class T power amplifiers. Proposed projector concepts shall address the acoustic transparency and mounting location requirements, and the conventional power amplifier goal. The concept shall then provide derived projector performance including, but not limited to, size, weight, mounting/attachment method, transmit voltage response (TVR), useable bandwidth and source level achievable (SL) with selected power amplifier.

Any specialty equipment required, but not normally associated with a submarine environment, shall be identified. The solution shall also address the environmental requirements associated with submarine use, including but not limited to, temperature (-28°C to 50°C), accelerations (frequencies up to 100 Hz over a range of 0.0 g to 25.0 g), and hydrostatic pressure (depths to 1200 psi). The proposer shall test these parameters at their facilities and may be independently verified at Navy facilities such as the Naval Undersea Warfare Center.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for an innovative acoustically transparent mid-frequency SONAR projector. Demonstrate that the concept can feasibly meet requirements in the Description through modeling and simulation or analysis. The Phase I Option, if exercised, shall include the initial system specifications, models and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver three innovative acoustically transparent mid-frequency SONAR projector prototypes for testing and evaluation. Demonstrate that the technology meets Navy performance goals for source level, frequency and bandwidth as defined in the Description. Conduct testing and evaluation at a company-provided facility and may be independently verified at a Government facility such as the Naval Undersea Warfare Center. Develop a Phase III plan.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use for submarine arrays in Integrated Warfare Undersea Systems through system integration and qualification testing. (Note: Government personnel will independently verify test results for the prototype projector, pre-production units, and first article inspection at Navy test facilities prior to Navy use in SONARs aboard submarines.)

Commercial applications that currently utilize various forms of active acoustic transmission and reception that could benefit from lightweight and acoustically transparent projectors include oil exploration, seismic survey, rescue and salvage, and bathymetric survey.

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KEYWORDS: Acoustically Transparent; Mid-frequency SONAR Projector; Eliminate Specialty Mounting Infrastructure; Projector Technology Incorporated into Submarine Arrays; Non-traditional Acoustic Signal Generation; Projector Technologies Involving Meta-materials

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-067 TITLE: Kinematic Contact Tracking Using Hybrid Features

TECHNOLOGY AREA(S): Battlespace, Electronics, Sensors

ACQUISITION PROGRAM: PEO-IWS5: Surface ASW Combat System Integration, Surface ASW System Improvement

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop algorithms to use features of acoustic echoes to track and correctly classify multiple targets in noisy, cluttered environments, leveraging extended feature processing and kinematic association to enhance tracking and classification techniques.

DESCRIPTION: Active sonar in anti-submarine warfare (ASW) discriminates between echoes from submarine targets and clutter echoes, which are characterized by signal to noise ratio, echo range, bearing, and Doppler. Traditional tracking methods rely on consistent motion of the high-energy echoes in range, bearing, and Doppler space over multiple active sonar transmissions. While numerous sophisticated algorithms are associated with differentiating submarine targets from surface ships and clutter, these algorithms have traditionally been developed for situations where a single submarine is present.

Future conflicts could involve multi-ship combat operations with a peer competitor that would involve multiple targets in the midst of large amounts of clutter and high ambient noise. In this situation, state-of-the-art trackers, which rely primarily on kinematics, produce large numbers of false tracks, broken tracks, and incorrectly associated tracks. These bad tracks increase false alerts and miss or catastrophically delay true alerts. It is believed that considering features of echoes as well as kinematics can reduce false and broken tracks while retaining or improving correct target identification.

The Navy envisions future multi-ship operations that involve a diversity of sensors on manned and unmanned platforms, increasing the number of potential features that can be considered by a hybrid tracking system.

Tracking algorithms that combine emerging feature-aided detection techniques and kinematic tracking are desired to improve the effectiveness of active sonar against multiple targets in the cluttered, noisy acoustic environment expected during multi-ship ASW conflicts with peer competitors. These improved algorithms will also be crucial to the effectiveness of unmanned platforms utilizing active sonar.

Feature-aided tracking algorithms use measured echo features to inform how the tracker associates' consecutive echoes among the many potential echoes pass the kinematic test. Basic research in this area has been conducted on use of non-kinematic features as it relates to non-acoustic sensors, such as radar [Refs. 1-5]. However, innovation is required to apply emerging feature-aided tracking concepts to active sonar conducting real-time tactical operations in a diverse range of operating environments. The Navy has data sets representing a diverse range of acoustic propagation environments, bathymetric conditions, and operational conditions that can be used to evaluate the benefit of technologies developed under this topic.

For tactical sonar systems such as the AN/SQQ-89 surface ship sonar suite, the performance of the feature-aided tracker is expected to be highly dependent on the transmit waveform, environment, and selection of features to be used. Key tactical propagation environments include direct path, bottom bounce, and convergence zone environments. Anticipated sensor diversity in future multi-ship operations is expected to provide additional target feature data such as measurements of sonar cross-section, physical size, and scattering characteristics. This diversity of expanded feature information can be used with the kinematic information to improve the capabilities of automatic tracking and classification systems, especially in high-clutter, low signal-to-noise ratio and target-dense environments. The solution sought will provide innovative feature-aided tracking algorithms to improve track and classification measures of performance by at least 25% in environments with where acoustic clutter makes target tracking particularly difficult. Key measures of performance include track continuity, false alert reduction, increased true alerts, correct target tracking, and reduced target latency.

By improving these key measures of performance, the technology sought by this SBIR topic will streamline sonar-related tasks to reduce operator workload and enable reduced manning via improved automation. Use of this technology on unmanned platforms is anticipated to improve capability in a manner to enable reduction of acquisition costs.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been be implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop a concept for combining new feature-aided tracking tools with kinematic algorithms to track and correctly classify multiple targets in noisy (low signal-to noise ratio) cluttered environments. Demonstrate the concept can feasibly improve tracking performance against multiple targets in noisy, cluttered environments by at least 25% for the active sonar domain. Establish feasibility through analytical modeling and development with simulated or recorded sea data. The Phase I Option, if exercised, will require the initial system specification and capabilities description to build a feature-aided tracking prototype algorithm in Phase II.

PHASE II: Develop and deliver a prototype feature-aided tracking capability and evaluate with tactical active sonar data to show it meets the parameters in the Description. Validate the prototype using diverse data sets to evaluate performance across SQQ-89 transmit waveforms and a representative range of environmental conditions. Develop a Phase III plan.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Assist the Government in transitioning the technology for Navy use in an operationally relevant environment to allow for further experimentation and refinement. Integrate the software algorithms into an updated PEO-IWS 5 AN/SQQ-89 surface ship ASW combat system program. Validate, test, qualify, and certify the feature-aided tracking algorithms by using the ACB programs current 4-step risk reduction test process for incremental upgrades to the AN/SQQ-89 Program of Record, which will be provided after Phase II.

Commercial applications that currently utilize various forms of active acoustic transmission and reception that could benefit from a feature-aided tracking approach include oil exploration, seismic survey, rescue and salvage, and bathymetric survey.

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KEYWORDS: Active Sonar in Anti-submarine Warfare; Multi-ship Operations that Involve a Diversity of Sensors; Feature-aided Detection Techniques Combined with Kinematic Tracking; AN/SQQ-89 Surface Ship Sonar Suite; Direct Path, Bottom Bounce, and Convergence Zone Environments; Automatic Tracking and Classification Systems

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-068 TITLE: Compact High-energy Efficient System for Removing Carbon Monoxide from Ambient Air on Submarines and Other Closed Manned Environments

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 397, Columbia Class Program Office

OBJECTIVE: Develop a compact high-energy efficient forced-air (100 cfm) system for removing hazardous levels (less than 50 ppm) of carbon monoxide (CO) from ambient air on submarines.

DESCRIPTION: Nuclear submarines in the U.S. fleet use a central catalytic oxidation system to remove carbon monoxide (CO), hydrogen (H2), and volatile organic compounds (VOC) from air by converting them to carbon dioxide (CO2) and water vapor. A high ventilation rate is generally used to prevent hazardous gases from accumulating at their sources and is usually sufficient to prevent unsafe concentrations. However, some isolated or poorly ventilated spaces within the submarine would benefit from local removal of CO. Where contamination may accumulate to hazardous levels, if not removed locally, the severity would increase if there was a fire or failure of the central catalytic oxidation system. This SBIR topic seeks to develop an energy efficient, compact, portable, stable, and stand-alone system to prevent the build-up of CO in such isolated and poorly ventilated spaces. The current “CO and H2 Burner” draws a large volume of air from the Auxiliary Machinery Room (AMR) and catalytically removes CO by conversion to CO_2. The catalyst is only sufficiently active at elevated temperature (500°F) in the presence of humidity. No room temperature or portable systems exist. The proposed portable system would continually monitor its local space and activate when necessary (i.e., greater than 50 ppm CO) to continuously remove the CO until a local concentration of 5 ppm is attained. The airflow through the system must be at least 100 cubic feet per minute (cfm). The catalyst must achieve 95% removal rate over a temperature range of 15°C to 25°C and humidity in the range of 50%-80% relative humidity (RH). The confined spaces do not have access to cooling water but will have access to electrical power for running a fan and operating a CO sensor (115 VAC, 100 Watt maximum). The system must operate for 10,000 hours without requiring maintenance when 115 VAC power is available. Battery backup must be included to allow the system to remove CO for one hour if 115 VAC electrical power is not available. The final target maximum system weight and volume are 50 pounds (lbs.) and 2 cubic feet, respectively. In addition, the final design must pass shock (MIL-S-901) and vibration (MIL-STD-167) testing making it suitable for shipboard application.

References 2 - 4 provide a sufficient overview of the conditions present on submarines and the contaminants found in submarine air. Currently available sorbents are not suitable for this system because they do not have sufficient absorption capacity for low concentrations of CO and would require frequent regeneration or change-out. Platinum- and palladium-based catalysts are not active at room temperature and would require energy to maintain an elevated catalyst temperature. Air-to-air heat exchangers (recuperators) will not eliminate the energy requirement because their efficiency is too low for a lightweight and compact system. Compact high efficiency heat exchangers have a high-pressure drop, which would then require an unacceptably noisy fan or regenerative blower. A room temperature CO oxidation catalyst may be the most feasible option for this system and must be stable in the presence of moisture and other contaminants. Moisture sorbent guard beds that could require maintenance or noisy blowers are not permitted.

Hopcalite is commonly used for short-term room temperature oxidation of CO, but is not suitable for this topic because it rapidly deactivates in the presence of water vapor. Nano-gold has shown extraordinary activity for CO oxidation at sub-ambient temperatures but is not stable in the long-term submarine environment and has been observed to also deactivate in the presence of water vapor. Catalysts activated by ultra-violet light would be suitable if an overall system requiring less than 100 Watts could be designed.

PHASE I: Develop a concept for a catalytic material formulation that can achieve the CO removal under the conditions of flow, temperature and humidity specified in the requirements above. Demonstrate the feasibility of the concept catalyst material to achieve the required CO removal capacity for 10,000 hours continuous operation. The Phase I Option, if exercised, will include the initial design concepts and plan to build a prototype in Phase II.

PHASE II: Develop a non-dusting engineered prototype form of the material to enable a system design comprising a low-pressure fan as detailed in the Description. Provide a report documenting the results of MIL-S-901D and MIL-STD-167 testing and internal testing showing 90% removal of 50 ppm CO in an air stream at room temperature at 80% RH (relative humidity) for 1000 hours. Conduct shock and vibration testing at a suitable certified laboratory chosen by the proposer and approved by NAVSEA. Provide a sample (engineered form) of the material for Navy testing under the same conditions for 10,000 hours. (Note: Technical requirements will be satisfied if a 90% removal rate is maintained at room temperature for 10,000 hours with no increase in pressure drop.) Ensure that the performance of the engineered form does not decrease if the temperature is increased to 200°C for up to 10 minutes. Develop and submit a Phase III plan for Navy approval.

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the system for Navy use. The company may want to offer a non-militarized version for commercial or residential use. One possible use would be in automotive repair garages. The material developed in this SBIR topic will be useful for any system designed to remove CO from commercial or residential buildings.

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KEYWORDS: Room Temperature Oxidation; Carbon Monoxide; Moisture Resistant Catalyst; Poison Resistant Catalyst; Nano-Gold; Indoor Air Quality

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-069 TITLE: Low-cost, High Efficiency, and Non-rigid, Perovskite-based Single-junction or Tandem Solar Cells

TECHNOLOGY AREA(S): Battlespace, Materials/Processes

ACQUISITION PROGRAM: Ground Renewable Expeditionary Energy Network System (GREENS)

OBJECTIVE: Develop and demonstrate, on increasing scales, novel solar cell designs and manufacturing processes relevant to production of robust perovskite-based solar cell modules that outperform crystalline silicon solar cells in terms of cost, efficiency, and energy payback time and have a comparable expected lifetime. Target DoD applications include flexible solar cells mounted on lightweight semi-rigid substrates such as in the current Marine Corps GREENS expeditionary solar power system.

DESCRIPTION: Metal halide perovskites were researched in the 1990’s as easy to form semiconductors that formed and crystallize from solution and immediately had promising properties [Ref 1]. However, the poor stability in air (oxygen, moisture) and the presence of lead persisted as major hurdles for further development and commercialization. After a dormant phase, interest was resurrected when the perovskite materials showed excellent performance as absorbers for dye-sensitized solar cells and eventually as the active layer in thin-film solid-state solar cells [Ref 2]. Researchers quickly developed methods to grow films with large grain sizes and fabricate devices with interfacial layers that provided short-term protection from moisture and oxygen to allow facile characterization. Seemingly overnight, hundreds of labs entered this research area and the inherently high-performing semiconductor gave solar cells that increased in power conversion efficiency from below 10% to over 22% within five years [Ref 3], appearing to have the potential to challenge crystalline silicon as a commercial solar cell alternative.

The incredible thrill of research that yielded new record cells every few weeks is satisfyingly in the past (2010–2015). Further records in power conversion efficiency come more slowly and much of the research has moved towards improving inherent stability, removing lead, and developing stable and high-performing device stacks. Inherent stability has been improved by tuning the perovskite composition to tighten the crystal lattice without a large drop in performance. Longer-term research on two-dimensional (2D) lattices currently sacrifices efficiency for stability. Likewise, lead replacement reduces efficiency. Eventually these areas of research may lead to thin film lead-free perovskite devices with reasonable lifetimes and high efficiency that can be applied to flexible substrates with reduced packaging. In the short term, 3-dimensional metal halide perovskites in well crystallized layers, in an appropriately designed device stack, and robustly packaged form-factor promise to compete with silicon on a cost and efficiency basis.

In the perovskite solar cell community, academic institutions and small businesses have demonstrated power conversion efficiencies above 18%, but significantly fewer have investigated each specific layer of the stack for both optimal performance and stability under accelerated aging conditions. Even fewer have begun scaling deposition processes and carried out market analyses to identify device formats that will compete in a crowded, competitive market. This SBIR topic is a manufacturing technology project. The Navy is interested in companies with plans to commercialize perovskite-based solar cells who have progressed to the stage where they have demonstrated a viable device stack of >1 cm2 area and >18% power conversion efficiency. The Phase I proposal should describe the company's development of the device stack including how various layers were selected/developed, how they are currently deposited, and plans to scale processing. The proposal should include stability data for unpackaged devices under ambient conditions or other stability characterization. The proposal should include a cost analysis.

PHASE I: The entry point into this SBIR is for the performer to have developed and characterized a high-performing perovskite based solar cell that has achieved >18% power conversion efficiency and to have adequately described the packaged stack performance and stability in the initial proposal. At the start of Phase I, the performer will pursue certification of this device stack at the 1-cm2 level if this has not been done, either with an independent laboratory or with the Navy.

By the end of the 6-month Phase I effort, the performer should develop: (1) a mini-module with >18% power conversion efficiency, 50 cm2 or larger, fully packaged device on flexible or rigid substrate, produced by any combination of deposition techniques; (2) a commercial module design; (3) detailed plans on how to develop the manufacturing technology to fabricate larger >18% efficiency modules on flexible substrates over the two-year Phase II including identification of key technical and cost barriers; and (4) an updated business plan/market evaluation with strong cost analysis.

The fabrication and performance of the mini-module should be presented in the final report along with the other deliverables mentioned in the above paragraph. The mini-module performance should be verified by standard techniques and be available for independent evaluation.

PHASE II: Continuously mature device stack, processing, and packaging towards a >18% power conversion efficiency solar cell mini-module (>200 cm2), fully packaged on a flexible substrate with target 10 year lifetime, threshold 5 year lifetime. Include regular submission of packaged small multi-cell modules to an independent party for performance and stability characterization. Provide quarterly metrics and quarterly reporting. Deliverables include the module described above and a final report which details the progress towards a commercially viable product, remaining technical and cost hurdles, and an updated business plan.

PHASE III DUAL USE APPLICATIONS: Scale to cost-effective production level. Work with DoD acquisition programs or current vendors to design and produce application specific solar cell modules for incorporation into products for military applications.

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KEYWORDS: Perovskite; Solar Cells; Stability; Efficiency; Flexible Substrate; Mini-module

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-070 TITLE: Sensors and Autonomy for Unmanned Maritime Missions

TECHNOLOGY AREA(S): Ground/Sea Vehicles, Information Systems, Sensors

ACQUISITION PROGRAM: INP: Full Spectrum Undersea Warfare

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate effective sensors and autonomous behaviors that enable unmanned vehicles to conduct missions of relevance to the Navy.

DESCRIPTION: New concepts in the employment of unmanned vehicles in Naval missions will require suitable sensing equipment and the necessary autonomous behaviors to support the desired mission goals. The Navy seeks sensor and autonomy solutions that support timely and effective use of unmanned vehicles in three maritime mission areas. Proposals must address one of these mission areas and suggest the necessary additional vehicle modifications that are expected to be necessary for achieving mission success. The desired vehicle classes and mission areas are:

1) Vehicle Description: Navy Class III Large Unmanned Underwater Vehicle, for example LDUUV "Snakehead". Mission Description: Cable Repair – Locate and survey undersea cables; examine/record exposed cable surface for potential damage; mark precise locations of damaged sections.

2) Vehicle Description: Vertical Takeoff Unmanned Aerial Vehicle, for example Firescout. Mission Description: Anti-Submarine Warfare – Given approximate location data of a submarine, re-locate the enemy and deliver operator-selected effects.

3) Vehicle Description: Tier 2 Unmanned Aerial Vehicle, for example TERN. Mission Description: Anti-Surface Search – Given approximate location data of surface ships, conduct all-weather search, location, and identification and transmit the information to a remote operator.

The specific details of these mission concepts can be classified.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Identify a sensor and autonomy design that can be developed to meet the specifications. Examine the key mission activities that require use of autonomous behaviors. Analyze key design considerations assuming a particular unmanned vehicle and assess the strengths and weaknesses of the proposed approach. Conduct a design review for the proposed concept to be pursued in a proposed Phase II plan, including the impact on the selected unmanned vehicle.

PHASE II: Develop and test a prototype for the proposed approach. Complete preliminary performance testing in a surrogate but possibly classified environment. Where necessary, hardware in the loop simulations can be used for demonstrating autonomous behaviors.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: In Phase III, extensively test the prototype fabricated in Phase II and examine mission performance under nominal operating conditions and well as performance in suboptimal environments and conditions. Potential dual use applications include hydrographic surveys, remote monitoring of harbor traffic, and undersea cable fault identification and repair.

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KEYWORDS: Autonomous Vehicles; Unmanned Vehicles Sensors; ASW; ASuW

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-071 TITLE: Ultra-Fast Metastable Implant Activation System for Selective Area Doping of III-Nitrides

TECHNOLOGY AREA(S): Electronics, Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: PEO ships: PMS 320 Electric Ships Office

OBJECTIVE: Develop a commercially relevant tool for activation of implanted dopants for gallium nitride (GaN) and related semiconductor materials and devices at elevated gas pressures with sub-second heating and cooling cycles to achieve dopant activation without decomposition of the GaN surface.

DESCRIPTION: Future Navy ships will require high-power converters for systems such as the rail gun, Air and Missile Defense Radar (AMDR), and propulsion on DDG-51 size ship platforms. High-voltage, high-efficiency power switches are required to achieve the needed power density. Gallium Nitride (GaN) and related III-N alloy materials provide a tunable direct band gap from 0.7 eV to 6.1 eV with high breakdown fields and enable high-power and high-switching frequency devices. In particular, GaN has ~1.5x the breakdown field and ~5x the Baliga Figure-of-Merit compared to SiC, the current state-of-the-art, as well as ~11x and ~850x compared to Si, the current standard. The large Baliga Figure-of-Merit for GaN technology will enable >10kV power switching devices with low on-resistance and high efficiency.

While GaN devices have been commercialized for blue and white LEDs, challenges remain in establishing arbitrary device geometries and doping profiles required for efficient high-voltage and high-frequency devices. Ion implantation is the most versatile approach for the selective area doping required for the efficient high-power devices. However, in GaN materials, high nitrogen decomposition pressure at high temperature (60,000 bar at melt of GaN) causes the surface of the GaN crystal to decompose precluding conventional annealing to activate implanted dopants as employed in silicon and SiC, instead requiring novel annealing methods.

Annealing and activation of the ion implanted p-type magnesium (Mg) dopant in GaN has proven to be more than a 25-year research effort to find an approach that can activate the p-type Mg dopant without decomposition of the GaN surface. Annealing to reduce implant-induced damage requires temperatures near 2/3 the melting point of the crystal or approximately 1,400°C for GaN, whereas the nitrogen begins to leave the GaN surface and decompose the GaN crystal at temperatures less than 900°C at atmospheric pressures. Deposited capping layers allow annealing to 1,100-1,200°C at atmospheric pressures; however, these temperatures are not sufficient to allow activation of implanted p-type Mg dopants in GaN. A combination of ultrafast sub-second heating and cooling cycles and a high nitrogen overpressure is critical to activate implanted p-type Mg dopants in GaN [Refs 1-5].

A novel GaN implant activation approach has been investigated at the Naval Research Laboratory (NRL) [Refs 1-5]. It combines application of moderate nitrogen (N2) overpressure to prevent the GaN surface from decomposing and applying multiple rapid (seconds) heating and cooling temperature pulses above thermodynamic stability of the GaN crystal to accumulate long enough time at high temperatures for the required implant damage reduction processes by diffusion. The approach includes the steps of: (1) a long time annealing regime at temperatures at which the GaN crystal is still stable; (2) transient annealing in the metastable regime using multiple rapid heating/cooling cycles from a baseline temperature to peak temperatures above the thermodynamic stability of the GaN crystal; and (3) a long time annealing regime at temperatures when the GaN crystal is still stable.

The NRL annealing approach made it possible to demonstrate the first GaN p-i-n diode using Mg implantation; however, the GaN sample size is limited to less than 2 inches. Consistency in activation efficiency and implant damage removal remains problematic in the current implementation.

The shortest heating and cooling cycle duration provided by the RF heating in the NRL system is limited to the scale of seconds and heating/cooling rates of 200 K/s. It is the goal of this SBIR effort to develop a system with ultrafast sub-second heating and cooling rates (>1,000 K/s) that allows shorter temperature pulses and thereby achieves higher maximum peak GaN temperatures without the material decomposing. It is much more difficult to achieve sub-second cooling rates than sub-second heating rates, and thus novel cooling approaches should be investigated to achieve the 1,000 K/s cooling rate. In return, the higher peak temperature at each of the multiple heating pulses provides better conditions for diffusional processes in GaN, and results in better restoration of structure damaged by implantation and better activation of the implanted dopants while preserving the integrity of the GaN surface.

The proposed Ultra-Fast Metastable Implant Activation System for Selective Area doping of III-Nitrides should meet the following thresholds:
Deliverable Design Characteristics Value
• Sample size up to 8” diameter, 0.1 to 5 mm thick
• Stabilizing gas (N2, Ar, H2, O2) pressures up to 100 bar
• Primary heating method providing steady heating regime, and heating and cooling rates no less than 1,000 K/s for anneal (50 Bar pressure, baseline temperature ~1,000°C, peak temperature >1,500°C)
• Optional secondary heating method (possibly by laser heating) to exceed 500 K temperature pulse of heating and cooling in less than 100 millisecond (50 Bar pressure, baseline temperature ~1,000°C, peak temperature >1,500°C, mean heating/cooling rate >10,000 K/s)
• Inclusion of windows and ports that would allow process monitoring and control,
• Uniform heating across entire 8-inch wafer with less than 2 percent nonuniformity
• Achieve steady state temperatures up to 2,200°C for potential dopant activation
• Sub-ppb contamination of moisture or gas mixture (e.g., oxygen in nitrogen) inside the chamber
• Successful demonstration of electrical activation of Mg and Si implanted dopants in GaN
• Successful demonstration of maintaining GaN pristine surface integrity for anneals achieving 3 minutes of cumulative time between 1,300°C and 1,400°C

PHASE I: Determine feasibility and establish a plan for the design and development of a system to activate implanted dopants in GaN. Describe features and issues for the design and development of the ultrafast sub-second dopant activation system that can controllably conduct steady-state and transient uniform heating of 8” GaN wafers at required temperatures, heating pulse frequency, and gas pressures up to 100 bar. Ensure that the system is designed to meet all requirements, providing heat treatment regimes necessary for implant activation. Provide a Final Report that convinces that the proposed system can be properly designed to address the above desired and required features and be achieved if Phase II is awarded. Provide a Phase II development plan addressing technical risk reduction.

PHASE II: Develop a fully functional dopant activation system having all parameter monitoring and control tools and capable of producing p/n type conductive regions in GaN and related materials by activating impurities after ion implantation. Demonstrate that the system provides uniform heating of an 8” wafer as required in the technical specification with heating/cooling rates at gas pressures of 50 bar. Deliver a prototype of the fully operational system with appropriate control software to the Navy for evaluation as required by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Address the commercialization of the product developed as a prototype in Phase II. Work with suitable industrial partners for this transition to military programs and civilian applications by identifying the expected final state of the technology, its use, and the platform it will be used on. The expected final state of this product will match the requirements given in Phase II and will allow for the tool to be installed, certified, and operated within standards of a modern semiconductor fabrication facility. An implant activation system of this design will enable cost-effective, semiconductor-based, high-power devices for solid-state transformers to replace electromagnetic transformers for the electric grid, rail traction, large-vehicle power systems, and wind turbines.

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KEYWORDS: GaN; AlGaN; InGaN; III-nitrides; Power Electronics; Wide Bandgap Semiconductor; Electronic Switching Diode; Power Density

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-072 TITLE: Aligned Nanotube Reinforcement of Polymer-matrix Laminates

TECHNOLOGY AREA(S): Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: PMA265, JPO, Next Generation Air Dominance

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Demonstrate increased performance of polymer-matrix laminated composites using nanoscale additives resulting in a Phase II end product that is a nano-enhanced version of a commercially available fiber/resin system available and capability to produce at relevant scale for DoD programs.

DESCRIPTION: Polymer-matrix composites (PMCs) are used extensively in DoD systems due to their high specific strength and stiffness in-plane. While tensile properties are governed by fiber, many other properties are matrix-limited, including shear, fatigue, compression, impact, conductivity, and maximum service temperature. Polymers intended for high service temperature environments trade off mechanical properties for high Glass Transition Temperature (Tg), increasing the composite's susceptibility to interfacial failures and narrowing their applicability to supplant metallic incumbent structures. For example, AFRPE-4 has a Tg of 371°C (compared with Hexcel 8552 at 200°C), but interlaminar shear with standard modulus fiber is only 73 MPa (vs 128 MPa for Hexcel 8552) [Ref 1].

State-of-the-art structural epoxy-matrix composites are toughened with thermoplastic particles to address interlaminar failure. However, their performance tends to suffer under hot/wet conditions, and epoxy prepregs are limited to Tg < 200 °C, below the range of interest for engine compressor and nozzle applications.

High-temperature polymers like Polybismaleimides (BMIs) and polyimides are in current use in Navy systems. Existing components comprising these materials make design trades to mitigate limitations in mechanical performance, for example interlaminar shear strength. The typical approach to reducing interlaminar stresses in corner radii, such as those that occur at the interface between airfoils and platform features on stator vane twin-packs, and up-turned flanges on fan ducts, is to increase the size of the radius and/or increase the laminate thickness. This approach may in turn produce other detrimental effects. A larger radius at the ends of an airfoil may reduce the aerodynamic efficiency of the airfoil. Furthermore, thicker laminates present material processing challenges for high-temperature PMCs, particularly for polyimides, that may lead to an increase in manufacturing defects such as wrinkles and porosity.

Use of high Tg polymer matrices composites could address an expanded range of applications for structural composites in high service temperature environments, if their mechanical properties can be bolstered.

Carbon nanotube (CNT) forests oriented through-thickness have been demonstrated as an effective interlaminar reinforcement for epoxy-matrix laminates, significantly increasing interfacial properties such as impact resistance, shear strength, compression and fatigue [Refs 2-6]. These effects are observed even at low loadings. Furthermore, CNTs exhibit thermal stability comparable to carbon fiber, so they are intrinsically compatible with high Tg polymer matrices.

Increased interlaminar strength, toughness, and fatigue capability using aligned CNTs can relax current design constraints that drive increases in thickness and corner radii for high Tg polymer systems. Improving these key mechanical properties thus has the potential to reduce manufacturing defects and expand the design space. These compounded effects will enable future components with higher aerodynamic and structural efficiency. A higher-performing or lightened revision of an existing component using aligned CNT additives would effectively demonstrate these values: better performing existing systems and expanded design space for future components.

PHASE I: Develop an aligned CNT-based additive material that is compatible with one or more high temperature PMC prepregs in current Navy use. Identify current technical limitations (of the current PMC system) and improvement targets to enable wider adoption of high temperature PMCs, particularly in replacement of heavy or complex metallic components. Develop a process for controlled integration of the additive into the composite resulting in repeatable loading levels and morphology. Define and perform a test matrix to demonstrate relevant increases in performance, and verify property trades-off are minimized. Perform analyses to characterize the effect of the additive on damage modes. Develop a Phase II work plan including strategies for scaling, performance optimization and system targeting. Include a component-level technology demonstration in a Phase II work plan.

PHASE II: Identify one or more candidate components for high temperature PMCs where the current mechanical performance limits drive excess component weight or manufacturing complexity into the design; or preclude adoption altogether. Determine figures of merit and targets needed to improve the current component or modified component design. Refine additive material properties and integration methods to achieve stated targets repeatably, and demonstrate via coupon and/or subcomponent testing. Fabricate and test the candidate component(s) using the CNT-based additive to quantify increase in component performance under representative conditions. Quantify and demonstrate CNT synthesis manufacturing readiness level, and CNT-prepreg integration ("transfer") manufacturing readiness level of 8+.

PHASE III DUAL USE APPLICATIONS: Evaluate and qualify the system for Navy use and procurement including approved manufacturing locations to ensure that Navy end-users have access to the system. Manufacture and make the system available for procurement by Navy end-users.

If an aligned CNT material and processing technology is successfully demonstrated, it could benefit commercial manufacturing industries which use DoD-relevant high-temperature prepreg systems for structural applications.

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KEYWORDS: Composites; Nanomaterials; CNTs; High Tg; Aircraft Engines; Polymer; PMC

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-073 TITLE: Low Phase Noise Laser for Radio Frequency (RF) Photonics

TECHNOLOGY AREA(S): Air Platform, Information Systems, Sensors

ACQUISITION PROGRAM: FNT-FY17-02 Submarine Simultaneous Transmit And Receive (SUBSTAR)

OBJECTIVE: Develop a compact, low-phase-noise, semiconductor or diode-pumped solid-state laser to provide next-generation, low-noise-figure radio frequency (RF) photonic capabilities for electronic warfare (EW) applications. Ensure that the 100 mW class fiber-pigtailed lasers emits in the 1.32- or 1.5-micron wavelength range and is packaged in industry standard butterfly-type packages.

DESCRIPTION: Dominance of the electromagnetic (EM) spectrum is critical for DoD. As threat carrier frequencies extend above 20 GHz, electronics technologies are challenged to process wide bandwidths. RF photonics technologies have natural capabilities to above 100 GHz and can augment electronics to provide comprehensive electromagnetic maneuver warfare (EMW) solutions. To penetrate the electronic warfare application space, RF photonics technology requires low noise figures. The best path to achieving low noise figures is the development of low-phase-noise lasers combined with compact phase modulators that have shot-noise-limited noise performance throughout the 1 to 100 GHz frequency range [Ref 4]. Both diode-pumped solid state and quantum dot semiconductor lasers have been shown to have superior phase noise properties throughout the gigahertz regime inherent in their design due to the slow gain dynamics of rare-earth doped crystals and glasses (solid-state) or due to the discreteness of their energy levels (quantum dot).

PHASE I: Design an approach and determine its feasibility and expected performance. Develop a design that uses 100 mW low -phase-noise lasers combined with phase modulators that are compact (50 to 100 cubic centimeters), emit in the 1.32- or 1.5-micron range, and have shot-noise-limited noise performance throughout the 1 to 100 GHz frequency range. Simulations or practical supporting measurement data in this Phase are highly desirable and preferred over literature searches researching prior art. Supporting information stating how the proposed design will meet the power and shot noise limits is advantageous. Develop a Phase II plan.

PHASE II: Fabricate and package a laser in a representative small (25 to 50 cubic centimeters) butterfly package. Perform laboratory measurements of laser amplitude, phase noise, and power output . Ensure, that at the end of Phase II, this packaged laser should be at Technology Readiness Level (TRL) 4, performance measured in a laboratory environment.

PHASE III DUAL USE APPLICATIONS: Mature the laser to a higher TRL level (at least TRL-6) so a transition to a Program of Record can be achieved. Tailor the design to a specific air or submarine platform system to be determined between Phases II and Phase III.

Low phase-noise lasers may be of interest in commercial communication systems for use with modern coherent modulation formats, combined with high symbol rates, both of which stress the need for lower phase-noise lasers.

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KEYWORDS: Photonics; Solid-state Laser; Quantum Dot Laser; GHz; Noise Figure

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-074 TITLE: High Power Microwave (HPM) Waveform-enhancing Sub-nanosecond Semiconductor Pulse Sharpener

TECHNOLOGY AREA(S): Electronics, Materials/Processes, Weapons

ACQUISITION PROGRAM: ONR Code 352: High Power Microwave (HPM) Basic Research

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on

this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an electrically driven, sub-nanosecond, semiconductor pulse sharpener to improve the performance of high power microwave (HPM) pulse generators by reducing/sharpening the rise time of a driving pulse, preserving the trailing edge of the pulse, and increasing the bandwidth of the output.

DESCRIPTION: Wideband (WB) and ultra-wideband (UWB) high power microwave (HPM) source performance parameters can be described in terms of source power or output voltage across a load, pulse repetition rate, pulsewidth, and pulse rise time. When evaluating pulse compression techniques, it is observed that energy density within an inductor is higher than in a capacitor; consequently, the pulsed voltage generated during a short duration at a load may be many times higher than the voltage at which the energy has been stored [Ref 1]. HPM pulse generating sources utilizing inductive storage and discharge techniques to generate high voltage (10s to 100s of kV), at short pulsewidths (~ nanoseconds), are limited in their performance owing to the large trailing edge of the pulse. The performance of HPM pulse generators may be enhanced with the use of a pulse sharpener, which would serve to reduce, or sharpen, the rise time of a driving pulse. One such device employed for this purpose is the silicon avalanche shaper (SAS), which is a fast closing switch capable of switching high voltage (kV) pulses at sub-nanosecond time scales [Refs 2, 3].

During operation, a SAS diode is initially placed in reverse bias. A fast-rising, high voltage driving pulse (~ kV/ns) applied to the cathode initiates a delayed impact ionization wavefront, which translates to a sharp voltage ramp (kV/ps). One example of SAS construction is a typical p+-n-n+ structure, where the width of the n-base layer is on the order of 100–300 µm. Static breakdown voltages of SAS devices can be on the order of 1 kV for a 1 mm diameter device, but differential voltages (dV/dt) strongly depend on the rise rate of the incident pulse and the material composition (Si, SiC, GaN) [Ref 5].

KEY SEMICONDUCTOR PULSE SHARPENER PARAMETERS
• Sharpen the 10-90% driving pulse rise time from 3-5 ns to < 200 ps, with minimal impact to peak pulse amplitude
• Static Breakdown Voltage, Vbr = 3 kV or higher
• Dynamic Breakdown Voltage = 3 times Vbr
• Differential Voltage Objective: dV/dt = 200 V/ps
• Differential Voltage Threshold: dV/dt = 20 V/ps
• Diode Restoration Time < 2 µs
• FWHM Switching Time < 300 ps
• Peak Current Rating > 1 kA

PHASE I: Develop a concept for a semiconductor pulse sharpener for sub-nanosecond rise time sharpening of a 3-5 ns driving pulse generated from a HPM inductive storage type pulsed power source. Ensure that the resulting device meets the specific electrical and performance characteristics, and is fabricated in a compact form factor to fit within a constrained operational footprint. Ensure that the contacts of the device are flat, stackable, and solderable, such that multiple wafers can be stacked in series, and parallel, and allow for the addition of heatsinks for thermal management. In addition to electrical and performance characteristics, the device should be analyzed for its thermal properties. Prepare a Phase II plan.

PHASE II: Fabricate single wafer and stacked wafer sub-nanosecond semiconductor pulse sharpeners. Deliver samples to be performance tested. Improvement of key performance parameters such that a pulse output with the 10-90% rise time of a 3-5 ns and a dV/dt of 10 v/ps to a rise time of less than 100ps and a dV/dt of greater than 200 V/ps, while maintaining breakdown voltage, peak pulse amplitude, and compact form factor. Improve device mounts, stacking techniques, and thermal dissipation.

PHASE III DUAL USE APPLICATIONS: Develop manufacturing methods to improve component yield, production time, operational lifetime, and component cost.

Potential applications include: Ultra-wideband radar, Pockels cell drivers, output switches for gas discharge laser systems, perimeter security, and altimeters.

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KEYWORDS: Semiconductor Pulse Sharpener; Sub-nanosecond; Semiconductor Avalanche Shaper; SAS; Silicon Avalanche Shaper; Improved Pulse Rise Time; High Power Radio Frequency; HPRF; High Power Microwave; HPM; Wideband; Solid-state; Ultra-Wideband; UWB; Drift Step Recovery Diode; DSRD

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-075 TITLE: Enabling Technologies for Marine eDNA Sampling

TECHNOLOGY AREA(S): Battlespace, Sensors

ACQUISITION PROGRAM: N45 6.4 Living Marine Resources and FLT/SYSCOM Marine Species Monitoring Programs

OBJECTIVE: Technologies and techniques for sampling and analysis of marine environmental DNA (eDNA) are improving rapidly but many barriers remain. This SBIR topic seeks to enable widespread, inexpensive use of marine eDNA for the accurate, timely identification of biological organisms in the maritime environment using autonomous modes of collection and analysis through the development of both small, inexpensive analysis payloads and enabling technologies for such payloads; in particular, techniques that reduce the amount time for sample analysis, reduce the volume of sample water, reduce false alarms from contaminants, and automatically generate sampling strategies, among many other possibilities.

DESCRIPTION: Remote monitoring of the biologic inhabitants of the world's ocean is extremely difficult. Advances in DNA methods present an opportunity to harness a new technology and fundamentally improve our capacity to monitor biological communities and human uses of the marine environment. Marine eDNA techniques identify genetic signatures that variously persist in the environment. Self-contained analysis payloads suitable for unmanned platforms, especially underwater ones, would greatly enable eDNA applications. This topic seeks both small, inexpensive analysis payloads and enabling technologies for such payloads; in particular, techniques that reduce the amount time for sample analysis, reduce the volume of sample water, reduce false alarms from contaminants, and automatically generate sampling strategies, among many other possibilities.

PHASE I: Develop concepts and determine feasibility of marine eDNA technologies and techniques suitable for unattended operation in an unmanned underwater vehicle, including the identification of methods to reduce eDNA vehicle payload, sample volume, analysis time, and need for filtration of nearshore samples; development of sampling approaches suitable for unmanned underwater vehicles. Develop key component technology milestones and conceptual designs for hardware. Prepare a Phase II plan.

PHASE II: Produce prototype hardware based on Phase I effort. Establish hardware performance and develop a conceptual plan for integration into an unmanned underwater vehicle. Deliver a prototype ready for integration and testing by the Government at the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Successful development of marine eDNA technology suitable for underwater vehicle use will open up tremendous opportunities for small businesses to provide marine eDNA capabilities to a wide range of Government agencies having equities in marine biological issues, for example, NOAA National Marine Fisheries, National Ocean Service, Office of National Marine Sanctuaries, Bureau of Ocean Energy Management, U.S. Geological Survey, Fish and Wildlife Service, National Park Service, Environmental Protection Agency, and National Institute of Environmental Health Sciences, among others.

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KEYWORDS: Environmental DNA; Polymerase chain reaction; PCR; Marine Mammals; Bacteria; Viruses; Plankton

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-076 TITLE: At-Scale Detection of Hardware Trojans on Chip Circuits

TECHNOLOGY AREA(S): Electronics, Ground/Sea Vehicles, Information Systems

ACQUISITION PROGRAM: Innovative Naval Prototype (INP) - Total Platform Cyber Protection (TPCP), PMW-160, PMW-170

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OBJECTIVE: Develop a method to scan chips on devices at scale to detect malicious implants known as hardware trojans. The Office of Naval Research (ONR) is seeking approaches that are non-destructive, do not require chip removal, and can scan boards and several devices in a timely fashion.

DESCRIPTION: Within the Navy there is a push to improve cybersecurity at all levels from application down to hardware. Many chips are made in other countries and potential hardware trojans could either exfil information or disable critical Navy systems such as weapons, communications, navigation, etc.

The Federal Government and its civilian workforce purchase vast quantities of electronics technologies. Much of this technology is provided from other countries. Supply chain attacks are realistic events. The Navy, DoD, and Federal Government must defend against malicious implants in chip technology. Analyzing chips is a difficult, tedious, and time-consuming task. It quite often involves destructive testing on a sample amount, chip removal, and some amount of delayering. This approach is not realistic due to the quantities of chips on boards in devices that may be suspicious. ONR is requesting approaches that are non-destructive; do not require decapping/delayering/desoldering; and can be implemented by simply removing the cover and possibly the entire board from the inherent device and then scanned for potential threats, specifically malicious hardware implants. The desired capability should be able to identify chip technology on the boards and make associated references to any existing/provided designs and/or operational capabilities/specifications. Please keep in mind that total or complete knowledge about the chip may not be available to the Government and any capability developed by the small business performer will need to address that possibility to be successful.

PHASE I: Demonstrate through a physical proof-of-concept or a model/simulation that the proposed approach is sound and feasible. The end result should be convincing from a physics perspective and from an ability to conduct this operation at scale on many chips. Develop a Phase II plan.

PHASE II: Develop a working prototype that is capable of maneuvering across a circuit board to asses all the chips.

PHASE III DUAL USE APPLICATIONS: It is expected that with the assistance of ONR, the performer will work with an acquisition group such as PMW-160 or PMW-170 (or another since this SBIR topic applies to many groups) to develop a system that could be used by Navy personnel (civilian or military) to detect the presence of hardware trojans on chips. A commercial device would also be appealing to many U.S. manufacturers selling any number of technologies to both businesses and consumers. Some examples include communications equipment, computers, and Internet of Things (IoT) devices.

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KEYWORDS: Reverse Engineering; Hardware Trojan; Chip Scanning; Cybersecurity; Supply Chain

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-077 TITLE: Machine Clustered and Labeled Decision Tracks Derived from AI-enabled Intent Recognition

TECHNOLOGY AREA(S): Human Systems, Information Systems

ACQUISITION PROGRAM: Minerva INP; MTC2 (PMW150); TSOA (MC3)

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a watchfloor decision aid service, enabled by recent advances in gaming artificial intelligence (AI),that, to be operationally relevant, must regulate the frequency of recommendations and improve their explainability; and that will identify clusters of sub-decision tracks within a decision track for an AI-enabled game plan in which a similar objective or state was met.

DESCRIPTION: The goal of this SBIR topic is to understand the mechanisms of AI-enabled game play in order to produce optimal strategies for multiple objectives and game states. As the Navy moves towards leveraging AI for decision support, maturing intelligent algorithms for execution plans and explainable AI is imperative. AI algorithms have been shown to produce not only optimal or close to optimal solutions, but also a larger set of eclectic strategies otherwise not derived by humans. An understanding of decision tracks leading to differing solutions/strategies will enable the Navy to be strategic given different mission states. The Navy seeks AI that recommends plans that consist of a set of clustered micro-tasks that optimally lead to the achievement of a specific objective.

Advances in deep reinforcement learning [Ref 1] have enabled agents to take low-level actions at a very high pace in support of higher-level plan execution. Researchers have also shown near human level performance for full games [Ref 2] that involve decisions that cut across classic warfighting domains. For the Naval domain, AI that can act confidently but less often and at the plan level are desired since it is not feasible to send human-based forces commands at machine speeds. To accomplish this, a product that can learn clusters of sub-decision tracks (micro-tasks) within a decision track for an AI-enabled plan for which a similar objective or state was met. Given multiple objectives in an AI-enabled game, the topic’s challenge is to use machine learning (ML) to cluster subsets of decisions (micro-tasks) that produce a given objective. These clusters will enable labels for specific game states and provide explainability for an otherwise blackbox AI agent. Tracks of micro-tasks will be approved for execution at the plan level as required by an objective. Newly published methods suggest technical feasibility [Ref 3]. Re-planning will have to be done if the state of a mission significantly changes. Furthermore, within a cluster the mature product should be able to identify a ranking of optimal to suboptimal sub-tracks. While proposers may utilize any data sets where AI was used, it may be helpful to utilize already published Starcraft data [Ref 4]. Inferring explainability from the actions of agents in Starcraft is an active research area whose accomplishments can be leveraged [Ref 5].

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Demonstrate the feasibility of developing operationally relevant techniques to cluster and label decision tracks as plans in an AI-enabled game. Conduct a detailed analysis of literature, commercial capabilities, and state-of-the-art AI/ML techniques relevant to this topic. Identify and begin to mitigate key technical risks to a Phase II prototype. Demonstrate progress. Develop Phase II plans with a technology roadmap, development milestones, and projected Phase II achievable performance.

PHASE II: Move development of prototype techniques from a commercial game to a military simulator such as JSAF, OneSAF, or NGTS. Agent interfaces using JSON messaging can be leveraged. Develop and test against an increasingly complex mission plan that spans all warfighting domains. Develop metrics for decision track clustering and similarity measures. Attempt to identify or develop decision track rankings within clusters. Demonstrate an end-to-end AI-enabled capability at the plan level for at least 3 mission contexts (e.g., sea control or amphibious assault). Work with programs of record and training sites to transition the Phase II prototype.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Produce a final prototype capable of deployment to training centers, operational command and control centers, and as a virtual application. Adapt the system to transition as a component to a larger system or as a standalone commercial product. Provide a means for performance evaluation with metrics for analysis (e.g., accuracy of assessments) and a method for operator assessment of product interactions (e.g., display visualizations). The Phase III system should have an intuitive human computer interface. The software and hardware should be modified and documented in accordance with guidelines provided by the engaged Programs of Record and any commercial partners. Technology development should be applicable to any domain that requires the training of end to end AI for a complex game or mission simulation.

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KEYWORDS: Artificial Intelligence; StarCraft; Decision Support; Deep Reinforcement Learning; Machine Learning; Plans; AI; ML

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-078 TITLE: Small-scale Health Monitoring Device for In-tube Environment Monitoring

TECHNOLOGY AREA(S): Materials/Processes, Weapons

ACQUISITION PROGRAM: Trident II D5 Missile System, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a novel sensor or suite of sensors to be integrated into a future environmental monitoring system with sensor(s) that will collect environmental conditions for analysis motors and will be exposed to explosive environments.

DESCRIPTION: The Navy has a need for on-motor environment monitoring. Understanding the exposure conditions of a motor allows for better evaluation of motor health and aging trends. A sensor or an array of sensors that provide sensing, on-board power, and data storage is ideal. This effort should produce a sensor or suite of sensors that can monitor near-motor environment at all times, but is not integrated into a larger monitoring system. The approach should consider and recommend a solution for powering the sensor and storing the data or performing the same process through passive means.
The sensors must have the ability to collect temperature and humidity, with the possibility of the following additional measurements:
- Pressure
- Shock
- Vibration
- Strain
- Chemical vapor sensor (e.g., nitric oxide, nitrogen dioxide, nitrous acid, ozone, carbon dioxide, and methane)

This SBIR topic is focused on sensors only and not on an integrated environmental monitoring system, which will be notionally mounted to aft and forward domes of a rocket motor. The sensor(s) should be functional if left on the rocket motor for long periods of time (at least 10 years, but up to 40 or more years) and be self-powered. The sensor(s) should have low power and low voltage requirements, at or below 12V, meet Hazards of Electromagnetic Radiation to Ordnance (i.e., HERO) requirements for off-shore use, and be capable of intermittent use while maintaining calibration within 1% for an extended period of at least 10 years.

PHASE I: Develop a technical concept for motor environmental monitoring sensors. Proposed design concepts should be completed during this Phase. Laboratory-scale experiments and/or modeling to verify the proposed concept(s) for health monitoring sensors should be completed, and the completion of key tests to transition from Phase I to Phase II. Identify risks to the technical approach and develop/evaluate plans to mitigate those risks for

Phase II. Coordinate with Navy SBIR liaisons key technical requirements for environmental properties to be measured, size of sensor, application method, lifespan of sensor, power, and data storage/transmission.

PHASE II: Design and develop a prototype of the environmental sensor or sensor array based on the concept(s) from Phase I. Ensure that the design includes, at a minimum, temperature and humidity monitoring capabilities. Ensure that the design yields the ability to apply the sensor on the forward or aft dome of the rocket motor. Complete laboratory tests of the sensor prototype to validate operation and feasibility. Design the test to emulate the installation, sensing period, removal, and download of the data. Perform laboratory-scale experiments and modeling to verify the concept for environmental monitoring. Test a performance of material compatibility test to ensure survivability of the system over long periods of time.

PHASE III DUAL USE APPLICATIONS: Update the sensor or sensor array design from Phase II efforts. Manufacture an updated prototype and demonstrate use on a fleet asset through certification and qualification of the system for deployment and use in the fleet. This technology has the potential to be used commercially in any industry that has a need for environment monitoring in areas of high hazards.

REFERENCES:
1. Buswell, J. “Lessons Learned from Health Monitoring of Rocket Motors.” 41st AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit, July 2005. https://arc.aiaa.org/doi/pdf/10.2514/6.2005-4558

2. Miller, M. ”Health Monitoring of Munitions for Mission Readiness.”, 43rd AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit, July 2007. https://arc.aiaa.org/doi/pdf/10.2514/6.2007-5789

KEYWORDS: Solid Rocket Motor; Environment Monitoring; Environmental Sensors; Self-powered Sensors; Explosive Material Monitoring; Rocket Motor Health Management

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-079 TITLE: Extremely Accurate Star Tracker

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: Trident II (D5) ACAT I

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OBJECTIVE: Design and develop a star tracker (using interferometery fringe methodology developed by NASA's Jet Propulsion Laboratory (JPL)) that is extremely accurate, light weight and consumes little power as compared to current commercial products. The developed star tracker will be designed for potential deployment on the Trident II (D5) weapons system and for astronomical data collections (including measures of stellar photometry, variability, and astrometry) that are used by the Navy.

DESCRIPTION: Current commercial star trackers’ size, weight, and power (SWaP) needs preclude the Navy from considering deploying these star trackers to the Trident II weapon system. Acquisition of an accurate, low-weight, small, and power-efficient star tracker would allow strategic weapon systems to be deployed with less expensive maintenance cost while also providing weapons system designers options to increase weapon system performance with less expensive hardware cost and maintenance. Furthermore, the new developed star tracker could assist in exo-atmosheric astronomical data collections needed for Navy, DoD and other commercial utility. The innovation needs to leverage already developed techniques by NASA JPL into a hardware electronics instruments package that is portable for missile and spacecraft environments. The Navy expects the star tracker to be no bigger than 64 cubic inches, weigh no more than 500 grams, and powered for at least two hours, and that new technology will demonstrate calibration of star tracker focal planes up to 100 times more accurate than current commercial capability. The star tracker will be expected to interface with navigation systems that will be matured through the proposal cycle. Power range for the star tracker should be 5W, or under, of navigation system power.

PHASE I: Develop and define a concept design for a star tracker that employs a NASA JPL interferometric fringes technique to measure stars extremely accurately. Ensure that the star tracker will be very small in size and will require low amounts of power. Work with the Navy to fully understand and document the star tracker SWaP and accuracy requirements since the star tracker is to be no bigger than 64 cubic inches, weigh no more than 500 grams, and powered for at least two hours, and that the accuracy of the star tracker to be up to 100 times more accuracy than current technology with pointing accuracy of 0.04 arc seconds. Identify risks in the proposed concept. Develop Phase II plans that include ways to mitigate those risks.

PHASE II: Produce and deliver a prototype star tracker. Assist the Navy in setting up the prototype star tracker for Hardware-in-the-Loop (HWIL) testing that emulates missile and space craft environments; and includes trouble shooting plus resolving implementation and execution issues. Establish feedback loop with the Navy for implementing changes due to prototype testing.

PHASE III DUAL USE APPLICATIONS: Deliver to NSWCDD/USNO a refined star tracker manufacturing prototype that the Navy can test for its function and portability in their land-based HWIL testing facilities. Provide design and test cases that demonstrate that the star tracker's accuracy is 100 times current technology (based on JPL's techniques); and is small, lightweight, and portable according the requirements matured in Phase I. Assist the Navy in setting up the star tracker manufacturing prototype for HWIL testing that emulates missile and space craft environments; and will include trouble shooting plus resolving implementation and execution issues. Support field qualification testing with Navy hardware and software applications. This product would support commercial aerospace space navigation, telescope pointing and tracking.

REFERENCES:
1. "IEEE Standard for Application of Systems Engineering on Defense Programs." IEEE 15288.1, 2014. https://standards.ieee.org/standard/15288_1-2014.html

2. "Department of Defense Standard Practice: Documentation of Verification, Validation, and Accreditation (VV&A) for Models and Simulations." MIL-STD-3022 Chg. 1. https://www.scribd.com/document/136735764/MIL-STD-3022-Documentation-of-Verification-and-Validation

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5. MShao, M. and Nemati, B. "Sub-Microarcsecond Astrometry with SIM-Lite: A Testbed-based Performance." Astronomical Society of the Pacific, Vol. 121, p. 41, January 2009. https://iopscience.iop.org/article/10.1086/596661/pdf

KEYWORDS: Star Tracker; Stellar Photometry; Astrometry; Missile; Spacecraft; Accurate Navigation

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-080 TITLE: Remote Telescope Control Software (RTC SW) System

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: Trident II (D5) ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a standardized, accredited software application that will run on the proposed Remote Telescope Control Hardware (RTC HW) and interface with the United States Naval Observatory (USNO)’s Telescope Control System (TCS) already under development at USNO, allowing for secure client-server access to telescope sites around the world. (Note: USNO has access to numerous sites around the world, but does not staff these sites on a permanent basis, and must thus develop a solution for collecting this data remotely.)

DESCRIPTION: The Trident II (D5) weapon system utilizes information and data collected by various telescope systems. These astronomical data sets need to be measured and monitored periodically to ensure weapons system utility and performance. Today, data gaps exist that require USNO to measure stars from various remote telescopes around the world. These data gaps include current collections of numerous bright stars' photometry and astrometry. A Remote Telescope Control Software (RTC SW) solution will fill this data gap in a manner that is repeatable, affordable and enduring. Current software technology requires human on-site interaction and site-specific software applications to collect and store astronomical data. An innovative software application will allow remote data collections from various sites around the world and will save much labor in manning the telescopes. This SBIR topic is expected to work in conjunction with a proposed hardware counterpart. This sort of HW/SW solution and the access it provides will be required to support future plans for USNO collection of data supporting Naval Surface Warfare Center, Dahlgren Division (NSWCDD) programs. Commercialization of this system would involve providing this solution to DoD and other observatories and laboratories who are facing similar challenges.

PHASE I: Develop and define a concept design that standardizes RTC SW that will run on the proposed RTC HW and interface with USNO’s TCS, preferred software language is, either, Python or C++. The TCS description from the Navy will mature during Phase I and be provided to topic proposers. Work with the Navy to construct tests that will ensure the SW application runs on the RTC HW and USNO's TCS. Establish the proper standards and accreditation procedures for the SW application. Identify any risks in the proposed concept. Develop Phase II plans to include ways to mitigate those risks.

PHASE II: Produce and deliver a prototype RTC SW application that will allow for secure client-server access to RTC HW boxes with Navy telescopes at various places around the world and that interface with USNO’s TCS. Work with the Navy to fully understand the software standards and software accreditation procedures that must be met to ensure that the SW application meets cyber secure client-server access requirements. Establish a feedback loop for implementing changes during prototype testing. For software and associated hardware configurations, apply appropriate cybersecurity standards as addressed by Security Technical Implementation Guides (STIGS) that is provided by the DoD cyber exchange.

PHASE III DUAL USE APPLICATIONS: Deliver a RTC SW application that is executed on RTC HW and interfaces with USNO's TCS and enables secure client-server access. Provide design and test cases that demonstrate the RTC SW application function. Support remote field qualification testing with USNO on several Navy telescope systems and RTC HW applications in development. Assist USNO in setting up RTC SW including trouble-shooting plus resolving implementation and execution issues at various Navy, DoD, and civilian telescope observatories.

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2. "IEEE Standard for Application of Systems Engineering on Defense Programs." IEEE 15288.1, 2014. https://standards.ieee.org/findstds/standards/15288.1-2014.html

3. "Standard for Technical Reviews and Audits on Defense Programs." IEEE 15288.2, 2014. https://standards.ieee.org/findstds/standards/15288.2-2014.html

4. "Department of Defense Standard Practice: Documentation of Verification, Validation, and Accreditation (VV&A) for Models and Simulations." MIL-STD-3022 Chg. 1. https://www.scribd.com/document/136735764/MIL-STD-3022-Documentation-of-Verification-and-Validation

5. “DODi 4650.06, Positioning, Navigating and Timing (PNT) Management.” https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/465006p.pdf

6. “Security Technical Implementation Guides (STIGS) “. https://public.cyber.mil/stigs/

KEYWORDS: Remote Telescope; Interfaces; Client-server; Remote Telescope; Software Standards; Software Accreditation; Software Application

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-081 TITLE: Automatic Coding Standards Validation Tool

TECHNOLOGY AREA(S): Information Systems

ACQUISITION PROGRAM: TRIDENT II (D5) in support of Strategic Systems Program (SSP) ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate an automatic static code analysis tool that can dynamically adapt to changing Navy organizational software standards and will incorporate Strategic Systems Program (SSP)-directed coding standards such as prologue categories (e.g., authors, notes, description, argument list), structured programming conventions, consistent indentation and comment location, and identification of redundant source code.

DESCRIPTION: Formal Navy software developments employ coding standards for C++ that are required to be met to ensure the software is maintainable, readable, and demonstratively of high quality. Currently these type of standards can only be validated manually, which takes time and resources. As the organization moves to an agile software development process that values the use of automation, an automated static analysis tool for C++ is necessary to identify standards violations.

Hardware requirements dictate that this tool be operational and maintainable on both RedHat Linux on Intel x86 and Solaris Sparc systems and that it is able to be executed stand-alone and integrated in an automated development and testing pipeline (DevOps). The tool should have an option to automatically fix the standards violations on an item-by-item basis.

Currently there is a tool to automatically perform static analysis for C code but no tool to do this for C++ code. The tool should perform analysis and correction processing on software consisting of both C and C++ code. An additional benefit would be that the user can tailor the portion of code to be analyzed and possibly fixed.

SSP and Naval Surface Warfare Center, Dahlgren Division (NSWCDD) will be able to provide feedback to allow for expedient operational tool updates.

PHASE I: Determine technical feasibility of automated static analysis of those standards on C and C++ code, with a chosen/given set of versatile C and C++ standards. Develop approaches to creating a tool that is easy to adapt to different C and C++ coding standards and determine a mechanism for validating the automated tool. Identify risks to the technical approach and develop Phase II plans that include ways to mitigate those risks.

PHASE II: Produce and deliver prototype software and associated test cases. Work with the Navy to fully understand the coding standards implemented and provide a draft installation guide for Linux and Solaris systems and a user's guide. Work with the Navy to troubleshoot the software and resolve implementation and execution issues. Establish a feedback loop with NSWCDD for implementing changes due to findings during prototype testing.

PHASE III DUAL USE APPLICATIONS: Deliver software that can be dropped into NSWCDD automated testing and development environment and distributed to other Navy technical partners.
Work with the Navy to provide updates and fix issues. Establish a maintenance agreement that allows evolution of the tool.

This product will perform static analysis according to customizable coding standards. The fact that the coding standards are customizable makes the product marketable to a wide set of commercial software development applications.

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1. "Systems and Software Engineering - Systems Life Cycle Processes." IEEE 15288, 2015.https://www.iso.org/standards/63711.html

2. "IEEE Standard for Application of Systems Engineering on Defense Programs." IEEE 15288.1, 2014. https://standards.ieee.org/standard/15288_1-2014.html

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KEYWORDS: Automated Testing; Coding Standards; C/C++; Software Validation; Solaris/Linux; Static Analysis; DevOps

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-082 TITLE: Visible to Near-Infrared Integrated Photonics Development for Quantum Inertial Sensing

TECHNOLOGY AREA(S): Electronics, Materials/Processes, Sensors

ACQUISITION PROGRAM: Strategic Systems Programs ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a novel integrated photonic component in the visible to near-infrared wavelengths, with a particular focus on devices suitable for quantum inertial sensing. Develop a method to combine commercially and not commercially available components with the manufacturing process to make the components compatible with the integrated photonics architecture.

DESCRIPTION: Advance the development process in the neglected visible and near-infrared wavelength regime, with a particular focus on components and component combinations most immediately relevant to an ultra-compact, robust, frequency-agile, and narrow-line laser system for quantum inertial sensing. This is of particular interest since quantum inertial sensing has the capability to be a single sensor sensitive to both acceleration and rotation.

The continual movement of laser-based devices from the laboratory environment to the commercial environment increases the demand for more compact, rugged, low power, and easily manufactured versions of their bulky lab-scale brethren. But while commercial interests have pushed for development of such integrated devices at the telecom wavelengths, development in the visible and near-infrared wavelengths has lagged behind. Although applications span a multitude of fields including quantum inertial sensing, optogenetics and bio-sensing, the basic building blocks of an integrated photonics system are universal: a light source followed by a mix of other components, which may include optical isolators, waveguides, beamsplitters, polarization manipulators, shutters, frequency shifters, phase shifters, photodetectors, micro-resonators, and grating couplers [Refs 1, 2].

Certain individual components of such an integrated photonics platform are commercially available in fiber-coupled packages. Indeed, some companies have already developed products that combine two of these components into a single package [Ref 3]. Although these fiber-packaged components are extremely compact compared to free-space optics, each exit and re-entry from a waveguide into fiber and back again results in light loss due to coupling inefficiencies. The compact nature of these fiber-packaged components also demands space for the necessary coupling lenses and fiber routings. The components inside the package may be based on laboriously assembled free-space components rather than on integrated photonics.

Moving beyond discrete fiber packages will require a concerted effort in both material and fabrication development. Several of the components mentioned, demand materials with special properties, like a high optical gain (for lasers), a strong Faraday effect (for optical isolators), or a strong optical nonlinearity (for phase modulators and optical frequency doublers). Many also require electrical signals to operate, which would have to be included in the fabrication process.

PHASE I: Perform a design and materials analysis to assess the feasibility of the fabrication of the selected integrated photonics component(s), for incorporation into a quantum inertial sensing system. Analyze potential materials, while exploring the risks and risk mitigation strategies associated with each and identifying the most promising option. If the proposed design operates at a wavelength other than 780nm or 850nm (the relevant wavelengths for most quantum inertial sensors) include a detailed plan for how the system can be adapted to work at those wavelengths and the risks involved in that adaptation. Similarly, perform an analysis that details the planned fabrication process, again identifying risks and risk mitigation strategies. Include an evaluation of the anticipated size, weight, electrical power draw, potential loses and environmental (including thermal, magnetic, vibration, and hermetic seal) sensitivities of the final design. The design must (a) demonstrate a performance benefit over existing technology and (b) demonstrate a pathway to a small and compact (goal of less than 0.15in2 chip cross section), lightweight (goal of less than 1 ounce) , and low-power (goal of less than 100mW). Finally, justify the need for the development of particular components or combination of components, by creating a detailed plan underscoring the necessary reduction in size, weight, or power afforded by the new device(s) for incorporation into a quantum inertial sensing system. Propose in a Phase II plan, a specific device design for fabrication based upon this analysis.

PHASE II: fabricate and characterize a lot of at least ten (10) prototype devices that will be installed into fiber-coupled and electrically-connectorized packages. Perform characterization of the components, demonstrating their basic performance (e.g., optical power production or handling capability, bandwidth, extinction ratio, electrical power draw, etc., as appropriate for the device in question). Evaluate the device’s thermal, magnetic, and vibration sensitivities. Perform tests in accordance with MIL-STD-202, MIL-STD-750, and MIL-STD-883, required to validate the use of the device for the application(s) identified in Phase I. Demonstrate the performance of the device as part of one of those applications. Deliver the ten or more prototypes by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Based on the prototypes, continual advancement of integrated photonics in visible and near-infrared wavelengths should lead to production of the design suitable for use in quantum inertial sensing system. The end product technology could be leveraged to bring quantum inertial sensing technology towards a price point that could make it more attractive to the telecommunication and biomedical commercial markets.

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KEYWORDS: Integrated Photonics; Inertial Sensor; Accelerometer; Navigation; Quantum Inertial Sensing; Near-infrared Wavelengths

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-083 TITLE: High Performance Natural Composite

TECHNOLOGY AREA(S): Materials/Processes

ACQUISITION PROGRAM: Strategic Systems Programs, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a scalable process to increase performance and consistency of natural wood as a structural material.

DESCRIPTION: Natural composites - wood - were the main structural components in the early years of Aerospace. Due to strength constraints and variability of a naturally sourced material, man-made composites soon started taking over the industry. Wood plies have the benefits of being radio frequency (RF) transparent and show little aging. An innovative process that expands the use of natural materials or wood species/types, while keeping the benefits of wood as a composite material, allows the program to continue to utilize previous designs.

Composite lay-up should have the following characteristics:
Nominal Thickness - 0.5 inch
Tensile Strength – Longitudinal > 8.0 ksi Property quantified
Bending Strength – Longitudinal > 5.0 ksi
Shear Strength > 1.6 ksi Property quantified
Internal material damping - Loss Factor = 0.01 or higher
Radio Frequency Transparent in the GigaHertz region of the electromagnetic spectrum (EM) spectrum
Manufacturability – Must be able to form into a complex curvature (doubly curved shell of revolution)
Service Life – capable of lasting longer than 25 years

PHASE I: Conduct a feasibility study for development of a suitable process to strengthen natural composite material that satisfies characteristics defined in the Description. Develop a method of fabrication for subscale articles. Identify technology and manufacturing development challenges and approaches to address during Phase II.

PHASE II: Develop, fabricate, demonstrate, and validate sub-scale component prototypes. Manufacture nine articles in sub-scale prototypes to characterize the capability of the technology and calibrate analysis models. Ensure that the manufacturing process demonstrates scalability and repeatability. Measure physical and mechanical properties and validate that they meet or exceed the characteristics provided in the Description. Conduct mechanical property testing of fabricated specimens and verify adequate performance to advance to full-scale representative components.

PHASE III DUAL USE APPLICATIONS: Provide support in transitioning the technology for Navy use in Strategic Systems Programs. Support the Navy with certifying and qualifying the system for Strategic Systems Programs use. Navy Strategic Systems Programs will provide the assets and test support as Government Furnished Equipment and Services.

Commercial companies that currently use man-made composites for radomes or structural components could find this natural composite as a possible replacement for the material.

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KEYWORDS: Strategic Missiles; Composite Materials; Materials Development; RF Transparent Structural Materials; Ultrastrong Materials; Super Wood; Densified Wood; Natural Composite Materials

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-084 TITLE: Remote Telescope Control Hardware (RTC HW) System

TECHNOLOGY AREA(S): Sensors

ACQUISITION PROGRAM: Trident II (D5) ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate a standardized Remote Telescope Control hardware (RTC HW) solution that will allow the United States Naval Observatory (USNO) to deploy telescopes to various places around the world and to assure data and network connection integrity. These RTC HW boxes will include a set of standard interfaces, on-board computing and data storage capability allowing for use in a client-server mode from USNO, and meet all Risk Management Framework (RMF), Information Assurance (IA), and physical security rules.

DESCRIPTION: The Trident II (D5) weapon system utilizes astronomical information and data collected by various telescope systems. These astronomical data sets must be measured and monitored yearly to ensure weapons system utility and performance. These measurements will persist for an amount of time to sufficiently baseline particular stars’ photometric variability, which in some cases are expected to span decades. Today, astronomical data gaps exist that require USNO to measure stars from various remote places around the world. These data gaps include current collections of numerous bright stars' photometry and astrometry. An RTC HW solution will fill this data gap in a manner that is repeatable, efficient, and testable by using standard interfaces, on-board computing, and data storage. The current state of deploying astronomic telescopes is not standardized in terms of data and network connectivity. Current hardware technology requires on-site personnel. Additional cost is incurred by synthesizing various data collection from the dissimilar hardware environments. An innovative RTC HW solution would lessen schedule impacts and cost of data collections by using standardized equipment and remote utility. This SBIR topic is expected to work in a software counterpart under development.

PHASE I: Develop and define a concept design that standardizes RTC HW in a manner that assures data and network connection integrity. Work with the Navy in understanding size, function, and interface requirements for the RTC HW solution that would enable nightly measurement of preselected stars with visual magnitude greater than 10 and the ability to extract measured data on an ad hoc basis. Construct measures that ensure data and network connection integrity and USNO software application. Identify risks to the proposed concept and develop Phase II plans that include ways to mitigate those risks for Phase II. For hardware and associated software configurations, apply appropriate cybersecurity standards as addressed by Security Technical Implementation Guides (STIGS) that is provided by the DoD cyber exchange [Ref 6].

PHASE II: Produce and deliver a prototype RTC HW solution. Work with the Navy to fully understand the RMF and IA requirements, as well as data and network connectivity measures of success. Work with the Navy to understand hardware standards for various software applications to be executed on the RTC HW box including standards and software applications being developed for the RTC system. Provide testing scenarios that ensure RMF and IA requirements are met. Test the hardware interfaces, on-board computing, and data storage capability. Establish a feedback loop with the Navy for implementing changes due to prototype testing. As with cybersecurity standards, RMF and IA requirements will be addressed by STIGS as provided by the DoD cyber exchange.

PHASE III DUAL USE APPLICATIONS: Deliver a RTC HW solution for telescopes deployed by USNO in a manner that works with a USNO software application under development. Provide design and test cases that demonstrate RTC HW interfaces, on-board computing, and data storage capability. Support remote field qualification testing with RTC software applications that are in development. Work with the Navy to set up RTC HW including trouble shooting plus resolving implementation and execution issues at various Navy, DoD, and civilian telescope observatories.

REFERENCES:

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3. "Standard for Technical Reviews and Audits on Defense Programs." IEEE 15288.2, 2014. https://standards.ieee.org/findstds/standards/15288.2-2014.html

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5. “DODi 4650.06 Positioning, Navigating and Timing (PNT) Management." https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/465006p.pdf

6. “Security Technical Implementation Guides (STIGS) “. https://public.cyber.mil/stigs/

KEYWORDS: Remote Telescope; Standard Interfaces; Repeatable; Hardware Interfaces; Connection Integrity; On-board Computing; Data Storage; Photometry and Astrometry

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-085 TITLE: Machine Learning-Based Data Analysis

TECHNOLOGY AREA(S): Human Systems, Information Systems

ACQUISITION PROGRAM: Strategic Weapons Systems: Trident II D5 and D5 Life Extension (LE) ACAT IC

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop, demonstrate and field an algorithm and process for conducting an automated real-time scan of navigation subsystem data from a database for disturbances, abnormal trends, and problems that can learn to predict future disturbances, abnormal trends, and problems, which would be implemented to provide real-time fault analysis and failure prediction for inertial navigation systems (INS).

DESCRIPTION: Data analysis of INS performance has historically been human labor intensive and heavily reliant on the ability of a person or team of people to perform data analysis in a lab instead of in real- time. Typical real-time monitoring of INS performance relies upon the system to create discrete error codes based on physical sensors and conditions. While this approach has been successful in the past, it has limitations and has an element of human error risk in the analysis of large data fields. The use of scanning and evaluation tools based on machine learning (ML) technology would significantly enhance the abilities of the human analyst to focus on problems identified from synthesized data rather than sifting thru raw data streams or reacting to one of many hundreds of discrete alarms that may occur. ML technology has the potential to dramatically reduce the likelihood of an analyst missing anomalies in the analysis of data caused by sensors or equipment that have degraded performance, but not by enough to exceed a human-established threshold or ability for pattern matching. ML technology should also offer the ability to detect higher order abnormalities with INS system performance by aggregating a variety of seemingly unrelated direct sensor error codes. It should offer the ability to classify errors, and have behavior-based or anomaly-based detection that may otherwise go undetected. ML should also offer the ability to conduct extensive data mining to predict a potential system failure and the opportunity to conduct the analysis in real time on the ship instead of time late.

Often times, anomalies caused by sensors or equipment falling into this category go undetected because humans have limitations such as imperfect memory, fatigue, etc., that make them reliant on the tripping of an alarm or passing of an established threshold to identify issues that a machine can learn to identify based on the big data set it was trained with. ML tools can be used to classify data sets to recognize abnormal subsystem behaviors to be flagged for further analysis. After these algorithms are developed to improve the lab analysis, they may be integrated as a real-time out-of-band problem monitor on the associated system. Similar to the way Network Intrusion Detection Systems can monitor network data flow for problem behaviors, these tools could passively monitor the system data for problem trends and behaviors, and then issue warnings to the operators of more significant systemic faults.

With a focus on optimizing system affordability, reliability, maintainability, serviceability, and operability, any proposed design concept, demonstration model, or production model must utilize standard interfaces wherever possible, leverage commercially available components or elements, be diagnosable and serviceable by qualified Navy sailors for any preventative or anticipated corrective maintenance required at a periodicity more frequently than once every nine months; have a mean time between failure in excess of twelve months; be configuration controlled and upgradable; be modular with an open systems architecture; and include the identification of potentially replaceable components or units to be carried as spares.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and Strategic Systems Programs (SSP) in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Conduct a concept development effort of the requirements outlined in the Description. Identify or develop an analysis methodology or ML technology and process to conduct an automated scan of various data streams related to INS that has the ability to learn to predict future disturbances, abnormal trends, and problems. Conduct feasibility studies of the proposed concept. Develop a Phase II plan.

Phase I will be UNCLASSIFIED, and the contractor will not require access to any classified data (in other words, if the research outcome relates to classified data, the work itself can be performed using "dummy" data of the same level of complexity).

PHASE II: Further develop the proposed concept and build a demonstrational prototype based on the concept. Ensure that the prototype is able to conduct an automated scan of various data streams of INS-related information using provided data and has the ability to learn to predict future disturbances, abnormal trends, and problems. Once the algorithm demonstrates the ability to learn to predict future problems, ensure that it is able to automate a scan on similar data streams as was used for the algorithm training. Ensure that the algorithm is able to report identified anomalies and sufficient background information to simplify root cause analysis of the subject problem/disturbance by the subject matter expert (SME). Develop a transition plan that identifies the scope, effort, and resources required to extend the prototype algorithm and process to additional analysis tasks, to include training for additional combinations of data streams to look for different problems or disturbances; and development of an out-of-band problem detector that could be considered for shipboard installation for real-time disturbance detection. Provide onsite training of the algorithm design, operation, maintenance, and interfaces with the host system.

Participate in a Preliminary Design Review (PDR) event. Install on a test ship for system performance testing. Deliver a Data Disclosure Package (DDP) that includes at a minimum: form, fit, function, operation, maintenance, installation and training data, procedures and information plus the data necessary or related to: overall physical, functional, interface, and performance characteristics; corrections or changes to Government-furnished data or software; and data or software that the Government has previously received unlimited rights to or that is otherwise lawfully available to the Government.

(Note: Though Phase II work may become classified (see Description section for details), the Proposal for Phase II work will be UNCLASSIFIED. If the selected Phase II contractor does not have the required certification for classified work, the SSP program office will work with the contractor to facilitate certification of related personnel and facility.)

PHASE III DUAL USE APPLICATIONS: Work with the Navy to implement the analysis toolkit as described in the Phase III transition plan at a designated Navy lab and as a SSP alteration (SPALT) on designated ships. Provide documentation and support materials to transfer the mature analysis toolkit to Navy SMEs. Ensure sufficient cyber security and software assurance requirements are met in accordance with DFARS Clause 252.204-7012, NIST Special Publication 800-171, NIST Special Publication 800-53, and NIST Special Publication 800-37. In addition, SPALT requirements to enable the software to be deployed at Navy data analysis labs and ships must be met.

Provide an updated DDP prior to fielding that must include at a minimum: any updates to the Phase II DDP and installation and maintenance procedures and processes; cyber security and authority to operate certifications for Navy ship use; qualification requirements and results; demonstrated compliance with SPALT requirements; and testing results.

This ML application has dual use commercial or military applications in any complex system that uses sensors to detect abnormalities, synthesize multiple unrelated data streams, and conduct failure analysis or fault localization of the underlying system such as propulsion or power generation plants, ships, aircraft, and space systems.

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KEYWORDS: Data Analysis; Machine Learning; Pattern Matching; Anomaly Detection; Classification; Data Mining; Behavior Based Detection

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-086 TITLE: Avionics Packaging Technology

TECHNOLOGY AREA(S): Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: Strategic Weapon System: Trident II D5 and D5 Life Extension Programs - ACAT 1C

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate avionics packaging materials that are low mass; and provide radio frequency (RF) and radiation attenuation, and excellent thermal heat sink properties for use in Submarine Launched Ballistic Missile (SLBM) systems.

DESCRIPTION: Avionics package enclosures provide structural integrity, endo- and exo-atmospheric environmental protection (e.g., thermal, radiation), and Circuit Card Assembly (CCA) attach points, thermal relief paths, and structural stability. Package enclosures used in this program provide passive cooling during flight. Advanced materials could reduce mass and improve thermal management properties. Since the end products have a long shelf life, known or potential outgassing of compounds and material integrity over multiple decades would need to be assessed.

Existing electronics enclosures and materials utilize available materials, machining techniques, what would be considered now as loose mechanical tolerances to accommodate wire wrapped CCAs, large feature size components, and a multi-layered approach to materials that provide different attributes to enclosure needs that are either bolted on

or attached via adhesive materials. A multitude of new materials development technologies, such as advanced composites and 3D printing, enable the use of advanced materials and production techniques that reduce lifecycle cost and further attenuate environments. Elimination of multi-step manufacturing processes utilizing lightweight materials that provide the package enclosure with the required material properties could reduce program costs and reduce missile weight.
Material attributes include:

• High thermal conductivity or thermal heat sink capability (min. of 147 W/m-C)
• RF shielding (target of 80dB at 10MHz)
• X-ray radiation shielding (target 5% transmission for Photon Attenuation at 5 KeV)
• Strength to withstand and operate through missile launch and flight environments (e.g., acceleration, shock, vibration, vacuum, thermal)
• Retention of properties for decades when utilized as package enclosure material
• No outgassing of noxious elements or compounds or particles
• Ability to remain fully operational through short duration (<60 minutes) space radiation environments described in MIL-STD 1089
• Assessment of limiting factors or concern areas
• Assessment of cost, reliability, size, and weight (target mass 20% reduction vs traditional fabrication)

PHASE I: Develop a concept and assess its feasibility based on concept formulation, development, and possible validation.
Develop approaches and recommendations for the design and fabrication of avionics packaging using new materials and processes for use in SLBM systems. Conduct a feasibility assessment for the proposed solution showing advancements in contrast to existing devices packaging approaches. Address, at a minimum, the capabilities listed in the Description. Document, in a Phase II plan, the design and feasibility assessment for Phase II consideration.

PHASE II: Develop and validate a prototype (not necessarily hardware). Design and fabricate avionics test packages, including internal circuitry to test operational effectiveness of enclosure. Conduct testing to exercise the designs in relevant environments and collect performance data, which may be used to characterize the capabilities of the design.

PHASE III DUAL USE APPLICATIONS: Manufacture, demonstrate, and integrate the end product Avionics Package into the missile and submarine systems. Provide support in transitioning the technology for Navy use in SSP. Support the Navy with certifying and qualifying the system for SSP use. (Note: Navy SSP will provide the assets and test support as Government Furnished Equipment (GFE) and Services.)

REFERENCES:
1. “MIL-STD-464 DoD Interface Standard: Electromagnetic Environmental Effects, Requirements for systems.” https://quicksearch.dla.mil/qsSearch.aspx

2. “MIL-STD-461 Military Standard: Electromagnetic Interference Characteristics Requirements for Equipment.” https://quicksearch.dla.mil/qsSearch.aspx

3. “MIL-STD-2169 DoD Interface Standard: High-Altitude Electromagnetic Pulse (HEMP) Environment.” https://apps.dtic.mil/dtic/tr/fulltext/u2/a554607.pdf

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KEYWORDS: Strategic Missiles; Materials Development; Electronics Enclosures; Production Techniques; Shielding; Attenuation

Questions may also be submitted through DOD SBIR/STTR SITIS website.

N201-087 TITLE: High-Power Superluminescent Diodes for High-Precision Interferometric Inertial Sensors

TECHNOLOGY AREA(S): Electronics, Materials/Processes, Sensors

ACQUISITION PROGRAM: Strategic Systems Programs ACAT IC

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop superluminescent diodes (SLDs) that provide high optical power, wide optical bandwidth, low spectral asymmetry, low gain ripple, high central degree of second order temporal coherence, fast centroid wavelength stabilization, and multi-decade environmental lifetime for use in strategic-grade high-precision inertial sensors such as interferometric fiber-optic gyroscopes (IFOGs) and accelerometers.

DESCRIPTION: The performance requirements for strategic and navigation-grade inertial sensors based on optical interferometry continue to become more stringent, necessitating continued innovation for optical component technologies. For example, IFOGs used in inertial navigation systems for fleet ballistic missile (FBM) submarine applications require unprecedented precision, characterized in terms of long-term bias stability, scale factor linearity, and angle random walk (ARW) performance.

A key component in these types of sensors is the light source. In principle, SLDs are an attractive option for such optical inertial sensors and are indeed employed in a number of commercial off-the-shelf (COTS) IFOGs. However, the relatively low optical power available from COTS SLDs limits the miniaturization of sense coils needed to achieve given ARW requirements, and furthermore is problematic with regard to splitting the optical power between multiple sense coils. In addition, inertial sensor performance may be limited by insufficient optical bandwidth, gain ripple, central degree of second order temporal coherence, centroid stabilization time, and environmental lifetime of COTS SLDs.

Therefore, the need remains for new technical approaches to improve SLD performance for interferometric inertial sensor applications. The objective of this topic relates to advanced SLDs designed for high-precision interferometric inertial sensors. In particular, SLDs are required with 1,550 nm operating wavelength, high optical power, wide optical bandwidth, low spectral asymmetry, low gain ripple, high central degree of second order temporal coherence, fast centroid wavelength stabilization, and at least thirty (30) year environmental lifetime.

PHASE I: Perform an analysis of design and materials aimed at an SLD that achieves stable performance over at least thirty (30) year lifetime for interferometric inertial sensor applications as compared to the current state of the art via novel designs, materials, and fabrication processes. Assess device performance parameters of fabricated test structures; consider all aspects of device fabrication; include a preliminary assessment of long-term environmental stability based on a materials physics analysis; and justify the feasibility/practicality of the approach. Propose, in a Phase II plan, a specific device design for fabrication based upon this analysis.

PHASE II: Fabricate and characterize a lot (up to ten (10)) of prototype SLDs in complete thermoelectrically cooled packages including lens-coupled fiber-optic polarization-maintaining pigtails, integrated isolators, and electrical connectorization suitable for incorporation into test beds for interferometric inertial sensors. Ensure that characterization testing is in accordance with MIL-STD-202, MIL-STD-750, and MIL-STD-883. Characterization testing comprises (1) optical power as a function of diode current; (2) polarization extinction ratio; (3) spectral characterization including sensitivity of centroid wavelength, optical bandwidth, gain ripple, and spectral asymmetry to diode current, chip-on-submount temperature, and case temperature; (4) and sensitivity of relative intensity noise (RIN) and central degree of second order temporal coherence to diode current, and centroid wavelength stabilization time. Perform an accelerated aging study involving SLDs under environmentally challenged conditions to develop a predictive model of long-term environmental stability. Perform a proof-of-concept study of one or more prototype SLDs in a suitable IFOG test bed. Deliver the prototypes by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Continue development that must lead to productization of SLDs suitable for interferometric inertial sensors. While this technology is aimed at military/strategic applications, SLDs are heavily used in many optical circuit applications including optical coherence tomography (OCT). An SLD that can meet the stringent performance requirements of strategic and navigation grade inertial sensors is likely to bring value to many existing commercial applications. Also, technology meeting the Navy needs could be leveraged to bring IFOG technology toward a price point that could make it more attractive to the commercial markets.

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KEYWORDS: Superluminescent Diode; SLD; Inertial Sensor; Fiber-optic Gyroscope; Navigation; Optical Power; Light Source

Questions may also be submitted through DOD SBIR/STTR SITIS website.

DEPARTMENT OF THE NAVY (DON)
20.1 Small Business Innovation Research (SBIR)
Direct to Phase II Announcement and Proposal Submission Instructions

IMPORTANT

- DON is soliciting proposals against three distinct types of SBIR topics:
  - Accelerated Delivery and Acquisition of Prototype Technologies (ADAPT): N201-X01 and N201-X02
  - Standard: N201-001 through N201-087
  - Direct to Phase II (DP2): N201-D01

  Each set of topics has a separate and unique set of proposal submission instructions.

  The following instructions apply to Direct to Phase II (DP2) only.

- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.

- Discretionary Technical Assistance (DTA) was renamed Discretionary Technical and Business Assistance (TABA).

- The optional Supporting Documents Volume (Volume 5) is available for the SBIR 20.1 BAA cycle. The optional Supporting Documents Volume is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation.

- A DP2 Phase I Feasibility proposal template, unique to DP2 topics, will be available to assist small businesses to generate a Phase I Technical Volume (Volume 2). The template will be located on https://www.navysbir.com/links_forms.htm.

INTRODUCTION

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For program and administrative questions, contact the Program Manager listed in Table 1; **do not** contact them for technical questions. For technical questions about a topic, contact the Topic Authors listed within the topic during the period **10 December 2019 through 13 January 2020.** Beginning **13 January 2020,** the SBIR/STTR Interactive Technical Information System (SITIS) (https://sbir.defensebusiness.org/) listed in Section 4.15.d of the Department of Defense (DoD) SBIR/STTR Program Broad Agency Announcement (BAA) must be used for any technical inquiry. For general inquiries or problems with electronic submission, contact the DoD SBIR/STTR Help Desk at 1-703-214-1333 (Monday through Friday, 9:00 a.m. to 6:00 p.m. ET) or via email at dodsbirsupport@reisystems.com.

TABLE 1: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N201-D01	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	jeffrey.a.kent@usmc.mil

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. Firms are encouraged to address the manufacturing needs of the defense sector in their proposals. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DON's mission can be obtained from the DON website at www.navy.mil.

During government fiscal years (FY) 2012 through 2022, the Department of Defense (DoD) including the Department of the Navy (DON) may issue an award to a small business firm under Phase II of the SBIR program with respect to a project, without regard to whether the firm was provided an award under Phase I of an SBIR program with respect to such project. Prior to such an award, the head of the agency, or their designee, must issue a written determination that the firm has demonstrated the scientific and technical merit and feasibility of the technology solution that appears to have commercial potential (for use by the government or in the public sector). The determination must be submitted to the Small Business Administration (SBA) prior to issuing the Phase II award. As such, DON issues this portion of the BAA in accordance with the requirements of the Direct to Phase II (DP2) authority. Only those firms that are capable of meeting the DP2 proposal requirements may participate in this DP2 BAA. No Phase I awards will be issued to the designated DP2 topic.

Each eligible topic requires documentation to determine that Phase I feasibility described in the Phase I section of the topic has been met.

The DON SBIR DP2 is a two-step process:

> STEP ONE: Prepare and Submit a Phase I Feasibility Proposal (instructions and link to template provided below). The purpose of the Phase I Feasibility Proposal is for the firm to provide documentation to substantiate that both Phase I feasibility and the scientific and technical merit described in the topic have been met. The Phase I Feasibility Proposal must: demonstrate that the firm performed Phase I-type research and development (R&D) and provide a concise summary of Phase II objectives, work plan, related research, key personnel, transition/commercialization plan, and estimated costs. Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work. The government will evaluate Phase I Feasibility Proposals and select firms to submit a Full DP2 Proposal. Demonstrating proof of feasibility is a requirement for a DP2 award. The firm must submit a Phase I Feasibility Proposal to be considered for selection to submit a Full DP2 Proposal.
>
> STEP TWO: Prepare and Submit a Full DP2 Proposal. If selected, the cognizant SYSCOM Program Office will contact the firm directly to provide instructions on how to submit a Full DP2 Proposal.

DON SBIR reserves the right to refuse to make any awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposers are to read the topic requirements carefully. The Government is not responsible for expenditures by the proposer prior to award of a contract. For 20.1 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the proposal will be deemed noncompliant and may be REJECTED.

- **Eligibility.** Each proposing firm must:
  - Have demonstrated feasibility of Phase I-type R&D work
  - Have submitted a Phase I Feasibility Proposal for evaluation
  - Meet Offeror Eligibility and Performance Requirements as defined in section 4.2 of the DoD SBIR/STTR Program BAA
  - During the Phase II award, primary employment of the principal investigator (PI) must be with the firm at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the PI's time is spent in the employ of the firm
  - Register in the System for Award Management (SAM) as defined in section 4.16 of the DoD SBIR/STTR Program BAA. To register, visit www.sam.gov

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR BAA section 5.4(a).

- **Technical Volume (Volume 2).** Technical Volume (Volume 2) must meet the following requirements:
  - Not to exceed **50** pages, regardless of page content
  - Single column format, single-spaced typed lines
  - Standard 8 ½" x 11" paper
  - Page margins one-inch on all sides. A header and footer may be included in the one-inch margin.
  - No font size smaller than 10-point*

  *For headers, footers, listed references, and imbedded tables, figures, images, or graphics that include text, a font size smaller than 10-point is allowable; however, proposers are cautioned that the text may be unreadable by evaluators.

  Volume 2 is the technical proposal. Additional documents may be submitted to support Volume 2 in accordance with the instructions for Supporting Documents Volume (Volume 5) as detailed below.

  The Technical Volume (Volume 2) should include the following sections:
  - Phase I Proof of Feasibility (NTE 35 pages)
    1. Introductory Statement
    2. Phase I Proof of Feasibility
    3. Assertions
    4. Commercialization Potential/Transition Plan Summary
  - Snapshot of Proposed Phase II Effort (NTE 15 pages)
    1. Description of Proposed DP2 Technical Effort and Objectives
    2. DP2 Work Plan
    3. Key Personnel Resumes – should be submitted for the Principal Investigator and up to 4 additional individuals. Resumes are limited to one page per person, and should be limited to only information relevant to the work to be performed under the project
    4. Subcontractors/Consultants
    5. Order of Magnitude Cost Estimate Table (example provided below in the Cost Volume (Volume 3) section).

It is recommended that proposers follow the DP2 Phase I Feasibility Template as a guide for structuring the DP2 Phase I Feasibility proposal. The template is located on https://www.navysbir.com/links_forms.htm.

Disclosure of Information (DFARS 252.204-7000)
In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this or any subsequent award, the proposer shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons. Simply identifying fundamental research in the proposal does NOT constitute acceptance of the exclusion. All exclusions will be reviewed and noted in the award. NOTE: Fundamental research included in the technical proposal that the proposer is requesting be eliminated from the requirements for prior approval of public disclosure of information, must be uploaded in a separate document (under "Other") in the Supporting Documents Volume (Volume 5).

- **Cost Volume (Volume 3).** The text fields related to costs for the proposed effort must be answered in the Cost Volume of the DoD Submission system (at https://www.dodsbirsttr.mil/submissions/), however, proposers DO NOT need to download and complete the separate cost volume template for the DON SBIR Phase I Feasibility Proposal. Proposers are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Technical Volume (Volume 2). Please refer to Table 2 below for guidance on cost and period of performance. Costs for the Base and Option are to be separate and identified on the Proposal Cover Sheet and in the Order of Magnitude Cost Estimate Table in the Technical Volume (Volume 2).

Order of Magnitude Cost Estimate Table			
Line Item - Details	**Estimated Base Amount**	**Estimated Option Amount**	**Total Estimated Amount Base + Option**
Direct Labor (fully burdened) – Prime			
Subcontractors/Consultants			
Material			
Travel & ODC			
G&A			
FCCM			
Fee/Profit			
TABA (NTE $25K, included in total amount)			
Total Estimated Costs			

TABLE 2: COST & PERIOD OF PERFORMANCE

Base		Option One		Total (NTE)
Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
$1,000,000	24 mos.	$500,000	12 mos.	$1,500,000

- **Company Commercialization Report (Volume 4).** Vol 4 not in use for 20.1 BAA

- **Supporting Documents Volume (Volume 5)**. DoD has implemented a Supporting Documents Volume (Volume 5). The optional Volume 5 is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation. Volume 5 must only be used for the following documents:
    - Letters of Support relevant to this project
    - Additional Cost Information - The "Explanatory Material" field in the online DoD Cost Volume (Volume 3) is to be used to provide sufficient detail for subcontractor, material, travel costs, and Discretionary Technical and Business Assistance (TABA), if proposed. If additional space is needed these items may be included within Volume 5.
    - SBIR/STTR Funding Agreement Certification
    - Technical Data Rights (Assertions) - If required, must be provided in the table format required by DFARS 252.227-7013(d) and (e)(3) and be included within Volume 5.
    - Allocation of Rights between prime and subcontractor
    - Disclosure of Information (DFARS 252.204-7000) (see Technical Volume 2 above)

  NOTE: The inclusion of documents or information other than that listed above (e.g., resumes, test data, technical reports, publications) may result in the proposal being deemed "Non-compliant" and REJECTED.

  A font size smaller than 10-point is allowable for documents in Volume 5; however, proposers are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD has implemented the optional Fraud, Waste and Abuse Training Certification (Volume 6). DON does not require evidence of Fraud, Waste and Abuse Training at the time of proposal submission. Therefore, DON will not require proposers to use Volume 6.

DON SBIR PHASE I PROPOSAL SUBMISSION CHECKLIST

- **Subcontractor, Material, and Travel Cost Detail.** In the Cost Volume (Volume 3), proposers must provide sufficient detail for subcontractor, material and travel costs. Enter this information in the "Explanatory Material" field in the online DoD Volume 3. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).

- **Performance Benchmarks.** Proposers must meet the two benchmark requirements for progress toward Commercialization as determined by the Small Business Administration (SBA) on June 1 each year. Please note that the DON applies performance benchmarks at time of proposal submission, not at time of contract award.

Discretionary Technical and Business Assistance (TABA). If TABA is proposed, the information required to support TABA (as specified in the TABA section below) must be added in the "Explanatory Material" field of the online DoD Volume 3. If the supporting information exceeds the character limits of the Explanatory Material field of Volume 3, this information must be included in Volume 5 as "Additional Cost Information" as noted above. Failure to add the required information in the online DoD Volume 3 and, if necessary, Volume 5 will result in the denial of TABA. TABA may be proposed for a DP2 effort, but the total value may not exceed $25,000 under this DP2 contract.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The SBIR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Firms may request to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the $1,600,000 or lower limit specified by the SYSCOM). The amount proposed for TABA cannot include any profit/fee application by the SBIR/STTR awardee and must be inclusive of all applicable indirect costs. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to $50,000 per project.

Approval of direct funding for TABA will be evaluated by the DON SBIR/STTR Program Office. A detailed request for TABA must include:

- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR applicant
- Propose a TABA provider that is the SBIR applicant
- Propose a TABA provider that is an affiliate of the SBIR applicant
- Propose a TABA provider that is an investor of the SBIR applicant
- Propose a TABA provider that is a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA must be included in the Cost Volume (Volume 3) as follows:

- Phase II: The value of the TABA request must be included in the Order of Magnitude Cost Estimate Table in the Snapshot of Proposal Phase II Effort section of the Technical Volume (Volume 2). The detailed request for TABA (as specified above) must be included as a note in the Order of Magnitude Cost Estimate Table and be specifically identified as "Discretionary Technical and Business Assistance".

Proposed values for TABA must NOT exceed:

- A total of $25,000 per award, not to exceed $50,000 per Phase II project

NOTE: The Small Business Administration (SBA) is currently developing regulations governing TABA. All regulatory guidance produced by SBA will apply to any SBIR contracts where TABA is utilized.

If a proposer requests and is awarded TABA in a Phase II contract, the proposer will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must attend a one-day DON STP meeting during the first or second year of the Phase II contract. This meeting is typically held in the spring/summer in the Washington, D.C. area. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

EVALUATION AND SELECTION

The DON will evaluate and select Phase I Feasibility and DP2 proposals using the evaluation criteria in Sections 6.0 and 8.0 of the DoD SBIR/STTR Program BAA respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. As noted in the sections of the aforementioned Announcement on proposal submission requirements, proposals exceeding the total costs established for the Base and/or any Options as specified by the sponsoring DON SYSCOM will be rejected without evaluation or consideration for award. Due to limited funding, the DON reserves the right to limit awards under any topic.

Approximately one week after the DP2 BAA closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Selected Phase I Feasibility proposers will be notified to submit Full DP2 Proposals. SYSCOM-specific Full DP2 Proposal guidance will be provided at the time of this notification.

Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests of the Phase I Feasibility evaluations and DP2 selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed directly with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the DON SYSCOM Program Managers listed in Table 1. If the protest is to be filed with the GAO, please refer to instructions provided in section 4.11 of the DoD SBIR/STTR Program BAA.

CONTRACT DELIVERABLES

Contract deliverables are typically progress reports and final reports. Required contract deliverables must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

AWARD AND FUNDING LIMITATIONS

Awards. The DON typically awards a Cost Plus Fixed Fee contract for DP2; but, may consider other types of agreement vehicles, such as an Other Transaction Agreement (OTA) or a Basic Ordering Agreement (BOA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. DP2 awards can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR/STTR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 5122 of the National Defense Authorization Act of Fiscal Year 2012. The statute set-aside is 1% of the available SBIR/STTR funding to be used for administrative support to accelerate transition of SBIR/STTR-developed technologies and provide non-financial resources for the firms (e.g., the DON STP).

TOPIC AWARD BY OTHER THAN THE SPONSORING AGENCY

Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular firm per topic using SBIR/STTR program funds, Head of Agency Determinations are now required (for all awards related to topics issued in or after the SBIR 13.1/STTR 13.A solicitations) before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact the original sponsoring agency before submitting a Phase II proposal to an agency other than the one that sponsored the original topic. (For DON awardees, this includes other DON SYSCOMs.)

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa. Please refer to instructions provided in section 7.2 of the DoD SBIR/STTR Program BAA.

ADDITIONAL NOTES

Human Subjects, Animal Testing, and Recombinant DNA. If the use of human, animal, and recombinant DNA is included under a DP2 proposal, please carefully review the requirements at: http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR/STTR Technical Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and/or their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

NAVY SBIR direct to Phase II 20.1 Topic Index

NAVY SBIR 20.1 DP2 Topic Description

N201-D01 TITLE: DIRECT TO PHASE II Exportable Power for Ultra Lightweight Tactical Vehicle (ULTV)

TECHNOLOGY AREA(S): Ground/Sea Vehicles

ACQUISITION PROGRAM: USMC PEO Land Systems, PM Ground Based Air Defense (GBAD), SMC PEO Land Systems, PM LTV

OBJECTIVE: Develop a compact, lightweight, engine-driven power generation system for vehicle and export electrical power with high specific power (kilowatts per kilogram) that fits within the confines of the chassis of recreational off-highway vehicles (ROVs) to meet expected power and energy demands and allow for future mission growth.

DESCRIPTION: Currently available vehicles capable of being internally transported in rotary wing aircraft have insufficient export power capabilities to meet power and energy demands of current Counter-Unmanned Aerial Systems (C-UASs) and allow for future mission growth. The current Light Marine Air Defense Integrated System (LMADIS) uses a 5 kilowatts (kW) diesel generator weighing 300 lbs. that results in the vehicle weighing 15 lbs. over the maximum gross vehicle weight (GVW) of the current ULTV. Future mission growth to add additional communications equipment to LMADIS is expected to increase the power demands to 10 kW. Currently available diesel generators that meet the higher power requirements weigh close to 500 pounds (lbs). and would result in the vehicle weighing 100 to 150 lbs. over maximum GVW. Compact and lightweight power generation systems are needed to power C-UAS and C2 systems and keep the vehicle safely within its allowable GVW. The system requirements are:

• Integrated system using the existing vehicle engine (current engine is approximately 85 horsepower)
• Export power output of 5 kW at idle Threshold (T); 10 kW at idle Objective (O) at 24 volts direct current (VDC)
• Reduced physical size of export power system (same approximate size as an alternator, 8 inches wide x 10 inches long x 8 inches high)
• Physical weight of export power system less than 225 lbs.
• Compatible with 24-VDC tactical electrical systems and 12-VDC vehicle electrical systems
• Electrical component and connections with an ingress protection rating of Ingress Protection(IP67) or higher in accordance with (IAW) American National Standards Institute (ANSI) / International Electrotechnical Commission (IEC) 60529-2004
• Modular design that can be inspected, serviced, and repaired in the field
• Full power output across the range of engine speeds, 400-4,000 Revolutions Per Minute (RPM)

PHASE I: For this Direct to Phase II (DP2) topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. It must have developed a concept for a workable prototype or design to address at a minimum the basic requirements of the stated objective above.
Documentation showing an engine driven power generation system concept is feasible and that the system requirements discussed in the description are in the realm of possible. The small business should have produced a model to evaluate different approaches to optimize on vehicle generator technologies. The small business should show they have identified higher power density electrical generator/alternator designs to at least double power output in a similar form factor when compared to existing military alternators.

FEASIBILITY DOCUMENTATION: Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic, but feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results.

Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI). Read and follow all of the DON SBIR 20.1 Direct to Phase II Broad Area Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this BAA.

PHASE II: Based on the Phase I equivalent effort and the Phase II plan, develop and use analytical modeling to assist in design and integration. Build prototypes for both fitment and functionality of power generation system. Support evaluation of prototypes to determine if the performance goals defined in the Phase II development plan and the requirements outlined in MIL-STD-1275E and MIL-STD-810H have been met. Demonstrate system performance through modeling and dynamometer testing. Refine the design based on the results of testing/modeling and support on vehicle testing. Prepare a Phase III plan to transition the technology to the Marine Corps and the commercial marketplace.

PHASE III DUAL USE APPLICATIONS: Upon successful completion of Phase II, provide support to the Marine Corps in transitioning the technology for Marine Corps use. Refine a power generation system for evaluation and determine its effectiveness in an operationally relevant environment. .Support the Marine Corps test and evaluation program to qualify the system for the Marine Corps use.

Commercial applications include law enforcement vehicles, search and rescue vehicles, tractor trailers, and general automotive to reduce vehicle weight and improve fuel economy.

REFERENCES:
1. “MIL-STD-810H - Environmental Engineering Considerations and Laboratory Tests”. U.S. Army Test and Evaluation Command, January 31, 2019. https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=35978

2. “MIL-STD-1275E Characteristics of 28 Volt DC Input Power to Utilization Equipment in Military Vehicles.” U.S. Army Tank automotive and Armaments Command, March 22, 2013. https://quicksearch.dla.mil/Transient/CFF7229D4AE841AA8C3229140257B53A.pdf

3. “Test Operations Procedure (TOP) 2-2-601 Electrical Systems (Vehicles and Weapon Subsystems)”. U.S. Army Developmental Test Command Test Operations Procedure, US Army Aberdeen Test Center, June 20, 1977. https://apps.dtic.mil/dtic/tr/fulltext/u2/a045343.pdf

4. “ANSI/IEC 60529-2004 Degrees of Protection Provided by Enclosures (IP Code)”. https://www.nema.org/Standards/ComplimentaryDocuments/ANSI-IEC-60529.pdf

KEYWORDS: Tactical Vehicle; Power Generation; Weight Reduction; Size Reduction; ULTV; UTV; LMADIS; NOTM-UTV; Permanent Magnet Generator; Exportable Power; Power

Questions may also be submitted through DOD SBIR/STTR SITIS website.

AIR FORCE
20.1 Small Business Innovation Research (SBIR)
Phase I Proposal Submission Instructions

INTRODUCTION

The Air Force (AF) proposal submission instructions are intended to clarify the Department of Defense (DoD) instructions as they apply to AF requirements. **Firms must ensure their proposal meets all requirements of the Broad Agency Announcement currently posted on the DoD website at the time the announcement closes.**

1. The AF Program Manager is Mr. David Shahady. The AF SBIR/STTR Program Office can be contacted at afsbirsttr-info@us.af.mil. For general inquiries or problems with the electronic submission, contact the DoD SBIR/STTR Help Desk via email at dodsbirsupport@reisystems.com (9:00 a.m. to 5:00 p.m. ET, Monday through Friday). For technical questions about the topics during the pre-announcement period (10 December 2019 through 13 January 2020), contact the Topic Authors listed for each topic on the Web site. For information on obtaining answers to your technical questions during the formal announcement period (14 Jan 2020 through 12 February 2020), go to https://sbir.defensebusiness.org. Your complete proposal **must** be submitted via the submissions site at https://www.dodsbirsttr.mil/submissions/ on or before the **8:00 pm ET, 12 February 2020 deadline.**

General information related to the AF Small Business Program can be found at the AF Small Business website, http://www.airforcesmallbiz.af.mil/. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach/conference events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers, http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

(Continued on next page.)

CHART 1: Consolidated SBIR Topic Information

Applicable Topics	Phase I					Phase II			
	Technical Volume (Vol 2)	Additional Info (Vol 5)	Award Amount	*Technical Duration	*Final Reporting Period	Technical Volume (Vol 2)	Additional Info (Vol 5)	Technical & Reporting	Initial Award Amount
AF201-001	Not to exceed 5 pages	Attach a pitch deck not to exceed 15 slides	Not to exceed $150,000	6 months	3 months	Not to exceed 15 pages	Attach a pitch deck not to exceed 15 slides	Typically 27 months	Not to exceed $750,000

*The technical duration and final reporting duration must be added together for the total duration of the project.

PHASE I PROPOSAL SUBMISSION

Read the DoD program announcement at https://sbir.defensebusiness.org for program requirements. When you prepare your proposal, keep in mind that Phase I should address the feasibility of a solution to the topic. For the AF, the contract period of performance for a Phase I shall be nine (9) months, and the award shall not exceed $150,000. We will accept only one Cost Volume per Topic Proposal and it must address the entire nine-month contract period of performance.

The Phase I topic awardees must accomplish the majority of their primary research during the first six months of the contract with the additional three months of effort to be used for generating final reports. Each AF organization may request Phase II proposals prior to the completion of the first six months of the contract based upon an evaluation of the contractor's technical progress and review by the AF technical point of contact utilizing the criteria in section 8.0 of the DoD announcement. The last three months of the nine-month Phase I contract will provide project continuity for all Phase II awardees so no modification to the Phase I contract should be necessary.

Limitations on Length of Proposal

The Phase I Technical Volume has a 5-page-limit (excluding the Cover Sheet, Cost Volume, Cost Volume Itemized Listing (a-j), The Technical Volume must be in no type smaller than 10-point on standard 8-1/2" x 11" paper with one (1) inch margins. Only the Technical Volume and any enclosures or attachments count toward the 5-page limit. In the interest of equity, pages in excess of the 5-page limitation will not be considered for review or award. The documents required for upload into Volume 5 "Other" category do not count towards the 5-page limit.

NOTE: The Fraud, Waste and Abuse Certificate of Training Completion (Volume 6) is required to be completed prior to proposal submission. More information concerning this requirement is provided below under "**PHASE I PROPOSAL SUBMISSION CHECKLIST".**

Phase I Proposal Format

Proposal Cover Sheet: If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released on the Internet; therefore, do not include proprietary information in these sections.

Technical Volume: The Technical Volume should include all graphics and attachments but should not include the Cover Sheet it is completed separately. The Phase I proposals shall include a technical volume (uploaded in Volume 2) that shall not exceed 5 pages and a pitch/slide deck not to exceed 15 slides (uploaded in Volume 5). The technical volume and slide deck will be reviewed holistically. It is recommended (but not required) that more detailed information is included in the technical volume and higher level information is included in the pitch deck. Most proposals will be printed out on black and white printers so make sure all graphics are distinguishable in black and white. To verify that your proposal has been received, click on the "Check Upload" icon to view your proposal. Typically, your uploaded file will be virus checked and converted to a .pdf document within the hour. If your proposal does not appear after an hour, please contact the DoD SBIR/STTR Help Desk via email at dodsbirsupport@reisystems.com (9:00 am to 6:00 pm ET Monday through Friday).

Key Personnel: Identify in the Technical Volume all key personnel who will be involved in this project; include information on directly related education, experience, and citizenship. A technical resume of the principal investigator, including a list of publications, if any, must be part of that information. Concise technical resumes for subcontractors and consultants, if any, are also useful. You must identify all U.S. permanent residents to be involved in the project as direct employees, subcontractors, or consultants. You must also identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For all non-U.S. citizens, in addition to technical resumes, please provide countries of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project, as appropriate. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a contract issued as a result of this announcement.

Phase I Work Plan Outline

NOTE: THE AF USES THE WORK PLAN OUTLINE AS THE INITIAL DRAFT OF THE PHASE I STATEMENT OF WORK (SOW). THEREFORE, DO NOT INCLUDE PROPRIETARY INFORMATION IN THE WORK PLAN OUTLINE. TO DO SO WILL NECESSITATE A REQUEST FOR REVISION AND MAY DELAY CONTRACT AWARD.

At the beginning of your proposal work plan section, include an outline of the work plan in the following format:

Scope: List the major requirements and specifications of the effort.
Task Outline: Provide a brief outline of the work to be accomplished over the span of the Phase I effort.
Milestone Schedule
Deliverables
Kickoff meeting within 30 days of contract start
Progress reports
Technical review within 6 months
Final report with SF 298

Cost Volume

Cost Volume information should be provided by completing the on-line Cost Volume and including the Cost Volume Itemized Listing specified below. The Cost Volume detail must be adequate to enable Air Force personnel to determine the purpose, necessity and reasonability of each cost element. Provide sufficient information (a-j below) on how funds will be used if the contract is awarded. The on-line Cost Volume and Itemized Cost Volume Information will not count against the 5-page limit. The itemized listing may be placed in the "Explanatory Material" section of the on-line Cost Volume (if enough room), or may be submitted in Volume 5 under the "Other" dropdown option. (Note: Only one file can be uploaded to the DoD Submission Site). Ensure that this file includes your complete Technical Volume and the information below.

a. Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment.

b. Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, and price and where appropriate, purposes.

c. Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, costs incurred in obtaining temporary use of specialized equipment. Proposals, which include leased hardware, must provide an adequate lease vs. purchase justification or rational.

d. Direct Labor: Identify key personnel by name if possible or by labor category if specific names are not available. The number of hours, labor overhead and/or fringe benefits and actual hourly rates for each individual are also necessary.

e. Travel: Travel costs must relate to the needs of the project. Break out travel cost by trip, with the number of travelers, airfare, per diem, lodging, etc. The number of trips required, as well as the destination and purpose of each trip should be reflected. Recommend budgeting at least one (1) trip to the Air Force location managing the contract.

f. Cost Sharing: If proposing cost share arrangements, please note each Phase I contract total value may not exceed $75,000 total, while Phase II contracts shall have an initial Not to Exceed value of $750,000. Please note that cost share contracts do not allow fees. NOTE: Subcontract arrangements involving provision of Independent Research and Development (IR&D) support are prohibited in accordance with

Under Secretary of Defense (USD) memorandum "Contractor Cost Share", dated 16 May 2001, as implemented by SAF/AQ memorandum, same title, dated 11 July 2001.

g. Subcontracts: Involvement of university or other consultants in the planning and/or research stages of the project may be appropriate. If the offeror intends such involvement, describe in detail and include information in the Cost Volume. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-third of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer. Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed. At a minimum, an offeror must include a Statement of Work (SOW) with a corresponding detailed Cost Volume for each planned subcontract.

h. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required and hourly rate.

i. Any exceptions to the model Phase I purchase order (P.O.) found at http://www.afsbirsttr.af.mil/Program/Overview/ should be included in your cost proposal. Full text for the clauses included in the P.O. may be found at http://farsite.hill.af.mil.

NOTE: If no exceptions are taken to an offeror's proposal, the Government may award a contract without discussions (except clarifications as described in FAR 15.306(a)). Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. If selected for award, the award contract or P.O. document received by your firm may vary in format/content from the model P.O. reviewed. If there are questions regarding the award document, contact the Phase I Contracting Officer listed on the selection notification. The Government reserves the right to conduct discussions if the Contracting Officer later determines them to be necessary.

j. DD Form 2345: For proposals submitted under export-controlled topics (either International Traffic in Arms (ITAR) or Export Administration Regulations (EAR)), a copy of the certified DD Form 2345, Militarily Critical Technical Data Agreement, or evidence of application submission must be included. The form, instructions, and FAQs may be found at the United States/Canada Joint Certification Program website, http://www.dla.mil/HQ/InformationOperations/Offers/Products/LogisticsApplications/JCP/DD2345Instructions.aspx. Approval of the DD Form 2345 will be verified if proposal is chosen for award.

NOTE: Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors; U.Group, Peerless Technologies, Engineering Services Network, HPC-COM, Mile Two, REI Systems, MacB (an Alion company), Infinite Management Solutions, LLC, Mile Two. In addition, only Government employees and technical personnel from Federally Funded Research and Development Centers (FFRDCs) MITRE and Aerospace Corporations working under contract to provide technical support to AF Life Cycle Management Center and Space and Missiles Centers may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. If you have concerns about any of these contractors, you should contact the AF SBIR/STTR Contracting Officer, Kris Croake, kristina.croake@us.af.mil.

k. The Air Force does not participate in the Discretionary Technical and Business Assistance (TABA) program. Contractors should not submit proposals that include Discretionary Technical and Business Assistance.

PHASE I PROPOSAL SUBMISSION CHECKLIST

NOTE: If you are not registered in the System for Award Management, https://www.sam.gov/, you will not be eligible for an award. Additionally, verify that you are registered to receive contracts (not just grants) and that your address matches between your proposal and SAM.

1) The Air Force Phase I proposal shall be a nine-month effort, and the cost shall not exceed $150,000.

2) The Air Force will accept only those proposals submitted electronically via the DoD SBIR Web site (https://www.dodsbirsttr.mil/submissions/).

It is mandatory that the complete proposal submission -- DoD Proposal Cover Sheet, Technical Volume with any appendices, Cost Volume, Itemized Cost Volume Information, and Fraud, Waste and Abuse Certificate of Training Completion -- be submitted electronically through the DoD SBIR Web site at https://www.dodsbirsttr.mil/submissions/) Each of these documents is to be submitted through the Website.

Please note that the Fraud, Waste and Abuse Training must be completed prior to submission of your proposal. This is accomplished under Volume 6 of the DoD SBIR Web site (https://www.dodsbirsttr.mil/submissions/)). When the training has been completed and certified, the DoD Submission Website will indicate this in the proposal which will complete the Volume 6 requirement. If the training has not been completed, you will receive an error message. Your proposal cannot be submitted until this training has been completed. The Fraud, Waste and Abuse Certificate of Training website can be found under Section 3.6 of the DoD 20.1 SBIR BAA Instructions. Your complete proposal **must** be submitted via the submissions site on or before the **8:00 pm ET, 12 February 2020 deadline.** A hardcopy **will not** be accepted.

The AF recommends that you complete your submission early, as computer traffic gets heavy near the announcement closing and could slow down the system. **Do not wait until the last minute.** The AF will not be responsible for proposals being denied due to servers being "down" or inaccessible. Please assure that your e-mail address listed in your proposal is current and accurate. **The AF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the AF. Changes of this nature that occur after proposal submission or award (if selected) for Phase I and II shall be sent to the Air Force SBIR/STTR site address, afsbirsttr-info@us.af.mil.**

AIR FORCE PROPOSAL EVALUATIONS

The AF will utilize the Phase I proposal evaluation criteria in section 6.0 of the DoD announcement in descending order of importance with technical merit being most important, followed by the qualifications of the principal investigator (and team), followed by the potential for commercialization as detailed in the Commercialization Plan.

The AF will utilize the Phase II proposal evaluation criteria in section 8.0 of the DoD announcement in descending order of importance with technical merit being most important, followed by the potential for commercialization as detailed in the Commercialization Plan, followed by the qualifications of the principal investigator (and team).

Proposal Status and Feedback

The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Cover Sheet will be notified by e-mail regarding proposal selection or non-selection. Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the Proposal

Number and Topic Number referenced. **If changes occur to the company mail or email address(es) or company points of contact after proposal submission, the information should be provided to the AF at afsbirsttr-info@us.af.mil.**

Feedback requests must be submitted in writing within 30 days after receipt of notification of non-selection. Written requests for feedback must be submitted via www.afsbirsttr.af.mil through the SBIR system. Requests for feedback should include the company name and telephone number/email address for a company point of contact and alternate. Also include the topic number under which the proposal(s) was submitted, and the proposal number(s). Feedback requests received more than 30 days after receipt of notification of non-selection will be fulfilled at the Contracting Officers' discretion. Unsuccessful offerors are entitled to no more than one feedback session for each proposal.

IMPORTANT: Proposals submitted to the AF are received and evaluated by different offices within the Air Force and handled on a Topic-by-Topic basis. Each office operates within their own schedule for proposal evaluation and selection**.** Updates and notification timeframes will vary by office and Topic. If your company is contacted regarding a proposal submission, it is not necessary to contact the AF to inquire about additional submissions. Additional notifications regarding your other submissions will be forthcoming.

We anticipate having all the proposals evaluated and our Phase I contract decisions within approximately three months of proposal receipt. All questions concerning the status of a proposal, or feedback, should be directed to the local awarding organization's SBIR Program Manager.

PHASE II PROPOSAL SUBMISSIONS

Phase II is the demonstration of the technology that was found feasible in Phase I. Only Phase I awardees are eligible to submit a Phase II proposal. All Phase I awardees will be sent a notification with the Phase II proposal submittal date and a link to detailed Phase II proposal preparation instructions, located here: http://www.afsbirsttr.af.mil/Program/Phase-I-and-II/. Phase II efforts are typically 27 months in duration (24 months technical performance, with 3 additional months for final reporting), and an initial value not to exceed $750,000.

NOTE: Phase II awardees should either have or start working towards having a Defense Contract Audit Agency (DCAA) approved accounting system. It is strongly urged that an approved accounting system be in place prior to the AF Phase II award timeframe. If you have questions regarding this matter, please discuss with your Phase I Contracting Officer.

All proposals must be submitted electronically at https://www.dodsbirsttr.mil/submissions/) by the date indicated in the notification. The Technical Volume is **limited to 15 pages** (unless a different number is specified in the notification; any advocacy letters, SBIR Environment Safety and Occupational Health (ESOH) Questionnaire, and Cost Volume Itemized Listing (a-j) will not count against the 15-page limitation and should be placed as the last pages of the Technical Volume file that is uploaded. The Phase II proposals shall also include a pitch/slide deck not to exceed 15 slides (uploaded in Volume 5). The technical volume and slide deck will be reviewed holistically and there is no set format requirements for the two documents. It is recommended (but not required) that more detailed information is included in the technical volume and higher level information is included in the pitch deck. (Note: For Phase II applications only one file can be uploaded to the DoD Submission Site. Ensure that this single file includes your complete Technical Volume and the additional Cost Volume information.) The preferred format for submission of proposals is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. Please virus-check your submissions.

AIR FORCE SBIR PROGRAM MANAGEMENT IMPROVEMENTS

The AF reserves the right to modify the Phase II submission requirements. Should the requirements change, all Phase I awardees will be notified. The AF also reserves the right to change any administrative procedures at any time that will improve management of the AF SBIR Program.

AIR FORCE SUBMISSION OF FINAL REPORTS

All Final Reports will be submitted to the awarding AF organization in accordance with the Contract. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

AIR FORCE SBIR 20.1 Topic Index

AIR FORCE SBIR 20.1 Topic Descriptions

AF201-001 TITLE: Flight Test Playback Tool
TECHNOLOGY AREA(S): Information Systems
ACQUISITION PROGRAM: N/A
OBJECTIVE: Develop, test, and implement a Flight Test playback and review tool that incorporates terrain data.

DESCRIPTION: The Air Force's Special Operations Forces/ Combat Search and Rescue team perform constant aircraft avionics system software and hardware revision cycles to meet new or improved Air Force mission capabilities. With each revision cycle (Block Upgrade), the 402nd Software Engineering Group (402 SWEG) performs extensive Independent Verification and Validation (IV&V) of the avionics suite.
Currently, the process of performing analysis on test-flight data is manpower and time intensive. Performing manual review has several limitations. For example, analysts cannot correlate terrain data with Unit Under Test (UUT). Radar terrain data accuracy cannot be evaluated. If topology can be incorporated with UUT sensor data, Software/Hardware performance accuracy can be confirmed and, the analysts will finally have a method to accurately evaluate radar returns. Being able to incorporate terrain data into flight test reviews will provide for more detailed analysis of aircraft dynamics as they relate to the environment allowing for analysis of the airframe as it moves through the test envelope.

This research topic is seeking innovative advancements and automation of the current technology available to the US Air Force to support UUT flight-test and radar data analysis. There are many limiting factors involving manual analysis of flight-test data. Currently, the ability to accurately compare radar return data with topology is non-existent. The research will bring about the process required for maximizing the effectiveness of all flight tests by the incorporation of specific terrain features providing a complete analysis of the complete test environment.
The US Air Force will see process improvement, elimination of safety risk, improved software sustainment, and benefits derived from the new process.

PHASE I: Develop a Flight Test playback and review tool that incorporates terrain data.

PHASE II: The Phase I technology will be tested, optimized and expanded to incorporate those characteristics that were not previously developed.

PHASE III DUAL USE APPLICATIONS: If Phase II is successful, the company will be expected to support the Air Force in transitioning the technology for use. Working with the Air Force, the company will integrate the technology for evaluation to determine its effectiveness in an operationally relevant environment.

REFERENCES:

1. “Terrain Synthesis from Digital Elevation Models.” Howard Zhou, Jie Sun, Greg Turk, and Jim Rehg, IEEE Viz. 2007. https://ieeexplore.ieee.org/document/4293025.

2. “Real-Time Editing, Synthesis, and Rendering of Infinite Landscapes on GPUs.” Jens Schneider, Tobias Boldte, Rüdiger Westermann, 2006. https://pdfs.semanticscholar.org/2000/fd31703293aaa08fe622a3b032f21ba707e6.pdf.

3. Digital Representations of the Real World: How to Capture, Model, and Render Visual Reality. A K Peters/CRC Press. May 7, 2015. Ps. 137 and 455.

4. Devouassoux, Y., 2001, Extended Kalman Filter For The Navigation System Of An Autonomous Helicopter, Special Problem Report, School of Aerospace Engineering, Georgia Institute ofTechnology, 2001.

KEYWORDS: automation, data analysis, topography, terrain

AIR FORCE (AF)
20.1 Small Business Innovation Research (SBIR)
Direct to Phase II Proposal Instructions

The AF 20.1 Direct to Phase II proposal submission instructions are intended to clarify the Department of Defense (DoD) instructions as they apply to AF requirements. This Announcement is for Direct to Phase II proposals only.

The AF Program Manager is Mr. David Shahady. The AF SBIR/STTR Program Office can be contacted at afsbirsttr-info@us.af.mil. For general inquiries or problems with the electronic submission, contact the DoD SBIR/STTR Help Desk via email at dodsbirsupport@reisystems.com (9:00 a.m. to 5:00 p.m. ET, Monday through Friday). For technical questions about the topics during the pre-announcement period (10 December 2019 through 13 January 2020), contact the Topic Authors listed for each topic on the Web site. For information on obtaining answers to your technical questions during the formal announcement period (14 January 2020 through 12 February 2020), go to https://sbir.defensebusiness.org. Your complete proposal **must** be submitted via the submissions site at https://www.dodsbirsttr.mil/submissions/ on or before the **8:00 pm ET, 12 February 2020 deadline.** A hardcopy **will not** be accepted.

All Phase II proposals must be prepared and submitted through the DoD SBIR/STTR electronic submission site: https://www.dodsbirsttr.mil/submissions/. The offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of this instruction. In order for a Phase II proposal to be submitted to the component, click "Start New Phase II Proposal" from the "My Portal Page". After uploading your full proposal, you will need to click "Submit". This action will notify the agency your proposal submission is complete and ready for evaluation. Once submitted, no further changes may be made to the proposal. **Note: If the proposal is not properly submitted in this manner by the solicitation close date/time identified above, it will receive no further consideration for evaluation/award.**

The AF recommends that you complete your submission early, as computer traffic gets heavy near the announcement closing and could slow down the system. **Do not wait until the last minute.** The AF will not be responsible for proposals being denied due to servers being "down" or inaccessible. Please assure that your e-mail address listed in your proposal is current and accurate. **The AF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the AF. Changes of this nature that occur after proposal submission or award (if selected) shall be sent to the Air Force SBIR/STTR site address, afsbirsttr-info@us.af.mil.**

Please note that changes have been made to these instructions. Firms must ensure their proposal meets all requirements of the Announcement currently posted on the DoD website at the time the Announcement closes. Incomplete proposals will be rejected.

I. DIRECT TO PHASE II

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows the Department of Defense to make an award to a small business concern under Phase II of the SBIR program with respect to a project, without regard to whether the small business concern was provided an award under Phase I of an SBIR program with respect to such project. Air Force is conducting a "Direct to Phase II" implementation of this

authority for this 20.1 SBIR Announcement and does not guarantee Direct to Phase II opportunities will be offered in future Announcements. Each eligible topic requires documentation to determine that Phase I feasibility described in the Phase I section of the topic has been met.

The Air Force Direct to Phase II Proposals are different than traditional Air Force Phase I SBIR/STTR proposals. The chart below explains some of these differences.

	STANDARD AIR FORCE SBIR/STTR PROCESS	AIR FORCE D2P2 PROCESS
PHASE 1 TYPICAL FUNDING LEVEL	~$150k	None
PHASE 1 TECHNICAL *POP DURATION	9 months	None
PHASE I TECHNICAL REPORT	3 months	None
PHASE II TECHNICAL VOLUME	50 Page Technical Volume (pre 19.3) or 15 Page Technical Volume (Vol 2) 15 Slides/Pitch Deck (Vol 5) (Post 19.3)	15 Page Technical Volume (Vol 2) 15 Slides/Pitch Deck (Vol 5)
PHASE 2 TYPICAL MAX FUNDING LEVEL	~$750k	$1.6125M
PHASE 2 TECHNICAL *POP DURATION	24 months	12 months
PHASE 2 TECHNICAL REPORT	3 months	3 months
NOTES		

*POP= Period of Performance

II. INTRODUCTION

Direct to Phase II proposals must follow the steps outlined below:

1. Offerors must create a Cover Sheet using the DoD Proposal submission system (follow the DoD Instructions for the Cover Sheet located in section 5.4.a.). Offerors must provide documentation that satisfies the Phase I feasibility requirement* that will be included as an Appendix to the Phase II proposal. Offerors must demonstrate that they have completed research and development through means other than the SBIR/STTR program to establish the feasibility of the proposed Phase II effort based on the criteria outlined in the topic description.

2. Offerors must submit a Phase II proposal using the AF Phase II proposal instructions below.

* NOTE: Offerors are required to provide information demonstrating that the scientific and technical merit and feasibility has been established. The Air Force will not evaluate the offeror's related Phase II proposal if it determines that the offeror has failed to demonstrate that technical merit and feasibility has been established or the offeror has failed to demonstrate that work submitted in the feasibility documentation was substantially performed by the offeror and/or the principal investigator (PI). Refer to the Phase I description (within the topic) to review the minimum requirements that need to be demonstrated in the feasibility documentation. **Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR or STTR work.**

III. PROPOSAL SUBMISSION

The complete proposal, i.e., DoD Proposal Cover Sheet, technical volume, and cost volume, must be submitted electronically at https://www.dodsbirsttr.mil/submissions/. Only one Phase II proposal file can be uploaded to the DoD Submission Site. Ensure your complete technical volume and additional cost volume information is included in this sole submission. The preferred submission format is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. **VIRUS-CHECK ALL SUBMISSIONS.**

Complete proposals must include all of the following:
Volume 1: DoD Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report – not in use for 20.1
Volume 5: Supporting Documents, e.g., SBIR/STTR Environment, Safety and Occupational Health (ESOH) Questionnaire, DoD Form 2345, Militarily Critical Data Agreement (if applicable)
Volume 6: Fraud Waste and Abuse Training Completion

Phase II proposals require a comprehensive, detailed submission of the proposed effort. AF Direct to Phase II efforts are 15 months; 12 months for technical performance and three (3) months for completion of the final report. AF Direct to Phase II efforts are awarded up to a maximum value of $1,612,500 per contract award. Commercial and military potential of the technology under development is extremely important. Proposals emphasizing dual-use applications and commercial exploitation of resulting technologies are sought.

All Phase II Research or Research and Development (R/R&D) must be performed by the small business and its team members in the United States, as defined in the DoD 20.1 BAA Announcement Instructions. The primary employment of the Phase II principal investigator must be with the small business concern at the time of award and during conduct of the entire proposed effort. Primary employment is defined as more than one-half of the principal investigator's time being spent working for the small business. This precludes full-time employment with another organization.

Knowingly and willfully making false, fictitious, or fraudulent statements or representations may be a felony under the Federal Criminal Statement Act, 18 U.S.C. Section 1001, punishable by a fine up to $250,000, up to five years in prison, or both.

IV. PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

The technical proposal is limited to 15 pages. The advocacy letters (if any), "SBIR/ STTR Environment, Safety and Occupational Health (ESOH) Questionnaire (Attachment 1 herein)" and the additional cost proposal itemized listing (17a through 17i) should be included in Volume 5, Supporting Documentation. This documentation and the Cover Sheet will not count toward the 15-page limitation. The Phase II proposal shall include a technical volume (uploaded in Volume 2) that shall not exceed 15 pages and a pitch/slide deck not to exceed 15 slides (uploaded in Volume 5). The technical volume and slide deck will be reviewed holistically and there is no set format requirements for the two documents. It is recommended (but not required) that more detailed information is included in the technical volume and higher level information is included in the slide deck.

Please note that the Fraud, Waste and Abuse Training must be completed prior to submission of your proposal. This is accomplished under Volume 6 of the DoD SBIR Web site (https://www.dodsbirsttr.mil/submissions//). When the training has been completed and certified, the DoD Submission Website will indicate this in the proposal which will complete the Volume 6 requirement. If the training has not been completed, you will receive an error message. Your proposal cannot be submitted until this training has been completed. The Fraud, Waste and Abuse Certificate of Training website can be found under Section 3.6 of the DoD 20.1 SBIR BAA Instructions. Your complete proposal **must** be submitted via the submissions site on or before the **8:00 pm ET, 12 February 2020 deadline.** A hardcopy **will not** be accepted.

A. Proposal Requirements. A Phase II proposal should provide sufficient information to persuade the AF the proposed advancement of the technology represents an innovative solution to the scientific or engineering problem and is worthy of support under the stated criteria. All sections below count toward the page limitation, unless otherwise specified.

B. Proprietary Information. Information constituting a trade secret, commercial or financial information, confidential personal information, or data affecting national security must be clearly marked. It shall be treated in confidence to the extent permitted by law. Be advised, in the event of proposal selection it is likely the Work Plan or Statement of Work (SOW) will be incorporated into the resulting contract, in whole or part, by reference or as an attachment. Therefore, segregate any information to be excluded from public release pursuant to the Freedom of Information Act (FOIA). See Section 5.3 of the DoD BAA Announcement regarding marking of proprietary information.

C. General Content. Proposals should be direct, concise, and informative. Type shall be no smaller than 11-point on standard 8 ½ X 11 paper, with one-inch margins and pages consecutively numbered. Offerors are discouraged from including promotional and non-programmatic items.

D. Proposal Format. The technical proposal includes all items listed below in the order provided.

(1) **Proposal Cover Sheet:** Complete and submit the SBIR Proposal Cover Sheet in accordance with the instructions provided at https://www.dodsbirsttr.mil/submissions//. The technical abstract should include a brief description of the program objective(s), a description of the effort, anticipated benefits and commercial applications of the proposed research, and a list of key words/terms. The technical abstract of each successful proposal will be submitted to the Office of the Secretary of Defense (OSD) for publication and, therefore, must not contain proprietary or classified information. The term "Component" on the Cover Sheet refers to the AF organization requesting the Phase II proposal.

(2) **Table of Contents:** A table of contents should be located immediately after the Cover Sheet.

(3) **Glossary:** Include a glossary of acronyms and abbreviations used in the proposal.

(4) **Milestone Identification:** Include a program schedule with all key milestones identified. If options are proposed, the schedule should provide notional option start date and period of performance.

(5) **Identification and Significance of the Problem or Opportunity:** Briefly reference the specific technical problem/opportunity that will be pursued under this effort.

(6) **Phase II Technical Objectives: Detail the specific objectives of the Phase II work, and describe the technical approach and methods to be used in meeting these objects.** The proposal should also include an assessment of the potential commercial application for each objective.

(7) **Proposer-Prepared Statement of Work (SOW):** The SOW shall be a separate and distinct part of the proposal package, using a page break to divide it from the technical proposal. The proposed SOW must contain a summary description of the technical methodology and task description in broad enough detail to provide contractual flexibility. The following is the recommended format for the SOW; begin this section on a new page. **DO NOT include proprietary information in the SOW.**

a) 1.0 – Objective: This section is intended to provide a brief overview of the specialty area. It should explain why it is being pursued and the expected outcome.
b) 2.0 – Scope: This section should provide a concise description of the work to be accomplished, including the technology area to be investigated, goals, and major milestones. However, the key elements of this section are task development and deliverables, i.e., the anticipated end result and/or product of the effort. This section must also be consistent with the information in 4.0 (below).
c) 3.0 – Background: The proposer shall identify appropriate specifications, standards, and other documents applicable to the effort. This section includes any information, explanation, or constraints to understanding the requirements. It may include relationships to previous, current, and/or future operations. It may also include

techniques previously found to be ineffective.

d) 4.0 – Task/Technical Requirements: The detailed description of the individual tasks to accomplish the work to be performed is considered to be legally binding on the proposer. Therefore, it must be developed in an orderly progression with sufficient detail to establish overall program requirements and goals. The work effort must be segregated into major tasks and identified in separately numbered paragraphs.

Each numbered major task should delineate by subtask the work to be performed. The SOW MUST contain every task to be accomplished; they must be definite, realistic, and clearly stated. Use "shall" whenever the SOW expresses a binding provision. Use "should" or "may" to express a declaration or purpose. Use "will" when no contractor requirement is involved, i.e., "... power will be supplied by the Government."

(8) **Deliverables:** Include a section clearly describing the specific sample/prototype hardware/ software to be delivered, as well as data deliverables, schedules, and quantities. Be aware of the possible requirement for unique item identification IAW DFARS 252.211-7003, Item Identification and Valuation, for hardware. If hardware/software will be developed but not delivered, provide an explanation. At a minimum, the following reports will be required under ALL Phase II contracts.

a) Scientific and Technical Reports: Rights in technical data, including software, developed under the terms of any contract resulting from a SBIR Announcement generally remain with the contractor. The Government obtains a royalty-free license to use such technical data for Government purposes during the period commencing with contract award and ending five (5) years after submission of the last contract deliverable. Upon expiration of the five year restrictive license, the Government has unlimited rights to the SBIR data, unless the firm receives another contract under which the SBIR data rights may be asserted.

i. Final Report: The draft is due 30 days after completion of the Phase II technical effort. The first page of the final report will be a single-page project summary, identifying the purpose of the work, providing a brief description of the effort accomplished, and listing potential applications of the results. The summary may be published by DoD; therefore, it must not contain any proprietary or classified information. The remainder of the report should contain details of the project objectives met, work completed, results obtained, and estimates of technical feasibility.

ii. Status Reports: Status reports are due quarterly at a minimum.

iii. Small Business Online Success Stories: Success Story submissions are due at the end of the technical effort via the http://launchstories.org/ website. Refer to the Contract Data Requirements List (CDRL) in your contract for submission instructions.

b) Cost Reports: Required if a cost-type contract is awarded.

c) Additional Reporting: AF may require additional reporting or documentation including:

i. Software documentation and users' manuals;

ii. Engineering drawings;
iii. Operation and maintenance documentation;
iv. Safety hazard analysis when the project will result in partial or total development and delivery of hardware; and
v. Updates to the commercialization results.

(9) **Related Work:** Describe significant activities directly related to the proposed effort, including any previous programs conducted by the principal investigator, proposing firm, consultants, or others, and their application to the proposed project. Also list any reviewers providing comments regarding the offeror's knowledge of the state-of-the-art in the specific approach proposed.

(10) Commercialization Potential:

a) The DoD requires a commercialization plan be submitted with the Phase II proposal, specifically addressing the following questions:

i. What is the first planned product to incorporate the proposed technology?
ii. Who are the probable customers, and what is the estimated market size?
iii. How much money is needed to bring this technology to market and how will it be raised?
iv. Does your firm have the necessary marketing expertise and, if not, how will your firm compensate?
v. Who are the probable competitors, and what price/quality advantage is anticipated by your firm?

b) The commercialization strategy plan should briefly describe the commercialization potential for the anticipated results of the proposed project, as well as plans to exploit it. Commercial potential is evidenced by:

i. The existence of private sector or non-SBIR/STTR funding sources demonstrating commitment to Phase II efforts/results.
ii. The existence of Phase III follow-on commitments for the research subject.
iii. The presence of other indicators of commercial technology potential, including the firm's commercialization strategy.

c) If awarded a Phase II contract, the contractor is required to periodically update the commercialization results of the Phase II project at https://www.dodsbirsttr.mil/submissions//. These updates will be required at completion of the Phase II effort, and subsequently when the contractor submits a new SBIR/STTR proposal to DoD. Firms not submitting a new proposal to DoD will be requested to provide updates annually after completion of the Phase II.

(11) **Military Applications:** Briefly describe the existing/potential military requirement and the military potential of the SBIR/STTR Phase II results. Identify the DoD agency/organization most likely to benefit from the project. State if any DoD agency has expressed interest in, or commitment to, a non-SBIR, Federally funded Phase III effort. This section should involve not more than one to two (1-2) paragraphs. Include agency

point of contact names and telephone numbers.

(12) <u>Relationship with Future Research or Research and Development (R/R&D) Efforts</u>:

a) State the anticipated results of the proposed approach, specifically addressing plans for Phase III, if any.
b) Discuss the significance of the Phase II effort in providing a basis for the Phase III R/R&D effort, if planned.

(13) **<u>Key Personnel</u>:** In the technical volume, identify all key personnel involved in the project. Include information directly related to education, experience, and citizenship. A technical resume for the principal investigator, including publications, if any, must also be included. Concise technical resumes for subcontractors and consultants, if any, are also useful. You must identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For these individuals, in addition to technical resumes, please provide countries of origin, type of visas or work permits under which they are performing, and explanation of their anticipated level of involvement in the project.

Foreign Nationals (also known as Foreign Persons) means any person who is NOT:

a. a citizen or national of the United States; or
b. a lawful permanent resident; or
c. a protected individual as defined by 8 U.S.C. § 1324b

ALL offerors proposing to use foreign nationals MUST follow Section 5.4. c. (8) of the DoD Program Announcement and disclose this information regardless of whether the topic is subject to ITAR restrictions.

When the topic area is subject to export control, these individuals, if permitted to participate, are limited to work in the public domain. Further, tasks assigned must not be capable of assimilation into an understanding of the project's overall objectives. This prevents foreign citizens from acting in key positions, such as Principal Investigator, Senior Engineer, etc. Additional information may be requested during negotiations in order to verify foreign citizens' eligibility to perform on a contract awarded under this Announcement.

The following will apply to all projects with military or dual-use applications that develop beyond fundamental research (basic and applied research ordinarily published and shared broadly within the scientific community):

(1) The Contractor shall comply with all U. S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

(2) The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed on-site at any Government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies, including technical data or software.
(3) The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.
(4) The Contractor shall be responsible for ensuring that these provisions apply to its subcontractors.

(14) **Facilities/Equipment:** Describe instrumentation and physical facilities necessary and available to carry out the Phase II effort. Justify equipment to be purchased (detail in cost proposal). State whether proposed performance locations meet environmental laws and regulations of Federal, state, and local Governments for, but not limited to, airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(15) **Consultants/Subcontractors**: Private companies, consultants, or universities may be involved in the project. All should be described in detail and included in the cost proposal. **In accordance with the Small Business Administration (SBA) SBIR Policy Directive, a minimum of 50% of the R/R&D must be performed by the proposing firm, unless otherwise approved in writing by the Contracting Officer.** Signed copies of all consultant or subcontractor letters of intent must be attached to the proposal. These letters should briefly state the contribution or expertise being provided. Include a SOW and detailed cost proposal. Include information regarding consultant or subcontractor unique qualifications. Subcontract copies and supporting documents do not count against the Phase II page limit. Identify any subcontract/consultant foreign citizens per (13) above.

(16) **Prior, Current, or Pending Support of Similar Proposals or Awards:** WARNING: While it is permissible, with proper notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work for consideration under numerous Federal program Announcements, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. Any potential for this situation must be disclosed to the Announcement agency(ies) before award. If a proposal submitted in response to this Announcement is substantially the same as another proposal previously, currently, or in process of being funded by another Federal agency/DoD Component or the same DoD Component, the company must so indicate on the Cover Sheet and provide the following:

a) The name and address of the Federal agency(ies) or DoD Component(s) to which proposals were or will be submitted, or from which an awarded is expected or has been received;
b) The date of proposal submission or date of award;
c) The title of the proposal;
d) Name and title of the principal investigator for each proposal submitted or award received; and
e) Title, number, and date of Announcement(s) under which the proposal was or will be submitted, or under which an award is expected or has been received.

f) If award was received, provide the contract number.
g) Specify the applicable topics for each SBIR proposal submitted or award received.

NOTE: If this section does not apply, state in the proposal, "No prior, current, or pending support for proposed work."

(17) **Cost Proposal:** A detailed cost proposal must be submitted. Cost proposal information will be treated as proprietary. Proposed costs must be provided by both individual cost element and contractor fiscal year (FY) in sufficient detail to determine the basis for estimates, as well as the purpose, necessity, and reasonableness of each. This information will expedite award of the resulting contract if the proposal is selected for award. Generally, cost plus fixed fee (CPFF) contracts are appropriate for Phase II awards but a firm fixed price contract may also be appropriate. The Contracting Officer will determine contract type during negotiations. Phase II contracts may include profit (Firm Fixed price) or fee (cost type).

Cost proposal attachments do not count toward Phase II proposal page limitations. The cost proposal includes:

a) Direct Labor: Identify key personnel by labor category. Number of hours, actual hourly rates, labor overhead, and/or fringe benefits per contractor FY is also required.
b) Direct Materials: Costs for materials, parts, and supplies must be justified and supported. Provide an itemized list of types, quantities, prices, and, where appropriate, purpose. If computer or software purchases are planned, detailed information such as manufacturer, price quotes, proposed use, and support for the need will be required.
c) Other Direct Costs: This includes specialized services such as machining or milling, special test/analysis, and costs for temporary use/lease of specialized facilities/ equipment. Provide usage (hours) expected, rates, and sources, as well as brief discussion concerning the purpose and justification. Proposals including leased hardware must include an adequate lease versus purchase rationale. Special tooling/test equipment/material costs are acceptable but will be carefully reviewed to determine the need/appropriateness of the work proposed. The Contracting Officer must decide whether these purchases are advantageous to the Government and are directly related to the proposed effort. Title to property furnished by the Government will be vested with the AF unless determined to be more cost-effective for transfer to the contractor. The Government's intention is not to directly fund purchase of general purpose equipment.
d) Subcontracts: Subcontract costs must be supported with copies of the subcontract agreements. Agreement documents must adequately describe the work to be performed and basis for cost. The agreement document should include a SOW, assigned personnel, hours and rates, materials (if any), and proposed travel (if any). A letter from the subcontractor agreeing to perform a task or tasks at a fixed price is not considered sufficient. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-half of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer.

   IAW FAR 15.404-1, price analysis, including reasonableness, realism, and completeness, of the proposed subcontractor costs by the prime is required. If based on comparison with prior efforts, identify the basis upon which the prior prices were determined to be reasonable. If price analysis techniques are inadequate or the FAR requires submission of subcontractor cost or pricing data, provide a cost analysis IAW FAR 15.404-1(c). Cost analysis includes, but is not limited to, consideration of materials, labor, travel, other direct costs, and proposed profit rates.

e) Consultants: For each consultant, provide a separate agreement letter briefly stating the service to be provided, hours required, and hourly rate and include a short, concise resume.

f) Travel: Each Phase II effort, at a minimum, should include a kickoff or interim meeting. Travel costs must be justified as related to the needs of the effort. Include destinations, the number of trips, number of travelers per trip, airfare, per diem, lodging, ground transportation, etc. Information regarding per diem and lodging rates may be found in the Joint Travel Regulation (JTR), Volume 2, www.defensetravel.dod.mil.

g) Indirect Costs: Indicate the basis of the proposed rates, e.g., budgeted/actual rates per FY, etc. The proposal should identify the specific rates used and allocation bases to which they are applied. Do not propose composite rates; proposed rates and applications per FY throughout the anticipated performance period should be provided.

h) Cost Share: Cost sharing is permitted. However, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal. Please note that cost share contracts do not allow fees.

i) DD Form 2345: For proposals submitted under export-controlled topics (either International Traffic in Arms (ITAR) and Export Administration Regulations (EAR)), a copy of the certified DD Form 2345, Militarily Critical Technical Data Agreement, or evidence of application submission must be included. The form, instructions, and FAQs may be found at the United States/Canada Joint Certification Program website, http://www.dlis.dla.mil/jcp/. Approval of the DD Form 2345 will be verified if proposal is chosen for award.

18. **Feasibility Documentation –** Should be uploaded to Volume 5, Supporting Documents

a. Maximum page length for feasibility documentation is 25 pages. If you have references, include a reference list or works cited list as the last page of the feasibility documentation. This will count towards the page limit.

b. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). If technology in the feasibility documentation is subject to intellectual property (IP), the offeror must provide IP rights assertions. Provide a good faith representation that you either own or possess appropriate licensing rights to all other IP that will be utilized under your proposal. Additionally, proposers shall provide a short summary for each item asserted with less than unlimited rights that describes the nature of the restriction and the intended use of the intellectual property in the conduct of the proposed research. Please see section 11.5 of the DoD instructions for information regarding technical data rights.

c. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated and WILL be redacted.

V. METHOD OF SELECTION AND EVALUATION CRITERIA

A. Introduction: Phase II proposals are evaluated on a competitive basis by subject matter expert (SME) scientists, engineers, or other technical personnel. Throughout evaluation, selection, and award, confidential proposal and evaluation information will be protected to the greatest extent possible. Phase II proposals will be disqualified and will not be evaluated if the Phase I equivalency documentation does not establish feasibility and technical merit of the proposed technical approach.

B. Evaluation Criteria: Phase II proposals will be reviewed for overall merit based on following criteria in descending order of importance:

(1) Technical Merit – The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
(2) Potential for Commercial Application – The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.
(3) Qualifications of the Principal Investigator (and Team) – Qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also ability to commercialize the results.

Cost reasonableness and realism shall also be considered to the extent appropriate.

The primary basis for selecting proposals for award will be overall merit, importance to agency programs, and funds availability. Other factors considered during the selection process include appropriate demonstration of feasibility of the technology, equivalent to that resulting from Phase I type efforts; commitment for Phase III funding; possible duplication with other R/R&D; program balance; budget limitations; and potential, if successful, of leading to a product of continuing interest to DoD. Phase II evaluations may include on-site assessment of the offeror's research results to date, or of the Contractor's facility, by Government personnel. The reasonableness of proposed costs for the Phase II effort will be examined to determine proposals offering the best value to the Government.

NOTE: Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors; U. Group, Peerless Technologies, Engineering Services Network and/or Stealth Entry LLC. In addition, only Government employees and technical personnel from Federally Funded Research and Development Centers (FFRDCs) MITRE and Aerospace Corporations working under contract to provide technical support to AF Life Cycle Management Center and Space and Missiles Centers may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. If you have concerns about any of these contractors, you should contact the AF SBIR/STTR Contracting Officer, Kris Croake, kristina.croake@us.af.mil.

VI. CERTIFICATIONS

In addition to the standard Federal and DoD procurement certifications, the SBA SBIR/STTR Policy Directives require the collection of certain information from firms at the time of award and during the award life cycle. Each firm must provide this additional information at the time of the Phase II award, prior to receiving 50% of the total award amount, and prior to final payment.

VII. DEBRIEFINGS

In accordance with FAR 15.505, a debriefing may be requested in writing. Consistent with the DoD SBIR/STTR Announcements, the request must be received within 30 days after receipt of notification of non-selection. Written requests for debrief must be sent directly to the Contracting Officer named on your non-selection notification. Requests should include the company name and telephone number/email address for a company point of contact, as well as an alternate. Also include the topic number under which the proposal was submitted and the proposal number. Requests received more than 30 days after receipt of notification of non-selection will be fulfilled at the Contracting Officers' discretion. Unsuccessful offerors are entitled to no more than one debriefing per proposal. NOTE: FAR15.505(a) (2) states, at the offeror's request, debriefs may be delayed until after award. Under the AF SBIR/STTR Programs, debriefs are automated and standardized. Therefore, pre- and post-award debriefs are identical.

Attachment 1: SBIR/STTR Environment, Safety and Occupational Health (ESOH) Questionnaire

Company Name:

Title:

1. Will hazardous materials (as defined by Federal Standard 313D, Material Safety Data, Transportation Data and Disposal Data for Hazardous Material Furnished to Government Activities and 40 CFR Part 260 – 279) be used in the contract?

Yes ☐ No ☐

If the answer is "yes," list materials:

2. Will explosives or ammunition be used in research? (See definitions listed below before answering.)

Yes ☐ No ☐

Explosives and ammunition mean:

(a.) Liquid and solid propellants and explosives, pyrotechnics, incendiaries and smokes in the following:

i. Bulk:
ii. Ammunition;
iii. Rockets;
iv. Missiles;
v. Warheads;
vi. Devices; and
vii. Components of (1) through (6), except for wholly inert items.

(b.) This definition does not include the following, unless the contractor is using or incorporating these materials for initiation, propulsion, or detonation as an integral or component part of an explosive, an ammunition or explosive end item, or of a weapon system.

1. Inert components containing no explosives, propellants, or pyrotechnics;
2. Flammable liquids;
3. Acids;
4. Oxidizers;
5. Powdered metals; or
6. Other materials having fire or explosive characteristics.

If the answer is "yes," list items:

3. Will any hazardous processes be performed under the contract? Examples include operation of heavy equipment or power tools, operation of lasers or radio frequency radiation emitters, use of high voltage (greater than 600 volts) equipment, or use of equipment operating at high pressure (greater than 60 psig) or high temperature (greater than 50°C).

Yes ☐ No ☐

If the answer is "yes," list processes:

4. Will this research be completed on a U.S. Air Force installation?

Yes ☐ No ☐

If the answer is "yes," list facilities:

5. Will the contract require the purchase, storage use or delivery of any chemicals or hazardous material to USAF facilities?

Yes ☐ No ☐

If the answer is "yes," list chemicals or hazardous materials:

6. Will any hazardous chemical or waste be generated during the course of this research?

Yes ☐ No ☐

If the answer is "yes," specify the hazardous chemical or waste to be generated:

7. Will any Class I ozone depleting substances (ODSs) be required in this research?

A list of Class I ODSs is located at the following website: http://www.epa.gov/ozone/ods.html

Yes ☐ No ☐

If the answer is "yes," list substances:

8. Does this effort involve the purchase or use of any radioactive materials?

Yes ☐ No ☐

If the answer is "yes," specify the radioactive materials:

9. Will this effort involve any asbestos, radiation, or chemical generating/using components that will be delivered to USAF facilities?

Yes ☐ No ☐

If the answer is "yes," specify the components:

10. Are there any special atmospheric or water resource requirements?

Yes ☐ **No** ☐

If "yes" specify the requirements:

AIR FORCE DIRECT TO PHASE II SBIR 20.1 Topic Index

AF201-D001	Interactive Multi-media Instruction Decision Tool for Aircraft Maintenance
AF201-D002	Airborne Radio Sustainment Modernization
AF201-D003	Development of Efficient Thermal Spray Coupon Metallurgical Laboratory Processing
AF201-D004	Mission Design for the New Space Environment

AF201-D001 TITLE: Interactive Multi-media Instruction Decision Tool for Aircraft Maintenance

TECHNOLOGY AREA(S): Human Systems
RESEARCH & TECHNOLOGY AREA(S):
ADVANCED CAPABILITIES:
ACQUISITION & SUSTAINMENT AOR:
ACQUISITION PROGRAM: NPOESS - National Polar-Orbiting Operations Environmental Satellite System

OBJECTIVE: Develop a methodology and associated computer based tool to define the type of training delivery methods that are most effective and efficient to perform aircraft maintenance training.

DESCRIPTION: The USAF aircraft maintenance training community has identified a need for a tool to aid in the decision process for selecting the most appropriate training format for students to learn aircraft sustainment maintenance actions. Specific maintenance actions are derived from training requests from both training units and active aircraft maintenance units, which will have a varied set of constraints. Current practice is to utilize corporate knowledge, best practices, and maintenance training requesters' opinions, coupled with skilled maintainers (not educators or training specialists) to determine the appropriate training format. With the emergence of new technologies such as Virtual Reality, Augmented Reality, and Mixed Reality, the AF training community desires to evaluate the benefits they could bring to students' initial understanding, as well as knowledge retention. Part of that is also determining the most appropriate opportunities to insert the new technology into the current training curriculum. The ultimate objective is to identify the type of training delivery method that yields the most value.

PHASE I: USAF will only accept Direct to Phase II proposals.

PHASE II: Develop, demonstrate, and deliver a methodology and associated computer based tool to define the type of training delivery methods that are most effective and efficient to perform aircraft maintenance training, based on: learning objectives, student skill state, technology availability, resource/environment/programmatic/mission constraints, etc. The methodology shall incorporate the results of rigorous scientific and engineering research and analysis regarding education and training effectiveness. The methodology is expected to evaluate currently utilized training methods, to include, but not limited to, written, 2D/3D images, instructor presentation, computer based training (CBT), interactive CBT, hands-on instruction, etc. as well as state of the art instruction methods, to include, but not limited to, Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), environmental feedback, etc. The tool is to be utilized by USAF aircraft maintenance training content development teams who are trainers, not experts in the theory of education. Phase II deliverables will be a methodology to define the best suited training delivery method(s) and a computer based tool that follows the methodology that is to be used by training content developers.

PHASE III DUAL USE APPLICATIONS: Refine and mature the training delivery decision tool to be marketed to other defense and commercial customer who require the ability to determine which type of training delivery method is best for the learning objective(s) and constrains related to aircraft maintenance training.

REFERENCES:

1. Stacy, W., Walwanis, M. M., Wiggins, S. & Bolton, A. (2013, Nov). Layered Fidelity: An Approach to Characterizing Training Environments. Presentation at the 2013 Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC), Orlando, FL.

2. Department of Defense Handbook. (2001). Development of Interactive Multimedia Instruction (IMI) (Part 3 of 5 Parts). MIL-HDBK-29612-3A

KEYWORDS: training, education, virtual reality, augmented reality, mixed reality, learning objectives, immersive, interactive multi-media instruction, VR, AR, MR, IMI, XR, eXtended Reality, aircraft maintenance

AF201-D002 TITLE: Airborne Radio Sustainment Modernization

TECHNOLOGY AREA(S):
RESEARCH & TECHNOLOGY AREA(S):
ADVANCED CAPABILITIES:
ACQUISITION & SUSTAINMENT AOR:
ACQUISITION PROGRAM: N/A

OBJECTIVE: Develop an Airborne Modernized Software Defined Radio (SDR) that uses Sensor Open System Architecture (SOSA) and is condensed enough to fit in the footprint of an RT-1505A version of the AN/ARC-164

DESCRIPTION: Modern radios in industry are now software defined radios that use common Commercial Off the Shelf (COTS) interfaces to allow manufacturers a greater source of parts versus using custom designed architecture. The Open Architecture also allows portability of software applications from one radio to the next. Some of these military airborne radios also have very small footprint requirements that have to be met. However, many of the current commercial radios do not meet MIL-SPEC and aircraft requirements. An opportunity exists to take advantage of SOSA requirements and condense the hardware down to a footprint that can be used. The opportunity also exists to take this design and make the internals common to all airborne communications even though the chassis footprint differs from aircraft to aircraft and system to system.

Currently, the technology exists to place a radio transceiver on a circuit card that is a 3U height. The software allows the transceiver card to be used in multiple radio bandwidths. Small businesses like Spectranetix4 and other companies like Epiq Solutions5 already market similar type hardware. However, the hardware will not fit in the 5.75 inches wide, 4.875 inches high, and 8.62 inches deep footprint needed by the legacy radio. Many of the parts also do not meet the MIL-STD-4616, MIL-STD-8107, and MIL-HDBK-5168 requirements. The current legacy radios are almost 30 years old design and custom made from discrete electronics. The radios are not upgradable to meet the new and changing threats faced by the warfighter. Also since all the different radios are unique design, parts are not swappable between systems and each system requires its own tailored repair line. The proposed research would consider existing SOSA compliance and tailor it to meet the unique requirements of the radio but still meet the openness and interoperability mandated by SOSA. Also, due to the high cost of aircraft integration, the proposed design must be able to drop into the existing footprint without forcing any changes to the aircraft mounting or wiring.

Development of this replacement will reduce the overhead cost associated with the sustainment of the legacy radio systems. Currently the Air Force Supply Chain manages thousands of piece parts associated with the legacy radios. This design will drastically reduce the number of parts due to internal commonality between the different radios. It will also reduce the support footprint needed by the depot due to not having to track, manage, and repair unique parts. By expanding this design to the different radios the Air Force can maintain a common supply chain for the hardware where the only difference is the software that is loaded on the circuit cards.

FEASABILITY DOCUMENTATION: For this Direct to Phase II topic, the Air Force is expecting that the submittal firm substantiate a present ability to:

- Develop a proof of concept non-airworthy prototype that can meet the aforementioned dimensional requirements while maintaining SOSA standards for open architecture.
- Develop a prototype capable of operating in the 225.00 to 399.975 MHz range and do basic AM and FM voice while allowing future software changes to add extra modes in future phases.

PHASE II: Develop a prototype based on the proof of concept in phase I. The radio must be able to fit in the dimensional foot print while allowing the housing of the front control panel similar to the RT-1505. It must also be able to demonstrate the ability to accept aircraft power, and operate with the following conditions:

- Transmits with a power output of 10 Watts on an RF Wattmeter with a 50 Ohm load
- Consume no more than 35W in receive and 110W in transmit
- Operate from 225.00 to 399.975 MHz
- Allow 7,000+ channels
- Operate with AM and FM voice
- Tone
- Automatic direction finder (ADF)
- Receive voice/data modulated signals using communications security devices
- Have a guard channel
- Use HAVE QUICK II
- Be able to tune within 7.5 milliseconds.

The prototype will also need to include MIL-SPEC parts to the greatest extent possible for this phase as some MIL-SPEC part changes may alter the design. The display and lighting should also include night vision goggle compliant parts to the greatest extent possible as well. The hardware and software must be compliant with SOSA standards for open architecture.

PHASE III DUAL USE APPLICATIONS: A successful prototype could market as a design option for other radios and avionics facing similar end of life limitations. Phase III will also address any design challenges that have not been addressed to make the prototype fully airworthy. It will also allow the groundwork to develop additional operational modes not currently in use.

REFERENCES:

1. "Software Defined Radio", Wikipedia, https://en.wikipedia.org/wiki/Software-defined_radio
2. "Sensor Open System Architecture, SOSA Website, https://www.opengroup.org/sosa
3. "AN/ARC-164(V) Radio Sets", Columbia Electronics, http://www.columbiaelectronics.com/id195.htm#anarc_164__late_models_
4. "Spectranetix Payload Cards", Spectranetix, Inc., http://www.spectranetix.com/index.php/m-sys-products-2/a-comscan-2/m-payload-cards-2/m-sx430-2

KEYWORDS: radio, sustainable, airborne

TPOC-1: Troy Andrews
Phone: 478-926-0563
Email: troy.andrews@us.af.mil

AF201-D003 TITLE: Development of Efficient Thermal Spray Coupon Metallurgical Laboratory Processing

TECHNOLOGY AREA(S): Materials/Processes
RESEARCH & TECHNOLOGY AREA(S):
ADVANCED CAPABILITIES:
ACQUISITION & SUSTAINMENT AOR:
ACQUISITION PROGRAM: N/A

OBJECTIVE: Develop thermal spray coupon management, dispensing and process tracking system to reduce/eliminate mistakes, improve efficiency, eliminate unnecessary overtime for sample issuance, ensure compliance with coupon handling and tracking requirements.

DESCRIPTION: Mission critical components that are coated using thermal spray methods require process verification coupons to be coated simultaneously with the components. These coupons then undergo rigorous processing and inspection in the metallurgical laboratory to ascertain the coatings have achieved quality microstructure characteristics such as bond strength, porosity, unmelts, oxides, integrity, hardness, etc. There are many types of coupons used, depending on the component to be coated and the type of coating to be applied. The coupons must be serialized and carefully managed throughout the entire production coating process and the laboratory inspection process to ensure the coated component receives certification before being placed in service.

Time is often of the essence, and the coated components can be delayed for production release if the coupons are not processed expediently. Additionally, due to the many types of coupons, the many types of coatings and the many types of laboratory inspection steps/processes, mistakes can be made that result in unnecessary re-coats and component release delays. Most coupon operations are currently performed manually, requiring significant technician hours that could be better spent on more technical duties.
Development of a system is needed that will manage the thermal spray coupon inventory, provide automated coupon dispense with intelligent serialization at time of use (date, booth, operator, process, etc.) and provide a means of tracking the coupons throughout the entire process of coating application, sectioning, mounting, polishing and the various inspections/evaluations. The system needs to provide automated visibility of coupon status at any time to ensure delivery of high priority components are not delayed. Research is needed to determine the optimal system/process that would initially be used on currently operational thermal spray booths. The research would need to identify how this system could integrate with any existing thermal spray management processes and data. The research would also need to include identification of requirements to expand the use of the system by facilities within DOD. The above-mentioned data is not currently available but would be of great benefit in process tuning and continuous process improvement.

PHASE I: Proposal must provide:
A) Feasibility analysis of automated dispensing of the thermal spray coupons and intelligent serialization at point of use.
B) Analysis of tracking/scanning methodologies for the various metallurgical lab process steps and providing data that can be queried for various purposes.
C) Feasibility analysis to achieve authority to operate adhering to Risk Management Framework (RMF) requirements.
D) Feasibility analysis to integrate with any existing DOD thermal spray management processes and data.

FEASIBILITY DOCUMENTATION: Offerors interested in submitting a Direct to Phase II proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility described above has been met and to identify the potential commercial applications. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Read and follow all of the feasibility documentation portions of the Air Force 19.2 Instructions. The Air Force will not evaluate the offeror's related DP2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE II: Develop prototype concepts and methodologies for thermal spray coupon management, dispensing and process tracking through the entire coating application and metallurgical laboratory inspection processes, including integration with current thermal spray operations and processes. Demonstrate down selected concept and methodology with a prototype system. Develop and initiate plan to achieve authority to operate adhering to Risk Management Framework (RMF) requirements on a production system.

PHASE III DUAL USE APPLICATIONS: DUAL USE APPLICATIONS: This technology has application at all the DOD depot facilities engaged in thermal spray coatings for critical weapons system repair. Additionally, this technology would be a good tool for any commercial entity engaged in thermal spray coatings of components that require coupon verification prior to production release of the product.

REFERENCES:

1. Cooray, P. & Rupasinghe, T., 2015, A Real Time Production Tracking and a Decision Support System (PTDSS): A Case Study from an Apparel Company. 12th International Conference on Business Management (ICBM)

2. Kelepouris, T. & Baynham, T. & Mcfarlane, D., 2006, Track and Trace Case Studies Report.
3. Sobotoval, L. & Demec, P., 2015, Laser Marking of Metal Materials, Science Journal.

KEYWORDS: Thermal spray, metallurgical laboratory, track & trace, automated dispensing, Certification and Accreditation (C&A)

AF201-D004 TITLE: Mission Design for the New Space Environment

TECHNOLOGY AREA(S): Space Platforms
RESEARCH & TECHNOLOGY AREA(S):
ADVANCED CAPABILITIES:
ACQUISITION & SUSTAINMENT AOR:
ACQUISITION PROGRAM: N/A

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the AF SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

OBJECTIVE: Develop capability for rapid design of space missions that leverages new and evolving space services, commodity components, and emerging technologies. Establish and prove a rapid approach that involves specialist collaborators across multiple organizations.

DESCRIPTION: In the last several years, new developments in space access, small satellites and components, software and communications, combined with the investment of risk capital and other funding, have produced new capabilities for space services. These new services and the infrastructure that enables them have in turn created a fast-changing environment for further development. Mission planning now takes place in that dynamic context. The Air Force continues to deliver traditional capabilities but also has opportunities to do so more effectively and by wholly different approaches by exploiting and repurposing rapidly emerging space systems, services, components, and supporting infrastructure.

In previous generations, Air Force missions have been planned over extended time periods, assuming the availability of certain government assets, products and supporting services, with the government funding new developments that were required. Techniques for analyzing missions and performing trades were created and honed with each new application. Now, mission planners are presented with a fast-changing array of commercial services and unconventional mixes of commercially driven and government-driven capabilities including new technology and software-defined systems, commodity spacecraft components, small satellite buses, and launch and ground systems services. The environment is dynamic, choices are greater, and mission development, including rapid progression from concept to systems requirements to preliminary design, should adapt as well.

Given a set of needs and goals in a broad space-related area, the Air Force will benefit from a rapid capability to interpret needs and opportunities, structure candidate mission architectures, assess available and emerging services and technologies that may be relevant to solutions, and proceed systematically through trades to arrive at multiple feasible approaches. These in turn can be considered with respect to cost, schedule and risks, and the likelihood and degree of meeting goals. In most cases, the mission development capability will rapidly access and combine insight from multiple sources and companies.

Overlaps in different space-related domains have blurred the lines of simpler, focused mission development. Communications now involves GEO, MEO, and LEO over multiple wavelengths, with different antenna types and more use of relays. Satellites have greater on -board processing, increased potential for coordinated operation, more options for deployed subsystems and in-space changes. Launch services are lower cost, more frequent and agile, with emerging options for orbit insertions and transfers. Payloads are more programmable, adaptable and compact.

In addition, information management for space systems increasingly leverages software-defined systems and the cloud, from data management to scheduling and operations.

Mission design should keep pace with and help manage the complexity brought by these fast-evolving developments. It is envisioned this will involve model-based design processes, techniques and methodologies to develop conceptual designs that include expedient leveraging of the best new commercially-available and open source tools. A robust but flexible approach accessing knowledge across organizations will take appropriate advantage of software-driven automation and optimization.

PHASE I: Proposal must show, as appropriate to the proposed effort, technical feasibility or nascent capability of space mission design approach and techniques that are compatible with new modes of space development and operation. Proposal may provide example results from this new and enhanced mission design capability on a specific Air Force mission area. Demonstrate reduced time from concept to system requirements, flexible use of evolving architectures and services, and increased options for Air Force programs. Identify capability gaps that slow development, inadequately capture risks, or fail to explore and evaluate feasible but unconventional architectures.

FEASIBILITY DOCUMENTATION: Offerors submitting a Direct to Phase II proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility of the proposed development has been met, and to describe the potential commercial applications. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Read and follow all of the feasibility documentation portions of the Air Force 20.1 Instructions. The Air Force will not evaluate the offeror's related D2P2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE II: Develop and enhance the rapid space mission design capability, and demonstrate the utility in several Air Force need areas for missions that are at different stages of conceptual maturity, including where conceptual development has not yet begun. Provide intermediate products to be assessed by planning teams, summarizing information that captures sensitivity of mission-level outcomes, including schedule, cost and risk, to key architecture and implementation decisions. Carry at least one mission through to system design and development, working with other performers to rapidly assess mission-level impacts of spacecraft, payload, operations, data processing and other elements.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the technologies developed in Phase II for potential government and commercial applications. Government applications include rapid concept development and maturation for emerging military space missions. There are potential commercial applications to space system design, and evaluation and assessment of new business ventures.

REFERENCES:

1. Martin, Gary, (2016) NewSpace: The Emerging Commercial Space Industry, https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20160001188.pdf
2. Datta, Anusuya, (2017) The NewSpace Revolution: The emerging commercial space industry and new technologies, https://www.geospatialworld.net/article/emerging-commercial-space-industry-new-technologies/
3. Malaek, Seyed. (2018). A Generic Method for Sizing Satellites Conceptual Design and Rapid Sizing Based on "Design for Performance" Strategy. IEEE Aerospace and Electronic Systems Magazine

4. Jones, Melissa & Chase, James. (2008). Conceptual Design Methods and the Application of a Tradespace Modeling Tool for Deep Space Missions. IEEE Aerospace Conference Proceedings. 1 – 15

KEYWORDS: space mission design, concept development, New space, Concurrent Engineering Models, commercial space, mission planning, simulation

DEFENSE HEALTH AGENCY
20.1 Small Business Innovation Research (SBIR) Program
Direct to Phase II Proposal Submission Instructions

The Defense Health Agency (DHA) SBIR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

The 2020.1 DHA SBIR Direct to Phase II proposal submission instructions are intended to clarify the Department of Defense (DoD) instructions as they apply to DHA requirements. This Announcement is for Direct to Phase II proposals only. All Phase II proposals must be prepared and submitted through the DoD SBIR/STTR electronic submission site: https://www.dodsbirsttr.mil/submissions/. The offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of instructions. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

Specific questions pertaining to the DHA SBIR Program should be submitted to the DHA SBIR Program Management Office (PMO) at:

E-mail - usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@mail.mil
Phone - (301) 619-7296

1. DIRECT TO PHASE II

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows the Department of Defense to make an award to a small business concern under Phase II of the SBIR Program with respect to a project, without regard to whether the small business concern was provided an award under Phase I of an SBIR Program with respect to such project. DHA is conducting a "Direct to Phase II" implementation of this authority for this 2019.3 SBIR Announcement and does not guarantee Direct to Phase II opportunities will be offered in future Announcements. Each eligible topic requires documentation to determine that Phase I feasibility described in the Phase I section of the topic has been met.

DHA Direct to Phase II Proposals are different than traditional DHA SBIR Phase I proposals. The chart below explains some of these differences.

	STANDARD DHA SBIR PROCESS	DHA D2P2 PROCESS
PHASE 1 TYPICAL FUNDING LEVEL	$250,000	None
PHASE 1 TECHNICAL *POP DURATION	6 months	None
PHASE 2 TYPICAL FUNDING LEVEL	$1,100,000	$1,100,000
PHASE 2 TECHNICAL *POP DURATION	24 months	24 months

*POP= Period of Performance

2. INTRODUCTION

Direct to Phase II proposals must follow the steps outlined below:

1. Offerors must create a Proposal Cover Sheet (Volume 1) using the DoD Proposal submission system. The Cover Sheet must include a brief technical abstract of no more than 200 words that describes the proposed R&D project with a discussion of anticipated benefits and potential commercial applications. **Do not include proprietary or classified information in the Proposal Cover Sheet**. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits may be publicly released on the Internet.

2. Offerors must submit a Technical Volume (Volume 2) using the DHA SBIR Direct to Phase II proposal instructions below.*

* NOTE: Offerors must provide documentation showing they have completed research and development to establish Phase I feasibility outlined in the topic description. The DHA will not evaluate the offeror's related Phase II proposal if it determines that the offeror has failed to demonstrate that technical merit and feasibility has been established or the offeror has failed to demonstrate that work submitted in the feasibility documentation was substantially performed by the offeror and/or the Principal Investigator (PI). Refer to the Phase I description (within the topic) to review the minimum requirements for feasibility documentation.

3. Offerors must submit a Cost Volume (Volume 3) using the on-line cost volume form on the DoD Submission Web site.

3. PROPOSAL SUBMISSION

The complete proposal, i.e., DoD Proposal Cover Sheet, technical volume, cost volume, and Company Commercialization Report, must be submitted electronically at https://www.dodsbirsttr.mil/submissions/. Ensure your complete technical volume and additional cost volume information is included in this sole submission. The preferred submission format is Portable Document Format (.pdf).

Complete proposals must include all of the following:
a. DoD Proposal Cover Sheet (Volume 1)
b. Technical Volume (Volume 2):
Part 1: Phase I Justification (20 Pages Maximum)
Part 2: Phase II Technical Proposal (40 Pages Maximum)
c. Cost Volume (Volume 3)

Please note the DHA SBIR Program will not be accepting Volume Five (Supporting Documents).

Phase II proposals require a comprehensive, detailed submission of the proposed effort. DHA SBIR Direct to Phase II periods of performance are 24 months. DHA SBIR Direct to Phase II efforts are awarded up to a maximum value of $1,100,000 per contract award. Commercial and military potential of the technology under development is extremely important. Proposals emphasizing dual-use applications and commercial exploitation of resulting technologies are sought. For general inquiries or problems with proposal electronic submission, contact the DoD SBIR/STTR Help Desk at (1-703-214-1333) or Help Desk email at DoDSBIRSupport@reisystems.com (9:00 am to 5:00 pm ET).

4. Direct to Phase II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

PROPOSAL FORMAT (60 pages maximum)

A. **Cover Sheet**. As instructed on the DoD SBIR proposal submission website, prepare a Proposal Cover Sheet, include a brief description of the problem or opportunity, objectives, effort and anticipated results. Expected benefits and Government or private sector applications of the proposed research should also be summarized in the space provided. The Project Summary of selected proposals will be submitted for publication with unlimited distribution. Therefore, the summary should not contain classified or proprietary information.

B. **Phase I Justification (20 Pages Maximum)**. Offerors are required to provide information demonstrating that the scientific and technical merit and feasibility has been established as outlined in the topic description.

C. **Phase II Technical Objectives and Approach (40 Pages Maximum).** List the specific technical objectives of the Phase II research and describe the technical approach in detail to be used to meet these objectives.

D. **Phase II Work Plan.** Provide an explicit, detailed description of the Phase II approach. The plan should indicate what is planned, how and where the work will be carried out, a schedule of major events, and the final product to be developed. Phase II is the principal research and development effort and is expected to produce a well-defined deliverable product or process.

E. **Related Work.** Describe significant activities directly related to the proposed effort, including those conducted by the Principal Investigator, the proposing firm, consultants, or others. Report how the activities interface with the proposed project and discuss any planned coordination with outside sources. The proposers' awareness of the state-of-the-art in the technology and associated science must be demonstrated.

F. **Relationship with Future Research or Research and Development**. State the anticipated results of the proposed approach if the project is successful. Discuss the significance of the Phase II effort in providing a foundation for a Phase III research or research and development effort.

G. **Technology Transition and Commercialization Strategy.** Describe your company's strategy for converting the proposed SBIR research, resulting from your proposed Phase II contract, into a product or non-R&D service with widespread commercial use -- including private sector and/or military markets. Note that the commercialization strategy is separate from the Commercialization Report described in Section 4.L below. The strategy addresses how you propose to commercialize this research, while the Company Commercialization Report covers what you have done to commercialize the results of past Phase II awards. Historically, a well-conceived commercialization strategy is an excellent indicator of ultimate Phase III success. The commercialization strategy must address the following questions:

1. What is the first product that this technology will go into?
2. Who will be your customers, and what is your estimate of the market size?
3. How much money will you need to bring the technology to market, and how will you raise that money?
4. Does your company contain marketing expertise and, if not, how do you intend to bring that expertise into the company?
5. Who are your competitors, and what is your price and/or quality advantage over your competitors?

H. **Key Personnel**. Identify key personnel, including the Principal Investigator, who will be involved in the Phase II effort. List directly related education and experience and relevant publications (if any) of key personnel. A concise resume of the Principal Investigator(s) must be included.

I. **Facilities/Equipment**. Describe available instrumentation and physical facilities necessary to carry out the Phase II effort. Justify items of equipment to be purchased (as detailed in the cost proposal) here, including Government Furnished Equipment (GFE). All requirements for government furnished equipment or other assets, as well as associated costs, must be determined and agreed to during Phase II contract negotiations. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name) and local governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

J. **Consultants.** Involvement of university, academic institution, or other consultants in the project may be appropriate. If such involvement is intended, it should be described in detail and identified in the Cost Volume.

K. **Cost Volume** (**$1,100,000 Maximum**). A detailed, Phase II Cost Volume must be submitted online and in the proper format shown in the Cost Breakdown Guidance in Section 5.4 d of the DoD SBIR Broad Agency Announcement (BAA). Some items in the cost volume template may not apply to the proposed project. If such is the case, there is no need to provide information for each and every item. Provide enough information to allow the DHA evaluators to assess the proposer's plans to use the requested funds if the contract is awarded. Phase II proposers should provide cost data based upon a contract award date six months after submission of the Phase II proposal. Phase II contracts are awarded for a two year development and prototype production. Indicate funding requirements for "Year 1" and "Year 2" in the cost volume.

1. List all key personnel by name as well as number of hours dedicated to the project as direct labor.
2. Special Tooling, Test Equipment, and Materials Costs:
a. Special tooling, test equipment, and materials costs may be included under Phase II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed; and
b. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and should be related directly to the specific effort.
3. Cost for travel funds must be justified and related to the needs of the project. Cost-sharing is permitted; however, cost-sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

5. <u>METHOD OF SELECTION AND EVALUATION CRITERIA</u>

A. **Evaluation Criteria**. All proposals will be reviewed for overall merit based on the evaluation criteria published in the DoD SBIR Program BAA:

1. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
2. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development, but also the

ability to commercialize the results.
3. The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

6. CONTRACTUAL CONSIDERATIONS

A. **Awards**. The number of Direct to Phase II awards will depend upon the quality the Phase II proposals and the availability of funds. Each Phase II proposal selected for award will be funded under a negotiated contract to be signed by both parties before work begins. Phase II awards will be made to Small Businesses based on results of the scientific, technical, and commercial merit of the Phase II proposal.

B. **Reports.** For incrementally funded Phase II projects an interim, midterm written report may be required (at the discretion of the awarding agency).

C. **Payment Schedule**. Per DoD SBIR Program BAA.

D. **Markings of Proprietary Information**. Per DoD SBIR Program BAA, section 5.3. DHA does not accept classified proposals.

E. **Copyrights, Patents and Technical Data Rights**. Per DoD SBIR Program BAA.

F. **Joint Ventures or Limited Partnerships**. Per DoD SBIR Program BAA.

G. **Contractor Commitments**. The information in the DoD SBIR Program BAA is applicable to the types of provisions that may be included in a Phase II contract.

7. TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DHA SBIR Program does not participate in the Technical and Business Assistance (formally the Discretionary Technical Assistance Program). Contractors should not submit proposals that include Technical and Business Assistance.

The DHA SBIR Program has a Technical Assistance Advocate (TAA) who provides technical and commercialization assistance to small businesses that have Phase I and Phase II projects.

8. FOR RESEARCH CONTAINING ANIMAL USE

A. All research involving animals must be reviewed for compliance with Federal and Department of Defense (DoD) regulatory requirements and approved by the United States Army Medical Research and Development Command (USAMRDC) Animal Care and Use Review Office (ACURO) prior to initiation. All amendments to ongoing protocols must also be approved by ACURO prior to initiation. Approval by the local institutional animal care and use committee (IACUC) is required before ACURO review. Include the institutional protocol, documentation of IACUC approval, a completed ACURO appendix for research involving animals (available from ACURO's web page https://mrdc.amedd.army.mil/index.cfm/collaborate/research_protections/acuro/animal_appendix), and the research site's most recent USDA inspection report.

Please submit documents or questions to the electronic mailbox at USArmy.Detrick.MEDCOM-USAMRMC.Other.ACURO@mail.mil.

9. FOR RESEARCH CONTAINING HUMAN USE

A. All research involving humans, human data, human specimens, or cadavers must be reviewed for compliance with Federal and Department of Defense (DoD) human subjects protection requirements and approved by the United States Army Medical Research and Development Command (USAMRDC) Office of Research Protections (ORP) before the research begins. Submission forms and instructions are provided here:
https://mrdc.amedd.army.mil/index.cfm/collaborate/research_protections/hrpo.

Please submit protocol documents to the electronic mailbox at USArmy.Detrick.MEDCOM-USAMRMC.Other.HRPO@mail.mil.

10. REPORTING OF PHASE III COMMERCIALIZATION EFFORTS

A. Please send any corresponding Phase III documents in PDF format to:
usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@mail.mil

B. Reportable activities include: sales revenue from new products and non-R&D services resulting from the Phase II project; additional investment from sources other than the Federal SBIR program in activities that further the development and/or the commercialization of the Phase II technology; the portion of additional investment representing clear and verifiable investment in the future commercialization of the technology (i.e. "hard investment"); whether the Phase II technology has been used in a fielded DoD system or acquisition program and, if so, which system or program; the number of patents resulting from the contractor's participation in the SBIR/STTR program; growth in number of firm employees, and; whether the firm completed an initial public offering (IPO) of stock resulting in part from the Phase II project.

DHA SBIR Direct to Phase II 20.1 Topic Index

DHA SBIR Direct to Phase II 20.1 Topic Descriptions

DHA201-D001 TITLE: Field-Expedient, Antimicrobial/Anti-Biofilm Hydrogel or Hydrogel-like Wound Dressing Designed for Large Burn Wounds

TECHNOLOGY AREA(S): Biomedical

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition- USAMRDC

OBJECTIVE: Develop a field-expedient, antimicrobial, hydration-providing wound dressing for acute care of large burn wounds.

DESCRIPTION: In future battlespace scenarios, mission-impactful increases in the numbers of burned casualties and in burn wound severity in terms of burn depth and size may be anticipated compared to recent conflicts. The projected operational paradigm also suggests that casualty evacuation may be delayed in the future fight, creating conditions in which burn injury treatments to save lives, hasten return to combat effectiveness, and improve functional recovery must be provided out of hospital for a period of days or longer, under degraded circumstances in the absence of surgical capability (i.e., prolonged field care). This prolonged care context will preclude the current standard of care for burn injuries, defined as evacuation from Theater to the San Antonio Military Medical Center Burn Center for definitive treatment. Currently only minimal burn wound management tools are available in the prehospital environment, consisting primarily of silver-containing wound dressings to prevent/minimize infection until evacuation to surgical care. There remains in the marketplace a lack of proven, clinically effective, acute burn wound treatment technologies, for example, to not only reduce infection but also promote healing of severe burn injuries. Furthermore, the prevalence of known and emerging weapon systems capable of thermal, electrical, and novel mechanisms of burn injury underscores a need for applicability of advanced acute burn care tools to mass casualty situations, potentially in dense urban environments, where the care capability and capacity of available medical providers may be rapidly overwhelmed. These circumstances underscore a critical necessity for the development of novel, advanced, effective, easy to use therapies for acute management of severe burns under austere, prolonged prehospital care to save lives, preserve combat readiness in the operational environment, and optimize long-term recovery and functional outcomes for burned Service members.

PHASE I: Advanced, innovative, topical solutions (e.g., dressings) for acute stabilization of large-sized, deep partial-thickness and full-thickness burn wounds are sought. Prevention of fluid loss, antimicrobial activity (to include anti-biofilm activity), and acceleration of wound healing are important qualities for the product to be developed. The candidate technology will demonstrate properties suggesting ease of use of the ultimate product by lower skilled responders under austere, prehospital conditions. Severe burns are defined as deep partial thickness and full thickness burn injuries. The technology developed will eventually be required to be incorporated into a therapeutic product that is highly mobile with low logistic burden (weight, power, cube) for field use under prolonged care. The minimum end goal of Phase I is readiness of an innovative, novel, candidate technology for acute care of severe burn for proof-of-concept studies in an established, combat-relevant animal model of severe burn.

PHASE II: Using the novel burn wound healing material developed in Phase I, the Offerer must design and engineer the candidate material /dressing formulation and demonstrate feasibility of use in austere environments by unskilled individuals for acceleration of large size (>15% total body surface area), deep partial thickness or full thickness burn wound healing in the absence of grafting. Initial prototypes and proof of principle of the material’s ability to control gram-negative and/or gram-positive infections using standard microbiological tests must be demonstrated in a time frame of use relevant to prolonged field care conditions.

The Offeror must conduct a proof-of-concept evaluation of the technology compared to standard of care silver-containing dressings available in the marketplace in appropriate combat-relevant, animal model(s) of large-sized, deep-partial thickness or full-thickness burn wound. Efficacy in preventing/managing infection and potentiating healing in vivo is a priority.

Topical treatments which are thin, conformable, breathable, non-toxic (safe), and bio-absorbable are sought. The ultimate product should also be self-administrable in the field, functional immediately upon application, provide a barrier to fluid loss, prevent or reduce infection, and potentially reduce blood loss. In addition, the product should be easily removed (i.e., dressing changes) without causing damage to the wound bed or not require active removal (i.e., left in place as self-shed or biodegradable).

Expected users of the technology are medical providers (including those who are not burn care specialists), non-providers (i.e., medics), and untrained personnel (i.e., “buddy care”) in austere operational environments. Field-expediency is an important characteristic of the desired technological solution. Field-expediency standards for the expected use profile of the developed technology require that the candidate solution must be readily applicable in dirty, harsh, resource limited, prehospital conditions for up to 72 hours of prolonged care prior to surgical intervention, as well as durable during storage for long periods of time and during use. Reasonable cost is also key.

Other required Phase II deliverables include: biocompatibility, cytotoxicity and immunogenicity analysis, and the demonstration of acceleration of burn wound healing over standard of care in both uninfected and infected wounds. During Phase II product safety/toxicity and stability using FDA standardized models performed under appropriate Good Laboratory Practice (GLP) conditions must be demonstrated. A detailed description of any additional studies, strategy for clinical studies, and transition pathway of the novel product into clinical practice must be addressed. Development and discussion of a plan for the potential regulatory pathway for the material for ACURO and HRPO and approval is required.

Additional objectives, which are desirable but not required, are that the technology demonstrates eschar-stabilizing, anti-inflammatory, and local pain analgesic properties. Efficacy in preventing/treating acute infection and accelerating healing of other traumatic soft tissue injuries in addition to severe burn wounds would be advantageous, while effectiveness specifically in acute management of large-size, severe burn injuries is paramount and required.

PHASE III DUAL USE APPLICATIONS: Phase III efforts should include focus on technology transition, preferably commercialization of SBIR research and development. The product developed is intended to be suitable for use and potential procurement by all of the Services for primary use in the field/prehospital environment, including austere, prolonged care scenarios. Realization of a dual-use technology applicable to both the military and civilian use is preferred. Therefore, the successful transition path of the technology is expected to include close engagement with military medical acquisition program managers (USAMMDA) during product commercialization to ensure appropriate product applicability for military field deployment. The minimum goal of Phase III is to finalize all pre-clinical testing and validation of a material for treatment of large, deep-partial thickness and/or full thickness burn wounds that can receive regulatory approval. In this phase the Offeror, in consultation with the FDA, may conduct a small, pilot, large animal validation study to establish safety/toxicity in an appropriate Good Laboratory Practice (GLP) model relevant to combat burn, and demonstrate appropriate product stability. Efforts leading to FDA approval require execution of Phase II plans on regulatory pathway, including identifying relevant patient population for clinical testing to evaluate safety and efficacy and GMP manufacturing of sufficient materials for evaluation. The end state of Phase III consisting of preclinical research is completion of appropriate studies required to receive FDA approval for the conduct of human clinical trials. Alternatively, dependent on the end state of Phase II of the program, the most desirable Phase III effort would consist of human clinical trials designed to demonstrate a product with the appropriate indications for treatment of large, deep-partial thickness and/or full thickness burns under prolonged care in austere environments. Human trials must demonstrate safety and efficacy of the product with the described desirable characteristics to promote burn wound healing and provide infection control. Demonstration that the novel technology yields improved results over standard of care for the parameters described in the “OBJECTIVE” and “DESCRIPTION” sections above is the ultimate goal of this SBIR program announcement. Phase III studies designed as human comparative effectiveness trials with competitive technologies under conditions relevant to the prolonged care combat environment are also sought.

REFERENCES:
1. TRADOC Pamphlet 525-3-1, The U.S. Army in Multi-Doman Operations; 6 DEC 2018; https://www.tradoc.army.mil/Portals/14/Documents/MDO/TP525-3-1_30Nov2018.pdf

2. JTS Clinical Practice Guideline: Burn Care (CPG ID: 12); 11 MAY 2016; https://jts.amedd.army.mil/assets/docs/cpgs/JTS_Clinical_Practice_Guidelines_(CPGs)/Burn_Care_11_May_2016_ID12.pdf

KEYWORDS: Burn, Hydrogel, Antimicrobial, Anti-inflammatory, Healing, Topical

DHA201-D002 TITLE: Optimize Performance and Mitigate Falls in Warfighters with Lower Limb Trauma and/or Loss

TECHNOLOGY AREA(S): Biomedical

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition- USAMRDC

OBJECTIVE: Develop and demonstrate a technology that can be easily implemented in a clinical setting to provide advanced fall-mitigation training and accelerate recovery to the highest possible levels of performance for Warfighters with lower limb trauma and/or loss.

DESCRIPTION: Even after participating in advanced rehabilitation and receiving state-of-the-art prosthetic and orthotic devices, Warfighters with lower limb trauma and/or loss are still at risk for falls. Warfighters with lower limb trauma and/or loss are often young and capable of high performance at the time of their injuries, and may be at increased risk of injury causing falls following rehabilitation due to their continued active lifestyle, sometimes including remaining on active duty and deployment [1].

Previous research on fall mitigation training has demonstrated success. However this research is often conducted on cost prohibitive systems requiring significant space and operator training [2-3]. These systems are not feasible for use in a clinical setting. A solution is sought that is clinically accessible, and easy to use for both clinicians and patients. As a use-case example, a regimen for the technology could be prescribed by a physical therapist based on individual patient needs and goals, executed by a physical therapy assistant or technician, and completed by the patient over the course of their treatment.

PHASE I: Conceptualize and design an innovative solution for a technology that optimizes the performance and mitigates the risk of falls in Warfighters with lower limb trauma and loss. The technology must be feasible for use in clinical settings and easy to use by clinical staff. The required Phase I deliverables will include: 1) a research design for engineering the device and 2) a preliminary prototype with limited bench-top testing to demonstrate proof-of-concept evidence, and 3) evidence that the technology, used in a clinical setting by a trained clinician, will result in the mitigation of falls and improved performance in those with lower limb trauma and/or loss. Other supportive data may also be provided during this 6-month Phase I effort.

PHASE II: Design, develop, test, finalize and validate the practical implementation of the prototype system that implements the Phase I methodology towards a technology that can be easily implemented in a clinical setting to provide advanced fall-mitigation training and accelerate recovery to the highest possible levels of performance for Warfighters with lower limb trauma and/or loss, over this Phase II effort. A plan for meeting FDA requirements toward regulatory approval is required. Plans for translation in rehabilitation clinics including end-user requirements, training and use guidelines/documentation, and operating standards are required. The testing and practical implementation of the prototype technology should be relevant to Warfighters who have experienced lower limb trauma and/or loss, and are undergoing rehabilitation to meet their goals. These patients are often young and active and may have the desire to remain on active duty. Roughly 15-20% of Warfighters with major limb trauma from the most recent conflicts remained on active duty following discharge from rehabilitation. Some re-deployed to theater. Others who separated from the military have engaged in high demand occupations (police, fire fighter, first responder, etc.). The developed technology should be implemented as part of the rehabilitation process and should result in outcomes related to mitigation of falls and increased performance or participation in injured Warfighters with lower limb trauma and/or loss.

PHASE III DUAL USE APPLICATIONS: Work with commercial partners, military subject matter experts (e.g. a military treatment facility that treats patients with limb trauma and/or loss), and/or the civilian marketplace to move towards a final commercial product. Ensure that the final product can be incorporated into clinical practice including ease of use, appropriate coding/billing, cost/benefit, and training, education, socialization, and outreach. While the technology should be focused on optimizing performance and mitigating falls in Warfighters with limb trauma and loss, there are other military, veteran and civilian populations that may benefit. The military's highest priority is readiness. Musculoskeletal injuries are one of the greatest factors limiting readiness. There is potential that this technology could extend to Warfighters with lower limb musculoskeletal injuries (e.g. chronic ankle instability, knee/ankle tendon or ligament injury, etc.) to accelerate recovery and return to duty. Additionally, it is envisioned that this technology could be applied within VA and civilian rehabilitation facilities to mitigate falls and improve performance, participation and quality of life for patients with stability and mobility issues following injury/illness.

REFERENCES:
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2. Grabiner, M. D., Bareither, M. L., Gatts, S., Marone, J., & Troy, K. L. (2012). Task-specific training reduces trip-related fall risk in women.

3. Sheehan, R. C., Rábago, C. A., Rylander, J. H., Dingwell, J. B., & Wilken, J. M. (2016). Use of perturbation-based gait training in a virtual environment to address mediolateral instability in an individual with unilateral transfemoral amputation. Physical therapy, 96(12), 1896-1904.

KEYWORDS: Stability, Limb Loss, Limb Trauma, Performance, Falls, Rehabilitation

DEFENSE HEALTH AGENCY
20.1 Small Business Innovation Research (SBIR) Program
Proposal Submission Instructions

The Defense Health Agency (DHA) SBIR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

Broad Agency Announcement (BAA), topic, and general questions regarding the SBIR Program should be addressed according to the DoD SBIR Program BAA. For technical questions about a topic during the pre-release period, contact the Topic Author(s) listed for each topic in the BAA. To obtain answers to technical questions during the formal BAA period, visit https://sbir.defensebusiness.org/topics/.

Specific questions pertaining to the DHA SBIR Program should be submitted to the DHA SBIR Program Management Office (PMO) at:

E-mail - usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@mail.mil
Phone - (301) 619-7296

PHASE I PROPOSAL SUBMISSION

Follow the instructions in the DoD SBIR Program BAA for program requirements and online proposal submission instructions.

DHA SBIR Phase I Proposals have three Volumes: Proposal Cover Sheets, Technical Volume and Cost Volume [Note: the Company Commercialization Report will NOT be available or required for the 20.1 BAA]. **Please note that the DHA SBIR will not be accepting a Volume Five (Supporting Documents) as noted at the DoD SBIR website.** The Technical Volume has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Do not duplicate the electronically ge
nerated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically generated Cover Sheets and Cost Volume are excluded from the 20-page limit. Technical Volumes that exceed the 20-page limit will be reviewed only to the last word on the 20th page. Information beyond the 20th page will not be reviewed or considered in evaluating the offeror’s proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

Companies submitting a Phase I proposal under this BAA must complete the Cost Volume using the on-line form, within a total cost not to exceed $250,000 over a period of up to six months.

The DHA SBIR Program will evaluate and select Phase I proposals using the evaluation criteria in Section 6.0 of the DoD SBIR Program BAA. Due to limited funding, the DHA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Proposals not conforming to the terms of this BAA, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

RESEARCH INVOLVING ANIMAL OR HUMAN SUBJECTS

The DHA SBIR Program discourages offerors from proposing to conduct human subject or animal research during Phase I due to the significant lead time required to prepare regulatory documentation and secure approval, which will significantly delay the performance of the Phase I award.

The offeror is expressly forbidden to use or subcontract for the use of laboratory animals in any manner without the express written approval of the US Army Medical Research and Development Command's (USAMRDC) Animal Care and Use Review Office (ACURO). Written authorization to begin research under the applicable protocol(s) proposed for this award will be issued in the form of an approval letter from the USAMRDC ACURO to the recipient. Furthermore, modifications to already approved protocols require approval by ACURO prior to implementation.

Research under this award involving the use of human subjects, to include the use of human anatomical substances or human data, shall not begin until the USAMRDC's Office of Research Protections (ORP) provides authorization that the research protocol may proceed. Written approval to begin research protocol will be issued from the USAMRDC ORP, under separate notification to the recipient. Written approval from the USAMRDC ORP is also required for any sub-recipient that will use funds from this award to conduct research involving human subjects.

Research involving human subjects shall be conducted in accordance with the protocol submitted to and approved by the USAMRDC ORP. Non-compliance with any provision may result in withholding of funds and or termination of the award.

PHASE II PROPOSAL SUBMISSION

Phase II is the demonstration of the technology found feasible in Phase I. All DHA SBIR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the DHA SBIR PMO. Submission instructions are typically sent toward the end of month five of the phase I contract. The awardees will receive a Phase II window notification via email with details on when, how and where to submit their Phase II proposal.

Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DoD SBIR/STTR Help Desk at (1-703-214-1333) or Help Desk email at DoDSBIRSupport@reisystems.com (9:00 am to 5:00 pm ET).

The DHA SBIR Program will evaluate and select Phase II proposals using the evaluation criteria in Section 8.0 of the DoD SBIR Program BAA. Due to limited funding, the DHA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. DHA Topic DHA201-002 is a candidate for a potential Jumbo award under the Phase II award process. Awardees under this topic may be awarded up to $3,000,000.

Small businesses submitting a proposal are required to develop and submit a Commercialization Strategy (please refer to DoD Instructions, section 7.4) describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal. This plan should be included in the Technical Volume.

The Cost Volume must contain a budget for the entire 24-month Phase II period not to exceed the maximum dollar amount of $1,100,000. These costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site), and may be presented side-by-side on a single Cost Volume Sheet.

DHA SBIR Phase II Proposals have four Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 40-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

Technical Volumes that exceed the 40-page limit will be reviewed only to the last word on the 40^{th} page. Information beyond the 40^{th} page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 40 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

PHASE II ENHANCEMENTS

The DHA SBIR Program has a Phase II Enhancement Program which provides matching SBIR funds to expand an existing Phase II contract that attracts investment funds from a DoD Acquisition Program, a non-SBIR government program or eligible private sector investments. Phase II Enhancements allow for an existing DHA SBIR Phase II contract to be extended for up to one year per Phase II Enhancement application, and perform additional research and development. Phase II Enhancement matching funds will be provided on a dollar-for-dollar basis up to a maximum $550,000 of SBIR funds. All Phase II Enhancement awards are subject to acceptance, review, and selection of candidate projects, are subject to availability of funding, and successful negotiation and award of a Phase II Enhancement contract modification.

TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DHA SBIR Program does not participate in the Technical and Business Assistance (formally the Discretionary Technical Assistance Program). Contractors should not submit proposals that include Technical and Business Assistance.

The DHA SBIR Program has a Technical Assistance Advocate (TAA) who provides technical and commercialization assistance to small businesses that have Phase I and Phase II projects.

DHA SBIR 20.1 Topic Index

DHA SBIR 20.1 Topic Descriptions

DHA201-001 TITLE: Diagnostic Platform for Rapid Identification of Pathogens in Infected Wounds that is Useable in a Battlefield Environment

TECHNOLOGY AREA(S): Biomedical

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition- USAMRDC

OBJECTIVE: Develop state-of-the-art diagnostic technology for rapid identification of pathogens in infected wounds that can be used to triage injured warfighters and guide clinical decisions in a modern battlefield environment.

DESCRIPTION: U.S. military service members who are medically evacuated from theatre due to combat-related injuries have sustained high impact insults such as explosions, gunshot wounds and motor vehicle accidents, leading to significant skin and soft tissue injuries that may be frequently contaminated. A large proportion of these service members are at increased risk for infectious complications of their traumatic injuries, and the most common infections involve skin and soft tissue, wound infections, and osteomyelitis and sepsis if not treated in a timely manner. Acinetobacter baumannii has been identified as one of the most frequently associated organisms with skin and soft tissue infections among wounded warriors, occurring in 35% of wound infections. Within this 35%, up to 90% of the culture isolates were assessed to be antimicrobial resistant (AMR) [1]. Community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) is a well-recognized cause of skin and soft tissue infections (SSTI) in US military hospitals with a reported prevalence of 68% to 70% in selected military hospital emergency rooms [2]. High rates of MRSA skin and soft tissue infections have been observed among soldiers in training [3,4]. In addition to skin and soft tissue infection, MRSA is the most frequently isolated organism late in infection in traumatically injured service members [5]. Late infection in this population often results in limb salvaging amputation [6]. Pseudomonas aeruginosa and Klebsiella pneumoniae are responsible for significant morbidity and mortality among both civilian and military populations, often colonizing mucosal surfaces, wounds, and foreign devices such as catheters and endotracheal tubes with biofilms that are highly resistant to antibiotic penetration and clearance by the immune system. In civilian and veteran populations these same types of infections frequently occur in individuals that have skin and soft tissue and prosthetic joint infections [4,5]. In a patient infected with multi-drug resistant organisms, the treatment choices often become limited due to waning approvals of new antibiotics [6]. Frequently, these patients are hospitalized for prolonged periods of time and subsequently experience multiple episodes of hospital readmissions related to infectious complications of their wound or orthopedic implants. In addition to increased patient morbidity, provision of medical care for service members with infected traumatic wounds can be very costly and lead to intense resource utilization.

Early diagnosis of infection in injured warfighters could provide early guidance to caregivers. Treatment of chronic infections are less successful, so the goal is to improve early detection and rapid intervention before the infection is established and progressing. Current diagnostic systems are complex with often multiple steps from sample processing to interpretation, are often restricted to fixed laboratories, require cold chain for reagents, and not available to front line users. This effort seeks to support development of novel approaches to detect infected wounds at the bedside or in the field to rapidly inform medics and early caregivers on best approaches to wound and infection management.

PHASE I: Selected contractor determines the feasibility of the concept by developing a prototype diagnostic assay that has the potential to meet the broad needs discussed in this topic description. Currently there are no FDA-cleared, field-capable assays that can be used to rapidly identify the most common bacterial pathogens causing wound and sepsis infections as described in references 1-6 (to include but not limited to the ESKAPE group of pathogens: Enterococcus spp., Staphylococcus aureus, Klebsiella pneumonia, Acientobacter baumannii, Pseudomonas aeruginosa, Enterobacter spp, and Escherichia coli), as well as an ability to determine the respective antibiotic susceptibility of the detected pathogen to guide treatment decisions for wound infections in injured warfighters. Development of an assay for the detection of bacterial infections with MDR bacteria is therefore a high priority. In some infections, a possibility of multiple pathogens and bacterial strains can be present within a single sample, so the assay must be sensitive and specific enough to identify each pathogen.

PHASE II: Based on the results from Phase I, the selected contractor provides up to 3 Initial lots of 250 prototype assays each to the COR. These initial lots will be evaluated for sensitivity and specificity using a diversity set of bacterial strains for evaluation in vitro, then if efficacious for analysis of samples (blood and tissue, or directly) from preclinical animal infection studies. Can coordinate with WRAIR/NMRC for assistance with preclinical evaluation if needed. Feedback regarding the sensitivity/specificity of each lot of prototype assays will be provided to the contractor. This data will then be used to optimize each subsequent lot of assays. The goal In Phase II is the development of a prototype assay that provides 85% sensitivity and 85% specificity when compared to current bacterial culture and antibiotic susceptibility testing methods. Once sensitivity and specificity requirements have been met in preclinical tests, the selected contractor will confirm the performance characteristics of the assay (sensitivity, specificity, positive and negative predictive value, accuracy and reliability) using clinical specimens. The regulatory strategy for using different types of clinical specimen should be clearly described in the Phase II proposal. Human use protocols for using clinical specimen should be approved by Institutional Review Board (IRB) of all participating institutes. The elected contractor will require a Federal-Wide Assurance of Compliance before government funds can be provided for any effort that requires human testing or uses of clinical samples. The selected contractor will also conduct stability testing of the prototype device in Phase II. Stability testing will follow both real-time and accelerated (attempt to force the product to fail under a broad range of temperature and humidity conditions and extremes) testing in accordance with FDA requirements. The assay must be rapid (<30 min), soldier-friendly (i.e., easy to operate), inexpensive, portable, and stable (no requirement of refrigeration). The assay should be at least 85% as sensitive and specific as current (non-deployable, non-FDA cleared) assays and sera, plasma, whole blood, or other types of specimen can be used without sample processing. The data package plan required for application to the U.S. Food and Drug Administration will be prepared at the end of phase II.

PHASE III DUAL USE APPLICATIONS: During this phase the performance of the assay should be evaluated in a variety of field studies that will conclusively demonstrate that the assay meets the requirements of this topic. The contractor may coordinate with WRAIR/NMRC to set up field testing sites. The selected contractor shall make this product available to potential military and non-military users throughout the world. Military applications: MDR bacterial infections occur worldwide. The diagnosis of these wound infections and sepsis cases are often delayed, because the currently available tests, mostly reliant on bacterial culture or high-complexity nucleic acid amplification, are not field-capable, not rapid, and can vary considerably among different laboratories even when using the same procedure or method. With the availability of an easy and rapid assay developed under this topic, wounded and ill soldiers can be treated in a timely manner in any military medical organization (such as a Battalion Aid Station, a Combat Support Hospital, Forward operation base, or a fixed medical facility). The contractor should coordinate with WRAIR/NMRC to establish a National Stock Number (NSN) for potential inclusion in into appropriate "Sets, Kits and Outfits" that are used by deployed medical forces. Civilian applications: MDR bacterial infections occur in communities and hospitals, in wounds, skin and soft tissue infections, pneumonia, and blood stream infections. We envision that the contractor that develops the rapid diagnostic assay and will be able to sell and/or market this assay to a variety of civilian medical organizations, and that this market will be adequate to sustain the continued production of this device.

REFERENCES:
1. Davis, K.A., et al., Multidrug-resistant Acinetobacter extremity infections in soldiers. Emerg Infect Dis, 2005. 11(8): p. 1218-24.

2. Morrison-Rodriguez, S.M., et al., Community-associated methicillin-resistant Staphylococcus aureus infections at an Army training installation. Epidemiol Infect, 2010. 138(5): p. 721-9.

3. Burns, T.C., et al., Microbiology and injury characteristics in severe open tibia fractures from combat. J Trauma Acute Care Surg, 2012. 72(4): p. 1062-7.

4. Hospenthal, D.R., et al., Guidelines for the prevention of infections associated with combat-related injuries: 2011 update: endorsed by the Infectious Diseases Society of America and the Surgical Infection Society. J Trauma, 2011. 71(2 Suppl 2): p. S210-34.

5. Campoccia, D., L. Montanaro, and C.R. Arciola, The significance of infection related to orthopedic devices and issues of antibiotic resistance. Biomaterials, 2006. 27(11): p. 2331-9.

6. Ventola, C.L., The antibiotic resistance crisis: part 1: causes and threats. P T, 2015. 40(4): p. 277-83.

KEYWORDS: Wound Infections, ESKAPE, AMR, Diagnostic

DHA201-002 TITLE: Radioprotector Medical Countermeasure to Prevent the Effects of Acute Radiation Syndrome

TECHNOLOGY AREA(S): Biomedical

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition- USAMRDC

OBJECTIVE: To provide a radioprotector medical countermeasure (MCM) to the Joint Force with effective prophylactics to recover from and survive Acute Radiation Syndrome (ARS) resulting from ionizing radiation exposure. In concert with resuscitative intervention and supportive care, MCMs would improve survival and reduce recovery times for the individual contributing to a higher level of unit readiness.

DESCRIPTION: The current Joint Force requires Medical Counter Measures (MCMs) against threats to sustain the full range of military operations. The Joint Force must effectively protect the maximum number of personnel against the greatest number of hazards as far forward as possible, and sustain the casualty from the point of exposure to the point of definitive care. These MCMs will be administered at the lowest echelon of health care possible. They will work in concert with other medical products to lessen performance degradation and increase survival for the individual contributing to a higher level of unit readiness.

The Department of Defense requires MCMs for Acute Radiation Syndrome (ARS) that are safe and effective prophylaxes and therapeutics. To be effective, any prophylaxes must be available to Joint Force personnel prior to ionizing radiation (IR) exposure. It will reduce the likelihood of developing severe adverse health effects associated with ARS to increase survival. Prophylaxes would be administered to the Joint Force prior to operating in a known, high risk Ionizing Radiation (IR) environment.

ARS encompasses a spectrum of pathophysiologic changes caused by exposure to high doses of penetrating radiation in a relatively short time period. Injuries sustained depend on the dose and extent of radiation exposure (e.g., whole- or partial-body). Radiation exposures exceeding 2 Gray (Gy) in adults can result in the depletion of hematopoietic stem cells and cellular progenitors in the bone marrow, which may lead to severe neutropenia, thrombocytopenia, and death from infection or hemorrhage. Higher radiation doses can cause gastrointestinal (GI) complications, including mucosal barrier breakdown, bacterial translocation, and loss of GI structural integrity, which can lead to rapid death. Individuals who survive ARS may suffer from the delayed effects of acute radiation exposure (DEARE), which can include pulmonary, renal, cardiovascular, immunological, and cutaneous complications occurring weeks to months after radiation exposure.

There are three FDA-approved post-exposure therapeutic drugs to treat the hematopoietic subsyndrome of ARS. There are no FDA-approved prophylactic MCMs for IR exposures resulting in ARS. Future pharmaceuticals will be used in concert with the most appropriate and cost effective mix of existing protocols for treating radiation injuries and could be used at any role of care. Together, future pharmaceuticals and existing medical management protocols (e.g., supportive care, antioxidants, antiemetics, antibiotics, colony stimulating factors, blood/bone marrow transplants, isolation) will provide the means to effectively treat the maximum number of personnel.

For the purpose of this effort, the terms “MCM(s)” and “drug(s)” will include drugs, biologics, and cellular therapies. The objective of a prophylactic MCM is to reduce the likelihood of developing severe adverse health effects associated with ARS to increase survival. The prophylactic MCM must work in concert with other medical products to lessen performance degradation and increase survival for an individual contributing to a higher level of unit readiness. A prophylactic MCM will need to be given pre-exposure, pre-symptomatic and be administered at the lowest echelon of heath care possible to the Joint Force (age range of 18 - 62 years) prior to operating in a known, high risk irradiated environment. To achieve this effect the method of administration must be tailored to optimize ease of administration in an operational environment.

PHASE I: Offerors must propose proof-of-concept experiments to demonstrate the efficacy of proposed ARS prophylactic MCM against a relevant susceptible cell populations such as hematopoietic progenitors. Demonstration of efficacy in some form of an in vivo model is also acceptable, but not required for Phase I. Technologies of interest include, but are not limited to, drugs, but can include biologics or cellular therapies. Exit criteria for successful completion of Phase I research would be the demonstration of efficacy at the LD70/30 or greater radiation dose levels. The LD70/30 represents a radiation dose that would result in 70% mortality over 30 days in vehicle treated mice. Information garnered from Phase I experiments may be more qualitative than quantitative.

PHASE II: With successful completion of Phase I experiments, Phase II would further evaluate the medical countermeasure (MCM) in a small animal study. A Phase II effort will test effective prophylactic ARS MCMs at the LD70/30 dose level or greater in an appropriate animal model. In these studies, the MCM would be administered to animals prior to radiation exposure. The animal model should be of sufficient size and scope to demonstrate a statistically significant increase in survival in animals receiving the MCM. The SBIR Phase II studies shall include experiments of a manner that facilitates the collection of non-clinical GLP pharmacokinetic (PK) and pharmacodynamic (PD) data. The PK and PD information will be of paramount importance to inform subsequent Phase III studies. Optimized formulation studies involving development of a preparation of the drug should be conducted during this phase II effort. Responders to this SBIR should provide a test plan for in vivo evaluation prior to the start of Phase II studies.

PHASE III DUAL USE APPLICATIONS: Phase III studies would further refine the animal model and the compound/drug dosing regimen. The goal would be to work toward FDA approval of a MCM for one or more radioprotector MCMs against ARS. The studies in Phase III should support FDA approval/ licensure to include entry into clinical studies, cGMP manufacturing scale up, and pivotal efficacy studies. FDA licensure/approval is not necessary for the project to be deemed successful. One means for the offeror to document progress is through a Technology Readiness Assessment (TRA) of the technology using the harmonized Quantitative Technology Readiness Level (QTRL) guidance document as described by the Public Health Emergency Medical Countermeasures Enterprise (PHEMCE). A second means for demonstrating success is the establishment of funding and partnering with commercial companies (if necessary) to facilitate bringing the product to market.

Successful radioprotector MCM products directed against ARS will clearly have use by other government agencies, hospitals/ emergency departments, first responders, and others providing responses to nuclear and radiation dispersal incidents.

REFERENCES:

1. Rosen E, Day R and Singh V. New Approaches to Radiation Protection. Frontiers in Oncology, Vol 4, Issue 381, 2014.

2. Singh V, Newman V, Berg A and MacVittie T. Animal Models for Acute Radiation Syndrome Drug Discovery. Expert Opinion on Drug Discovery, Vol 10, Issue 5, 2015.

3. Joint Project Manager Medical Countermeasure Systems Broad Agency Announcement (BAA) for Medical Chemical Biological Radiological and Nuclear (CBRN) Countermeasure Developmental Studies. Attachment 1 Public Health Emergency Medical Medical Countermeasures Enterprise (PHEMCE) Harmonized Q-TRL List for Medical MCMs, MCS-BAA14-01, December 2013.

KEYWORDS: Radioprotectors, Prophylaxes, Medical Countermeasures (MCM), Acute Radiation Syndrome (ARS), Ionizing Radiation (IR), Sub-syndromes

DHA201-003 TITLE: Nano-synthetic Materials Smart System Enabling Sensor Discovery and Fabrication

TECHNOLOGY AREA(S): Biomedical

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition- USAMRDC

OBJECTIVE: Develop a smart system of the rapid discovery, development, and evaluation of nano-synthetic detecting materials as sensors for Synthetic Tissue, Organ, Nerve and Skin (STONeS). These discovered novel sensor materials will be used to fabricate new detectors that demonstrate “murmuration behavior” that record properly/improperly performed emergent procedures, useful in medical simulation training with additional potential utility seen in forward medical operational environments.

DESCRIPTION: Applying appropriate STONeS sensors into mannequins or part-task trainers to provide feedback signals can mimic close-to-real-life response, ensuring surgical procedural accuracy and improving training efficiency and fidelity for military medical service members. STONeS sensor enabled part-task trainers will increase training availability and accessibility, while decreasing overall training cost. Demand for the application of nanosensors in medical simulation training is rising as nanotechnology-enabled sensors to provide a faster, more accurate and sensitive detection, and therefore it enables new solutions in physical, chemical, and biological sensing STONeS applications. The diversity of nanosensor technologies and applications requires a broad diversity of nanomaterials. However, ideal sensing materials to satisfy the capability gaps remaining in civilian and military medical simulation have yet to be revealed in practice. To accelerate this sensor development, DHA considers R&D efforts in autonomous detection to enable the broad, application-driven discover of nano-synthetic material to be both necessary and urgent. Currently there is no similar effort available to provide an effective solution.

The goal of this topic is to create a nanomaterial synthetic platform with innovative methodology strategies to quickly discover novel nanomaterials as sensor materials to develop nanosensors fit for at least one of the following STONeS capabilities:

• Detection of touch
• Detection of pressure

• Detection of stretch
• Detection of disruption and closure
• Monitoring temperature
• Monitoring gases
• Monitoring humidity
• Monitoring liquids
• Monitoring radiation.

PHASE I: A feasibility study that demonstrates the scientific, technical, and commercial merit of the methodology. Identify and define the right approaches to establish a high throughput automatic nanomaterial synthetic and screening platform to rapidly discover appropriate STONeS sensing materials.

Required Phase I deliverables will include:

• Prove deep understanding and review of current nano-synthetic sensing material applications in STONeS.
• Develop a methodology to enable high throughput nanomaterial synthetic system.
• Develop approaches for application-driven discovery for sensing material for STONeS properties and targets.
• Provide proof of concept data and support the technical feasibility.
• Prove the proposed technology has advantages over the current technologies in use.

PHASE II: Phase II effort will culminate in a well-defined deliverable prototype based upon the Phase I proof of concept work, with an expectation of comprehensive development, detailed demonstration, and final validation. The prototyped high throughput platform should be utilized to produce at least two novel discoveries of nanomaterials. The characteristics of the new STONeS nanomaterials are expected to have some of the following features:

• Printable
• Flexible and/or Stretchable
• Scalable
• Unobtrusive
• Reliable
• Inexpensive
• Wireless
• Low-voltage and/or self-power

Required Phase II deliverables:
• Produce prototype hardware and software based upon Phase I work.
• Develop, test and validate the prototyped high throughput nano-synthetic material platform.
• Provide a detailed plan for nano-synthetic material discovery procedures.
• Provide practical implementation for nano-synthetic material discovery.
• Develop processes, select appropriate applications and demonstrate at least two productions as novel discoveries of nanosensing materials for STONeS applications.

PHASE III DUAL USE APPLICATIONS: Phase III work will be a continued R&D effort with the potential to transition to the advanced developer or the genesis of an advanced manufacturing capability. It’s expected to be a novel nanosensors development using Phase II discovered nanomaterials. All sensors developed will improve the use of STONeS in medical simulation training with important military and commercial impact. It can also have the potential to become an important large nano-synthetic sensing material database/library commercially available to significantly accelerate the sensor discovery and development. The discovery and fabrication of these new sensors will be benefit in both training and operational environment such prolong field care, telemedicine, and the future autonomous systems.

REFERENCES:
1. Meital Segev-Bar, et al., A Tunable Touch Sensor and Combined Sensing Platform: Toward nanoparticle-based Electronic Skin. ACS Applied Materials & Interfaces. 2013

2. Carlos Garcia Nunez, et al., Enery autonomous electronic skin, npj Flexible Electronics. 2019

3. David Escobar-Castillejos, et al., A Review of Simulators with Haptic Devices for Medical Training. J Med Syst (2016)

4. Yancong Qiao, et al., Multilayer Graphene Epidermal Electronic Skin. ACS Nano. 2018.

5. Donghee Son, et al., nanomaterials in Skin-inspired Electronics: Toward Soft and Robust Skin-like Electronic Nanosystems. ACS Nano. 2018.

6. Yicong Zhao, et al., Mechanisms and materials of Flexible and Stretchable Skin Sensors. Micromachines. 2017.

7. Sumit Majumder, et al., Wearable Sensors for Remote Health Monitoring. Sensors. 2017

KEYWORDS: Nanotechnology, Nanosynthetic Material, Sensor

DEFENSE LOGISTICS AGENCY
20.1 Small Business Innovation Research (SBIR) Program Direct to Phase II Proposal Submission Instructions

The Defense Logistics Agency (DLA) Small Business Innovation Program (SBIP) seeks small businesses with strong research and development capabilities to pursue and commercialize specific technologies to meet DLA objectives.

The intent of the 20.1 DLA SBIR Direct to Phase II proposal submission instructions is to clarify the Department of Defense (DoD) instructions as they apply to DLA requirements. This Announcement is for Direct to Phase II proposals only. All Phase II proposals must be prepared and submitted through the DoD SBIR/STTR electronic submission site: https://www.dodsbirsttr.mil/submissions/. The offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of instructions. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

Submit specific questions pertaining to the DLA SBIP Program to the DLA SBIP Program Management Office (PMO) at E-mail – DLASBIR2@dla.mil

1. <u>DIRECT TO PHASE II</u>

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY.

This allows the Department of Defense to make an award to a small business concern under Phase II of the SBIR Program with respect to a project, without regard to whether the small business concern received an award under Phase I of an SBIR Program with respect to such project.

DLA is conducting a "Direct to Phase II" implementation of this authority for this SBIR Announcement. This pilot does not guarantee DLA will offer any future Direct to Phase II opportunities.

DLA Direct to Phase II Proposals are different from traditional DLA SBIR Phase I proposals. The chart below explains some of these differences.

	STANDARD DLA SBIR PROCESS	DLA D2P2 PROCESS
PHASE 1 TYPICAL FUNDING LEVEL	$100,000***	None
PHASE 1 TECHNICAL POP* DURATION	6 months	None
PHASE 2 TYPICAL FUNDING LEVEL	$1,000,000**	$1,000,000**
PHASE 2 TECHNICAL POP DURATION	24 months	24 months

*POP= Period of Performance

** May Exceed $1,000,000 (up to $1,600,000) with Program Manager Approval (Pre-Release Discussion)

*** May Exceed $100,000 (up to $252,000) with Program Manager Approval (Pre-Release Discussion)

2. INTRODUCTION

Direct to Phase II proposals must follow the steps outlined in the following statements.

1. Offerors must create a Cover Sheet using the DoD Proposal submission system.
2. Offerors must provide documentation that satisfies the Phase I feasibility requirement*. that will be included in the Technical Volume of the Phase II proposal
3. Offerors must demonstrate that they have completed research and development through means other than the SBIR/STTR Program to establish the feasibility of the proposed Phase II effort.
4. Offerors must submit a complete Phase II proposal using the DLA Phase II proposal instructions below.

* NOTE: Offerors are required to provide information demonstrating that the scientific and technical merit and feasibility. DLA will not evaluate any Phase II proposal if it determines that the offeror has failed to demonstrate the establishment of technical merit and feasibility.

5. PROPOSAL SUBMISSION

Submit the complete proposal, i.e., DoD Proposal Cover Sheet, technical volume, and cost volume electronically at https://www.dodsbirsttr.mil/submissions/. Ensure your complete technical volume and additional cost volume information is included in this sole submission.

Complete proposals must include all of the following:
a. DoD Proposal Cover Sheet (Volume 1)
b. Technical Volume (Volume 2):
Part 1: Phase I Justification (20 Pages Maximum)
Part 2: Phase II Technical Proposal (40 Pages Maximum)
c. Cost Volume (Volume 3)

The DLA SBIR Program is accepting Volume 5 (Supporting Documents).

Phase II proposals require a comprehensive, detailed submission of the proposed effort. DLA SBIR Direct to Phase II periods of performance are 24 months. DLA may award SBIR Direct to Phase II efforts up to a maximum value of $1,600,000 per contract award. Commercial and military potential of the technology under development is extremely important. Successful proposals will emphasize dual-use applications and commercial exploitation of resulting technologies.

6. Direct to Phase II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

PROPOSAL FORMAT (60 pages maximum)

A. **Cover Sheet**. As instructed on the DoD SBIR proposal submission website, prepare a Proposal Cover Sheet (often two pages), include a brief description of the problem or opportunity, objectives, effort, and anticipated results. Summarize the expected benefits, as well as any government or private sector applications of the proposed research. OSD and SBA will post the Project Summary of selected proposals with unlimited distribution. Therefore, the summary should not contain classified or proprietary information.

B. **Technical Volume**

- Phase I Justification (20 Pages Maximum). Offerors are required to provide information demonstrating the establishment of the scientific and technical merit and feasibility.

- Phase II Technical Objectives and Approach (40 Pages Maximum). List the specific technical objectives of the Phase II research and describe the planned technical approaches used to meet these objectives.

- Phase II Work Plan**.** Provide an explicit, detailed description of the Phase II approach. The plan should indicate how and where the firm will conduct the work, a schedule of major events, and the final product to be developed. The Phase II effort should attempt to accomplish the technical feasibility demonstrated in the justification, including potential commercialization results. Phase II is the principal research and development effort and is expected to produce a well-defined deliverable product or process.

- Related Work. Describe significant activities directly related to the proposed effort, including those conducted by the Principal Investigator, the proposing firm, consultants, or others. Report how the activities interface with the proposed project and discuss any planned coordination with outside sources. The proposers must demonstrate an awareness of the state-of-the-art in the technology and associated science.

- Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. Discuss the significance of the Phase II effort in providing a foundation for a Phase III research or research and development effort.

- Technology Transition and Commercialization Strategy**.** Describe your company’s strategy for converting the proposed SBIR research, resulting from your proposed Phase II contract, into a product or non-R&D service with widespread commercial use -- including private sector and/or military markets.

    - What is the first product that this technology will go into?
    - Who will be your customers, and what is your estimate of the market size?
    - How much funding will you need to bring the technology to market, and how will you raise those funds?
    - Does your company contain marketing expertise and, if not, how do you intend to bring that expertise into the company?
    - Who are your competitors, and what is your price and/or quality advantage over your competitors?

- Key Personnel. Identify key personnel, including the Principal Investigator, who will be involved in the Phase II effort. List directly related education and experience and relevant publications (if any) of key personnel. Include a concise resume of the Principal Investigator(s).

- Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase II effort. Justify the purchase of any items or equipment (as detailed in the cost proposal) including Government Furnished Equipment (GFE). All requirements for government furnished equipment or other assets, as well as associated costs, must be determined and agreed to during Phase II contract negotiations. State whether or not the proposed work facilities will be performed meet environmental laws and regulations of federal, state (name) and local governments. This includes, but is not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal, and handling and storage of toxic and hazardous materials.

- Consultants**.** Involvement of university, academic institution, or other consultants in the project may be appropriate. If the firm intends to involve these type of consultants, describe these costs in detail in the Cost Volume.

C. **Cost Volume** (**$1,600,000 Maximum**). A detailed, Phase II Cost Volume must be submitted online and in the proper format shown in the Cost Breakdown Guidance in Section 5.4 d of the DoD SBIR Broad Agency Announcement (BAA). Some items in the cost volume template may not apply to the proposed project. Provide enough information to allow the DLA evaluators to assess the proposer's plans to use the requested funds if DLA were to award the contract.

- List all key personnel by name as well as number of hours dedicated to the project as direct labor.
- Special Tooling, Test Equipment, and Materials Costs:
- Special tooling, test equipment, and materials costs may be included under Phase II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed; and
- The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate it directly to the specific effort.
- Cost for travel funds must be justified and related to the needs of the project.

5. METHOD OF SELECTION AND EVALUATION CRITERIA

A. **Evaluation Criteria**. DLA will review all proposals for overall merit based on the evaluation criteria published in the DoD SBIR Program BAA:

6. CONTRACTUAL CONSIDERATIONS

A. Awards. The number of Direct to Phase II awards will depend upon the quality the Phase II proposals and the availability of funds. Each Phase II proposal selected for award under a negotiated contract requires a signature by both parties before work begins. DLA awards Phase II contracts to Small Businesses based on results of the agency priorities, scientific, technical, and commercial merit of the Phase II proposal.

B. Reports**.** For incrementally funded Phase II projects an interim, midterm written report maybe required (at the discretion of the awarding agency).

C. Payment Schedule. DLA Phase II Awards are Firm Fixed Price / Level of Effort contracts. Base monthly invoices on the labor hours recorded and the monthly costs associated with the project.

D. Markings of Proprietary Information In accordance with DoD SBIR Program BAA, section 5.3. DLA does not accept classified proposals. All Final Reports are marked with Distribution Statement B.

E. Copyrights, Patents and Technical Data Rights. DLA handles all Copyrights, Patents, and Technical Data Rights in accordance with the guidelines in the DoD SBIR Program BAA.

7. TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DLA SBIR Program does not participate in the Technical and Business Assistance (formally the Discretionary Technical Assistance Program). Contractors should not submit proposals that include Technical and Business Assistance.

Reportable activities include:

- Sales revenue from new products and non-R&D services resulting from the Phase II project
- Additional investment from sources other than the Federal SBIR program in activities that further the development and/or the commercialization of the Phase II technology;
- The portion of additional investment representing clear and verifiable investment in the future commercialization of the technology (i.e. "hard investment");
- Whether the Phase II technology has been used in a fielded DoD system or acquisition program and, if so, which system or program;
- The number of patents resulting from the contractor's participation in the SBIR/STTR program;
- Growth in number of firm employees, and; Whether the firm completed an initial public offering (IPO) of stock resulting in part from the Phase II project

DEFENSE LOGISTICS AGENCY
2020.1 Small Business Innovation Research (SBIR)
Program Direct to Phase II Proposal

DLA201-D003	Production of Industrial Rubber Gloves for the Nuclear Enterprise Support Office through Manufacturing Techniques that Support Multiple DoD Applications for the DLA
DLA201-D004	Deployable Additive Manufacturing Capability

DLA SBIR 19.3 Direct to Phase II Topic Descriptions

DLA201-D003 Production of Industrial Rubber Gloves for the Nuclear Enterprise Support Office through Manufacturing Techniques that Support Multiple DoD Applications for the DLA

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: The Defense Logistics Agency seeks to develop standardized and Additive Manufacturing (AM) production methods for certified Industrial Rubber Gloves for the Nuclear Enterprise Support Office (NESO) and related parts in the DoD supply chain. This project must demonstrate a standardized method for certifying Type I and Type III Industrial Rubber gloves and related parts for the DoD supply chain in a manner that is rapid, reliable, and scalable, although does not require production/purchase volumes beyond demand.

DESCRIPTION: DLA Logistics Operations has the goal of purchasing Industrial Rubber Gloves and related rubber protective equipment apparel in the DoD supply chain:
1. In monthly to quarterly quantities that meet but not exceed demand, estimated at 1300 pairs of gloves annually
2. With competitive pricing and enhanced performance
3. Timely delivery
4. Ability to rapidly transition chemistry and product through fused filament fabricated (FFF) 3D printed mandrels

Industrial rubber glove production is currently limited in part due to Berry amendment sourcing and production limitations. Consequently, DLA is looking for qualified companies and production methods that can address both small and large volume quantities. Ideally, glove, apparel, boots and parts may all be produced using natural rubber or polychloroprene chemistry.

PHASE I: Provide justification to bypass Phase I (Not to exceed twenty pages)

PHASE II: To qualify for the Phase II effort the proposer should possess a technology with proven feasibility – i.e. demonstration of Type I and Type III Industrial Rubber Gloves that meet the requirements outlined in MIL-DTL-32066A. Proposers should develop and propose a plan to enable certification of gloves and related parts using a flexible manufacturing process that allows for immersion production based on varied polymer chemistry and varied shapes using additively manufactured lost cost mandrels. It is DLA's expectation that commercialization occurs shortly following the Phase II effort.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in D2P2 should result in a functional Open Source System that can transition into the Government or the commercial markets.

COMMERCIALIZATION: Expand and enable a flexible and scalable supply chain where a firm may produce qualified gloves and related parts in reasonable quantities and with rapid reliable delivery.

REFERENCES:

1. MIL-DTL-32066Am 6 March 2014, SUPERSEDING, MIL-DTL-32066, 14 June 2000

2. https://www.dla.mil/Portals/104/Documents/TroopSupport/CloTex/2018%20JAPBI/Gloves.pdf?ver=2018-12-27-172424-167

3. https://www.wbparts.com/rfq/8415-00-266-8675.html

4. Rapidly Self-assembled Thin Films and Functional Decals, US20050064204A1, 2004

KEYWORDS: Industrial Rubber Gloves, NESO, Type I and Type III, MIL-DTL-32066A, Immersion, Seamless

Processing, Additive Manufacturing, and 3D Printed Mandrels

DLA201-D004 Deployable Additive Manufacturing Capability

TECHNOLOGY AREA(S): Materials/Processes

OBJECTIVE: The Defense Logistics Agency seeks to develop standardized and Additive Manufacturing (AM) production methods in a deployed environment.

DESCRIPTION: Repair and part obsolescence are on-going supply chain challenges. Often, there is a requirement for singular or just a few replacement parts. The cost and lead times of non-recurring expenses associated with standard manufacturing approaches can increase the cost and time to produce a "one-off" or low rate build part by orders of magnitude. Advanced manufacturing techniques (such as additive manufacturing) provide opportunities to provide on demand, zero tooling components. To realize the full capability of advanced manufacturing processes, quasi-automated manufacturing needs to move into the realm of truly automated. This will reduce the dependency on the user. Rapid deployment needs to be part of any future planning, allowing functionality in all environments and theaters.

The deployable system must meet DoD and military shelter safety requirements, ISO/CSC standard intermodal transportation requirements, necessary environmental controls for typical deployed environments, power consumption on the order of that already provided by deployed DoD generator systems, and provide a level of automation capable of supporting a novice controller. An ideal advanced manufacturing machine will provide flexibility in material and footprint (modular/customizable for theater). A system capable of manufacturing with plastics, metals, composites, and/or ceramics would provide maximum use.

While software currently exists to support and automate each manufacturing step individually, expert users are still required to interpret data from the previous step and establish appropriate inputs for the next step. There is an apparent need for a single software package to manage the workflow from part identification to part certification, automatically.

PHASE I: Provide justification to bypass Phase I (Not to exceed twenty pages)

PHASE II: To qualify for the Phase II effort the proposer should possess a technology with proven feasibility. An ideal system would provide the following qualities:

1. Part Scan to Part Geometric Certification with minimal hardware and software interfacing
2. Ability to build drop-in, optimized re-design, or new design parts
3. Digital tolerance control (physical part, to digital, back to physical) of +/-0.010"
4. Effective with metals, plastics, filled, and ceramic materials
5. A minimum print bed size of 12"x12"x12"
6. Overall system size that is only nominally larger than the print bed size in a minimum of one direction, but ideally two directions, to enable efficient packaging options (e.g., containerization). For example, a columnar printing system may have a footprint the size of the print bed, but be much taller than the print bed height.
    a. Material storage footprint is not of immediate concern due to different environmental and human access requirements
7. Be deployable within ISO standard shipping containers (8'x8' opening and up to 40' long). Containerization enables rapid deployment around the world.
8. Weight and power consumption conscientious
    a. A target system weight would be 10% of the container payload capacity (20' ISO container is capable to ~55,000 lbs. payload)
    b. Target power consumption would enable operation with standard deployable generator systems (such as MEP-805, MEP-806B or PU-805B)

9. Material and configuration modifiable without affecting the certification of the system rapidly transition chemistry and product through fused filament fabricated (FFF) 3D printed mandrels

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in D2P2 should result in a functional Open Source System, which can transition into the Government or the commercial markets.

COMMERCIALIZATION: Expand and enable a flexible and scalable supply chain where qualified and related parts may be produced in the required quantities.

REFERENCES:

KEYWORDS: Advanced manufacturing techniques, additive manufacturing, On-demand zero tooling components

SBIR 20.1 DEFENSE LOGISTICS AGENCY (DLA)
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

Proposal Submission Instructions

GENERAL

The Defense Logistics Agency (DLA) implements, administers, and manages the SBIR/STTR Program as part of the Small Business Innovation Programs through DLA J62LB Information Operations / Research, and Development (R&D) Division. Consult the program website at the following location: http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms for general information about the DLA SBIP Program and its mission. If you have any questions regarding the administration of the Program, please contact the DLA SBIR Program Manager (PM):

Denise Price email: DLASBIR2@dla.mil

TECHNICAL QUESTIONS

For questions regarding the SBIR/STTR topics during the pre-release period, contact the Topic Technical Point of Contact (TPOC) listed for each topic on the SBIR/STTR website at https://sbir.defensebusiness.org/ prior to the close of the pre-release. To obtain answers to technical questions during the open period a firm must submit questions through the online SBIR/STTR Q&A System at https://sbir.defensebusiness.org/.

For general inquiries or problems with electronic submission, contact Department of Defense (DoD) SBIR Help Desk at dodsbirsupport@reisystems.com or 703-214-1333 between 9:00 am and 5:00 pm ET.

PHASE I KEY DATES

20.1 BAA (Pre-release)	10 Dec, 2019
20.1 BAA (Open period)	14 Jan, 2020
20.1 BAA Closes	12 Feb 2020 (@ 8PM ET)

PROGRAM BROAD AGENCY ANNOUNCEMENT (BAA) 20.1

PHASE I GUIDELINES

A list of the topics currently eligible for proposal submission is included in the Topic Index, followed by full topic descriptions. Additional guidance is as follows:

- Proposal period of performance should not to exceed 9 months.
- Proposal Cost Estimate should not to exceed $100,000 however, the DLA Program Manager has the discretion to waive this limit up to $252,131. (This must be part of the discussion in the Pre Release period)
- Phase I proposals not to exceed the 20-page limit.
- Proposal attachments, appendices, or references are included in Volume 5.
- Notification of selection and non-selection occurs electronically via e-mail.

For detailed proposal submission guidance, refer to U.S. Department of Defense (DoD) Instructions 20.1 SBIR at: https://www.dodsbirsttr.mil/submissions.

PHASE II GUIDELINES

Phase II eligibility:

- Phase I awardees may submit a Phase II proposal without invitation.
- Proposal period of performance not to exceed 24 months
- Proposal Cost Estimate should not to exceed $1,000,000, however, the DLA Program Manager has the discretion to waive this limit up to $1,680,879
- Phase II proposals not to exceed the 40-page limit
- Proposal attachments, appendices, or references are included in Volume 5.
- Cost Estimate is not included in the 40-page limit.
- Commercialization Strategy Requirements:
    - Business Case highlighting benefits to the DoD/DLA
    - Transition Strategy and Key Tasks
    - Time-Phased Transition Plan
    - Projected Transition Cost Analysis

DLA Phase II proposals must follow the detailed proposal submission guidance in the original Phase I BAA. Refer to DoD Instructions at https://www.dodsbirsttr.mil/submissions.

EVALUATION CRITERIA

Phase I see Section 6 in the OSD BAA Phase II see Section 8 in the OSD BAA

TECHNICAL ASSISTANCE

The DLA SBIR Program does not participate in the Technical and Business Assistance (formally the Discretionary Technical Assistance Program). Contractors should not submit proposals that include Technical and Business Assistance.

DELIVERABLES / REPORTS

All DLA SBIR and STTR awardees are required to submit reports in accordance with the deliverable schedule. The recipient must provide all reports to the individuals identified in Exhibit A of the contract. Milestones: Each phase of the project will be milestone driven. The Principal Investigator will propose milestones prior to starting any phase of the project.

Phase I Proposals should anticipate a combination of any or all of the following deliverables:

- Plan of Action and Milestones (POAM) with sufficient detail for monthly project tracking
- Initial Project Summary: one-page, unclassified, non-sensitive, and non-proprietary summation of the project problem statement and intended benefits (must be suitable for public viewing).
- Monthly Status Report - DLA SBIP Team will provide a format at the project launch meeting.
- The TPOC and PM will determine a meeting schedule at project launch meeting. Phase I awardees can expect:
    - Mid Term Project Review (format provided at launch meeting); and possibly
    - Monthly (or more frequent) Project Reviews (format provided at launch meeting)
- Draft Final Report including major accomplishments, business case analysis, commercialization strategy, transition plan with timeline, and proposed path forward for Phase II.
- Final Report including major accomplishments, business case analysis, commercialization strategy and transition plan with timeline, and proposed path forward for Phase II
- Final Project Summary (one-page, unclassified, non-sensitive and non-proprietary summation of project results, non-proprietary high resolution photos or graphics intended for public viewing)
- Phase II Proposal is optional at the Phase I Awardee’s discretion (as Applicable)
- Applicable Patent documentation
- Other Deliverables as defined in the Phase I Proposal

Phase II Proposals should anticipate a combination of any or all of the following deliverables:

- Plan of Action and Milestones (POAM) with sufficient detail for monthly project tracking Initial Project Summary: one-page, unclassified, non-sensitive, and non-proprietary summation of the project problem statement and intended benefits (must be suitable for public viewing)
- Monthly Status Reports, The format will be provided at project launch meeting
- The Technical Point of Contact (TPOC) and PM will determine the meeting schedule at project launch meeting. Phase II awardees can expect:
    - Triannual Project Review (format provided at launch meeting)
    - Monthly (or more frequent) Project Reviews (format provided at launch meeting)
- Draft Final Report including major accomplishments, commercialization strategy and transition plan and timeline.
- A Final Report including major accomplishments, commercialization strategy and a transition plan and timeline

- Final Project Summary (one-page, unclassified, non-sensitive and non-proprietary summation of project results, non-proprietary high resolution photos or graphics intended for public viewing)
- Applicable Patent documentation
- Other Deliverables as defined in the Phase II Proposal.

DLA SBIR 20.1 Topic Index

DLA SBIR 20.1 Topic Descriptions

DLA201-001 TITLE: Engaging the Manufacturing Industrial Base in Support of DLA's Critical Supply Chains

TECHNOLOGY AREA(S): Air Platform, Materials/Processes, Nuclear Technology, Weapons

ITAR: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the Announcement.

OBJECTIVE: Improve product availability and increase competition through the development of Source Approval Requests (SAR) by small business manufacturers for National Stock Numbers (NSNs) with government provided technical data or through the Reverse Engineering (RE) of a technical data package. If DLA has adequate technical data available, the small business manufacturer will utilize the technical data to develop a SAR package.

If the technical data is not available or inadequate, the small business will conduct relevant research and reverse engineering resulting in the development of the technical data package (TDP) as well as a SAR. The intent is that the participating small business manufacturer will be responsive to future solicitations as well as participate in the development of additional SARs for technically related NSNs.

DESCRIPTION: DLA established the Nuclear Enterprise Support Office (NESO) so the Agency is in a position to be responsive to the needs of the United States Air Force and U.S. Navy nuclear communities. The sole mission of the office is to synchronize DLA's enterprise wide support to the nuclear enterprise and engage strategically with DLA customers. Through partnerships with the small business industrial base, DLA will augment existing sources of supply to enhance life-cycle performance, product availability, competitive pricing as well as ensure effective logistics support to the nuclear enterprise. This program is restricted to DLA managed NESO items where sources of supply are scarce and is in use to incentivize small business participation to address specific weapon system requirements as well as provide small manufacturers the opportunity to build a mutually beneficial relationship with DLA.

A SAR package is an assembly of information required of a prospective new supplier of a Critical/Weapon System Item (NSN). A SAR package contains all technical data needed to demonstrate that the prospective contractor can competently manufacture the Critical/Weapon System Item to the same level of quality or better than the system prime contractor, major subsystem contractor, or initial Approved Source (OEM).

There are SAR Guides with templates and charts that explain the process. Find these guides, charts, checklists, and templates via the internet at the referenced link 1. The list of candidate parts is posted on the DLA Small Business Innovation Program (SBIP) site http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms Specific parts may require minor deviations in the process dependent on the Engineering Support Activity (ESA) requirements. Those deviations will be addressed post award. Participating small businesses must have an organic manufacturing capability and a Commercial and Government Entity (CAGE) code and be Joint Certification Program (JCP) certified in order to access technical data if available.

Refer to "link 2" below for further information on JCP certification. Additionally, small businesses will need to create a DLA's Internet Bid Board System (DIBBS) account to view all data and requirements in C Folders.

Refer to "links 3 and 4" below for further information on DIBBS and C Folders. All available documents and drawings are located in the C Folder location "SBIR201A". If the data is incomplete, or not available, the effort will require reverse engineering.

PHASE I: The innovation research goals of Phase I are to provide small business manufacturers an opportunity to qualify as an Approved Source for one or more of the NSNs specifically identified in this BAA. In this phase, manufacturers will request SAR approval from the applicable Engineering Support Activity (ESA), if required, for the NSNs. During the project launch, the awardee will submit a Gantt chart (as well as other deliverables called out in the contract) detailing the steps and timing to complete any reverse engineering efforts necessary. The Chart should cover the process from the Launch meeting, through the beginning start of Low Rate Production (LRIP) of the NSN(s). In addition, it is encouraged that manufacturers and engineers consider innovation opportunities for the identified component for the potential for cost reduction, extended life cycle, and improvement of the performance of the component. The culmination of this research will provide the basis for the business case included in the final report.

The NESO team selected the list of items and associated details to address the needs of the Nuclear Enterprise to sustain critical weapons systems as described below. Proposals may include all or a subset of the NSNs listed at http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms . Firm may submit multiple proposals for this topic providing that the proposals address unique NSNs. In order to be competitive, firms should base proposal costs on the level of effort and not the maximum dollars available. The expected cost of a "SAR only" package should not exceed $30,000 per part, and the expected cost of a Reverse Engineering SAR package should not exceed $45,000 per part. **There are exceptions for more complex parts and the proposal should provide the rationale**.

PHASE II: The submission of a Phase II proposal is at the option of the Phase I awardee. Based on a successful Phase I project, the requirements / priorities at that time, and the quality and feasibility of the manufacturer's business case, DLA will decide whether to award the Phase II proposal. The goal of Phase II is for the awardee to become a qualified source for multiple NSNs, usually similar to the NSNs in the Phase I project. In cases where the Phase I addressed a particularly complex NSN or NSN with extended testing requirements, that effort may be continued into the Phase II. If the part identified is already in production resulting from a successful Phase I, the Phase II may be used to create additional manufacturing capacity to meet demand and/or pursue SARs for other DLA managed items.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in PHASE I and PHASE II should result in the manufacturer's qualification as an approved source of supply enabling participation in DLA procurement actions.

COMMERCIALIZATION: The manufacturer will pursue commercialization of the various technologies and processes developed in prior phases through participation in future DLA procurement actions on items identified with this BAA.

REFERENCES:
1. DLA Aviation SAR Package instructions. DLA Small Business Resources: http://www.dla.mil/Aviation/Business/IndustryResources/SBO.aspx

2. JCP Certification: https://public.logisticsinformationservice.dla.mil/PublicHome/jcp

3. Access the web address for DIBBS at https://www.dibbs.bsm.dla.mil , then select the "Tech Data" Tab and Log into c-Folders. This requires an additional password. Filter for solicitation "SBIR201A"

4. DLA Small Business Innovation Programs web site: http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms

KEYWORDS: Nuclear Enterprise Support (NESO), Source Approval, Reverse Engineering

DLA201-002

Title: Grain Boundary Engineering in Additive Manufacturing (AM)

TECHNOLOGY AREA(S): Materials and Manufacturing Processes

National Defense Strategy (NDS): Reform Business Practices. Developing grain boundary engineering will help DLA/DoD acquire metal parts made of AM more efficiently and routinely without having to manage large inventory.

OBJECTIVE: The Defense Logistics Agency (DLA) seeks technologies and processes in Additive Manufacturing (AM) design and engineering procedures that can predetermine the microstructure of AM parts with “tailored” grain boundaries to produce predictable mechanical properties including mode of failure.

DESCRIPTION: Department of Defense (DoD) demand for out-of-production parts to maintain mission readiness of various weapons system platforms is an ongoing challenge. DLA's strategic objective is to enable a flexible supply chain that can accelerate repairs and part replacements utilizing AM. However, AM technology is relatively new to manufacturing and has many hurdles to overcome before universal adoption as a replacement to traditional manufacturing. Variability in the mechanical properties of additively manufactured metal parts is a key concern for DoD Engineers. Understanding the microstructure development and evolution during the AM process of metallic alloys is an important precondition for the optimization of the parameters to achieve desired mechanical properties of the AM builds. DLA is looking to leverage this evolving technology to enable a supply chain that is flexible, scalable, and capable of producing parts that are more reliable.

Metallic alloys consist of individual crystallites commonly referred to as grains. The individual grain connections (grain boundaries) formed through recrystallization during metal part fabrication and heat treatment. A grain boundary is the interface between two grains, or crystallites. Grain boundaries influence the mechanical properties of the metal; hence, certain grain boundaries are preferred over others. For example, grain boundaries such as coincidence site lattice (CSL) grain boundaries and low angle grain boundaries exhibit improved properties as compared to equiaxed grain boundaries. The improved properties exhibited by the CSL grain boundaries and low angle grain boundaries may include increased resistance to stress, corrosion, and cracking. The performance of grain boundary engineering may attempt to create CSL grain boundaries and/or low angle grain boundaries. It is now recognized, that improved grain boundary engineering techniques are desirable and may be a viable technology to provide DoD with more reliable parts.

In subtractive manufacturing, the grain boundaries are predetermined in the net-shaped parts. In AM, it would be possible to design the grain size and grain boundaries of the net-shaped parts by altering the process parameters or by adding nano/micro particles in a specific localized region during the AM process.

PHASE I: Demonstrate the feasibility of “engineered” grain boundary in metal AM technologies and processes.

PHASE II: Develop a TRL 6 prototype demonstrating the technologies and processes of Grain Boundary Engineering in AM in a DLA environment.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in PHASE I and PHASE II should result in a functional Open Source System which can transition into the Government or the commercial markets.

COMMERCIALIZATION: Expand and enable Grain Boundary Engineering in AM technologies and processes to produce parts with predictable mechanical properties including mode of failure.

KEYWORDS: Additive Manufacturing; Grain Boundary; Engineering

REFERENCES:

1. Lou, Xiaoyuan (Rexford, NY, US), Dolley, Evan Jarrett (Clifton Park, NY, US), Morra, Martin Matthew (Schenectady, NY, US), "GRAIN BOUNDARY ENGINEERING FOR ADDITIVE MANUFACTURING",

2018. http://www.freepatentsonline.com/y2018/0085830.html "

2. Vyatskikh, Andrey, Delalande, Stéphane, Kudo, Akira, Zhang, Xuan, Portela, Carlos M., Greer, Julia R., "Additive manufacturing of 3D Nano-Architected Metals", 2018. Nature Communications, Volume 9, Issue 1. https://doi.org/10.1038/s41467-018-03071-9

DMEA
SBIR 20.1 PROPOSAL SUBMISSION INSTRUCTIONS

INTRODUCTION

The Defense Microelectronics Activity (DMEA) SBIR/STTR Program is implemented, administrated, and managed by the DMEA Office of Small Business Programs (OSBP). If you have any questions regarding the administration of the DMEA SBIR/STTR Program, please contact the DMEA SBIR/STTR Program Manager (PM), Mr. Greg Davis, at smbus@dmea.osd.mil.

For general inquiries or problems with electronic submission, contact the DOD SBIR/STTR Help Desk at 703-214-1333 between 9:00 am to 5:00 pm ET. For questions about the topic during the pre-release period (10 December 2019 through 13 January 2020), contact the Technical Point of Contact (TPOC) listed under each topic on the https://sbir.defensebusiness.org/ website prior to the Open phase of the DOD SBIR Program Broad Agency Announcement (BAA) FY 20.1. The SBIR/STTR Interactive Topic Information System (SITIS) will be open to questions during pre-release and close to new questions two weeks prior to the announcement close date. Information regarding the DMEA mission and programs can be found at http://www.dmea.osd.mil.

PHASE I GUIDELINES

DMEA intends for Phase I to be only an examination of the merit of the concept or technology that still involves technical risk, with a cost not exceeding $167,500 (excludes Discretionary Technical and Business Assistance (TABA) amount).

A list of the topics currently eligible for proposal submission is included in this section followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time. The topics are directly linked to DMEA's core research and development requirements.

Please ensure that your e-mail address listed in your proposal is current and accurate. DMEA cannot be responsible for notification to companies that change their mailing address, e-mail address, or company official after proposal submission.

PHASE I PROPOSAL SUBMISSION

Read the DOD SBIR Program BAA FY 20.1 for detailed instructions on proposal format and program requirements. When you prepare your proposal submission, keep in mind that Phase I should address the feasibility of a solution to the topic. Only UNCLASSIFIED proposals will be entertained.

The technical period of performance for the Phase I effort should be no more than six (6) months. DMEA will evaluate and select Phase I proposals using the evaluation criteria contained in Section 6.0 of the DOD SBIR Program BAA FY 20.1 Preface Instructions. Due to limited funding, DMEA reserves the right to limit awards under any topic, and only proposals considered to be of superior quality will be funded.

DMEA does not accept Phase I proposals exceeding $167,500. DMEA will conduct a price analysis to determine whether cost proposals, including quantities and prices, are fair and reasonable. Contractors should expect that cost proposals will be negotiated.

If you plan to employ NON-U.S. citizens in the performance of a DMEA SBIR contract, please identify these individuals in your proposal as specified in Section 5.4.c(8) of the DOD SBIR Program BAA FY 20.1.

It is mandatory that the ENTIRE Technical Volume, DOD Proposal Cover Sheet and Cost Volume are submitted electronically through the DOD SBIR website at https://www.dodsbirsttr.mil/submissions/.The DOD proposal submission site submission will lead you through the process for submitting your technical proposal and all of the sections electronically. Each of these documents is submitted separately through the website. If you have any questions or problems with the electronic proposal submission, contact the DOD SBIR/STTR Help Desk at 703-214-1333 or email dodsbirsupport@reisystems.com.

Your proposal submission must be submitted via the submission site on or before the 8:00 p.m. ET deadline on 12 February 2020.

Proposal submissions that are not complete or that are received after the closing date and time will not be considered for award.

PHASE II GUIDELINES

Phase II is the prototype/demonstration of the technology that was found feasible in Phase I. DMEA encourages, but does not require, partnership and outside investment as part of discussions with DMEA sponsors for potential Phase II efforts.

Phase II proposals may be submitted for an amount not to exceed $1,100,000 (excludes Discretionary Technical and Business Assistance (TABA) amount). The technical period of performance for the Phase II effort should be no more than twenty-four (24) months.

PHASE II PROPOSAL SUBMISSION

Phase I awardees may submit a Phase II proposal without invitation not later than sixty (60) calendar days following the end of the Phase I contract. The Phase II proposal submission instructions are identified in the Phase I contract, Part I – The Schedule, Section H, Special contract requirements, "SBIR Phase II Proposal Submission Instructions."

All Phase II proposals must have a complete electronic submission. Complete electronic submission includes the submission of Cover Sheet, Cost Volume, the entire Technical Volume, and any appendices via the DOD submission site (https://www.dodsbirsttr.mil/submissions/). The DOD proposal submission site will lead you through the process for submitting your technical volume and all of the sections electronically. Each of these documents is submitted separately through the website. Your proposal must be submitted via the submission site on or before the DMEA-specified deadline or it will not be considered for award.

The technical period of performance for the Phase II effort should be no more than twenty-four (24) months. DMEA will evaluate Phase II proposals based on the Phase II evaluation criteria listed in Section 8.0 of DOD SBIR Program BAA FY 20.1 Preface. DMEA does not have an established page limit for Phase II submissions. Please reference the DOD SBIR Submission site FAQs for more information on generating Phase II proposals. Due to limited funding, DMEA's ability to award any Phase II, regardless of proposal quality or merit, is subject to availability of funds. Please ensure that your proposal is valid for 120 days after submission, and any extension to that time period will be requested by the contracting officer.

Any follow-on Phase II proposal (i.e., a second Phase II subsequent to the initial Phase II effort) shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by the DMEA SBIR/STTR Program Manager in advance.

COST VOLUME GUIDELINES

The on-line cost volume for Phase I and Phase II proposal submissions must be at a level of detail that would enable DMEA personnel to determine the purpose, necessity, and reasonability of each cost element. Provide sufficient information (a. through h. below) on how funds will be used if the contract is awarded. Include the itemized cost volume information (a. through h. below) as an appendix in your technical proposal. The itemized cost volume information (a. through h. below) will not count against the 20-page limit on Phase I proposal submissions.

a. Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DOD Component; unless it is determined that transfer of the title to the contractor would be more cost effective than recovery of the equipment by the DOD Component.
b. Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, price, and where appropriate, purposes.
c. Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, costs incurred in obtaining temporary use of specialized equipment. Proposals, which include teased hardware, must provide an adequate lease *versus* purchase justification or rationale.
d. Direct Labor: Identify key personnel by name if possible or by labor category if specific names are not available. The number of hours, labor overhead and/or fringe benefits and actual hourly rates for each individual are also necessary.
e. Travel: Travel costs must relate to the needs of the project. Break out travel cost by trip, with the number of travelers, airfare, and per diem. Indicate the destination, duration, and purpose of each trip.
f. Cost Sharing: Cost sharing is permitted. However, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal.
g. Subcontracts: Involvement of university or other consultants in the planning and /or research stages of the project may be appropriate. If the offeror intends such involvement, describe the involvement in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases, or usage fees and other subcontract or purchase agreements may not exceed one-third of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer. Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e., Cost Volume). At the very least, a statement of work with a corresponding detailed cost volume for each planned subcontract must be provided.
h. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

DMEA SBIR PHASE II ENHANCEMENT PROGRAM

To encourage transition of SBIR into DOD systems, DMEA has a Phase II Enhancement policy. DMEA's Phase II Enhancement program requirements include: up to one-year extension of existing Phase II, and up to $550,000 matching SBIR funds. Applications are subject to review of the statement of work, the transition plan, and the availability of funding. DMEA will generally provide the additional Phase II Enhancement funds by modifying the Phase II contract.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

DMEA does not provide Discretionary Technical and Business Assistance (TABA).

PHASE I PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria must be met or your proposal will be REJECTED.

_____1. Your Technical Volume and DOD Cover Sheet, and the Cost Volume have been submitted electronically through the DOD submission site by 8:00 pm ET on 12 February 2020.

_____2. The Phase I proposal does not exceed $167,500 (excludes Discretionary Technical and Business Assistance (TABA) amount).

DMEA SBIR 20.1 Topic Index

DMEA SBIR 20.1 Topic Descriptions

DMEA201-001 TITLE: Robust Readout of DNA Marking for Electronic Counterfeit Detection

TECHNOLOGY AREA(S): Chemical/Biological Defense, Electronics, Materials/Processes, Sensors

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

OBJECTIVE: Develop and validate quantitative techniques to read and interpret DNA sequences used for management of supply chain security of electronic components.

DESCRIPTION: Management of supply chain security to detect counterfeit electronics is a global challenge. According to the Defense Standardization Program Office (DSPO) Journal, counterfeit electronic is defined as "One whose identity and pedigree has been deliberately altered, misrepresented or offered as an authorized product." [1] There are various ways to confirm the authenticity of electronics such as X-ray microscopy inspection, physical de-layering and imaging and etc. [2] However, these methods either rely on destructive analysis or have limitations in spatial resolution, and therefore do not present viable solutions to effectively mitigate the spread of counterfeit electronics in various sectors of society; specifically military components.

Deoxyribonucleic acid (DNA) can provide a form of forensic evidence since it is composed of a sequence of organic bases and is customized by organisms. [3] DNA-signature taggants have been demonstrated as a potential solution to protect electronic components against counterfeiting and diversion. [4] To utilize DNA for supply chain product tracking and anti-counterfeiting, it is important to develop efficient and defect free DNA readers. There is a trade-off that needs to be considered for the design of an effective DNA reader. Specifically, decreasing the amount of DNA constituents used for tagging an electronic part increases the potential for cost savings during authentication. However, more DNA constituent in the taggants allows for utilizing the emerging fast reader technologies; e.g., microarray technique and nanopore sequencing. Meanwhile, there are other developing techniques, electrical conductance measurement that can potentially be developed into DNA readers. [5] Therefore, it is expected that the performer come up with an innovative idea leveraging the already developed methods to efficiently read DNA taggants used to potentially authenticate electronic components.

PHASE I: Perform a feasibility study to read DNA sequences in a robust manner. Specifically, conduct research on both hardware and software techniques capable of identifying the organic bases within a DNA sequence. The feasibility study is expected to include the following items:

1) Read and interpret signature DNA taggants with a yield of greater than 95%
2) Incorporate artificial intelligent (AI) to predict issues of adulteration
3) Distinguish between defect-free DNA taggants and one with defects included

PHASE II: Phase II will result in building, testing and delivering a prototype of the method developed in phase I. Prototype demonstration will include numerous testing data on three main samples. The first sample is composed of an electronic part marked by DNA taggants. The second sample is identical to the first sample except for the sequence of DNA used to label the part. And, the third sample is still identical to the first and the second one; however, with no DNA taggants. It is expected that the performer deliver all the mathematical justifications, reasoning, and software coding utilized to develop the prototype.

PHASE III DUAL USE APPLICATIONS: Phase III will result in the expansion of the prototype system in Phase II into a tested pre-production system, which entails a technique to read DNA taggants from labeled electronic components to protect the electronic supply chain from counterfeiting.

REFERENCES:
1. [1] Department of Commerce Bureau of Industry and Statistics Survey Results, Department of Commerce (2010).

2. [2] N. Asadizanjani, et al., “PCB Reverse Engineering Using Nondestructive X-ray Tomography and Advanced Image Processing,” IEEE Transactions on Components, Packaging and Manufacturing Technology, vol. 7, no. 2, 2017.

3. [3] K. Sigmund, The physicist and the dawn of the double helix. Science, 366 (6461), p. 43, 2019.

4. [4] J. Hayward, et al., “DNA to Safeguard Electrical Components and Protect Against Counterfeiting and Diversion,” Proc 37th Int’l Symp for Testing and Failure Analysis, pp. 238-241, 2011.

5. [5] Hihath J., Xu B., Zhang P., Tao N. “Study of single-nucleotide polymorphisms by means of electrical conductance measurements,” Proc. Natl. Acad. Sci. USA. Pp. 16979–16983, 2005.

KEYWORDS: DNA Marking, Counterfeits, Semiconductor Devices, DNA Reading, Supply Chain

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY
20.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

GENERAL INFORMATION

The National Geospatial-Intelligence Agency has a responsibility to provide the products and services that decision makers, warfighters, and first responders need, when they need it most. As a member of the Intelligence Community and the Department of Defense, NGA supports a unique mission set. We are committed to acquiring, developing and maintaining the proper technology, people and processes that will enable overall mission success.

Geospatial intelligence, or GEOINT, is the exploitation and analysis of imagery and geospatial information to describe, assess and visually depict physical features and geographically referenced activities on the Earth. GEOINT consists of imagery, imagery intelligence and geospatial information.

With our unique mission set, NGA pursues research that will help guarantee the information edge over potential adversaries. Information on NGA's SBIR Program can be found on the NGA SBIR website at: https://www.nga.mil/Partners/ResearchandGrants/SmallBusinessInnovationResearch/Pages/default.aspx. Additional information pertaining to the National Geospatial-Intelligence Agency's mission can be obtained by viewing the website at http://www.nga.mil/.

Inquiries of a general nature or questions concerning the administration of the SBIR Program should be addressed to:

National Geospatial-Intelligence Agency
Attn: SBIR Program Manager, RA, MS: S75-RA
7500 GEOINT Dr., Springfield, VA 22150-7500
Email: SBIR@nga.mil

For technical questions and communications with Topic Authors, see DoD Instructions, Section. 4.15. For general inquiries or problems with electronic submission, contact DoD SBIR Help Desk at dodsbirsupport@reisystems.com or 1-703-214-1333 between 9:00 am and 5:00 pm ET.

PHASE I PROPOSAL INFORMATION

Follow the instructions in the DoD SBIR Program BAA for program requirements and proposal submission instructions at https://sbir.defensebusiness.org/.

NGA has developed topics to which small businesses may respond to in this fiscal year 2020 SBIR Phase I iteration. These topics are described on the following pages. **The maximum amount of SBIR funding for a Phase I award is $100,000, and the maximum period of performance for a Phase I award is nine months.** While NGA participates in the majority of SBIR program options, NGA does not participate in the either the Commercialization Readiness Program (CRP), Discretionary Technical Assistance (DTA or in future BAAs TABA (Technical and Business Assistance)) or Phase II Enhancement programs.

The entire SBIR proposal submission (consisting of a Proposal Cover Sheet, the Technical Volume, Cost Volume, and Company Commercialization Report) must be submitted electronically through the DoD

SBIR/STTR Proposal Submission system located at https://www.dodsbirsttr.mil/submissions/for it to be evaluated.
The Proposal Technical Volume (Volume 2) must be no more than 20 pages in length. The Cover Sheet (Volume 1) and Cost Volume (Volume 3) do not count against the 20-page Proposal Technical Volume page limit. Any Technical Volume that exceeds the page will not be considered for review. The proposal must not contain any type smaller than 10-point font size (except as legend on reduced drawings, but not tables). The vendor may submit supporting documents (Volume 5) but that material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation. Fraud, Waste and Abuse Training (Volume 6) will be addressed at time of contract award.

Selection of Phase I proposals will be in accordance with the evaluation procedures and criteria discussed in this BAA (refer to Section 6.0 of the BAA).

The NGA SBIR Program reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality in the judgment of the technical evaluation team will be funded. The offeror must be responsive to the topic requirements, as solicited.

An **unsuccessful offeror has 3 days after notification that its proposal was not selected to submit a written request for a debriefing to the Contracting Officer (CO).** Those offerors who get their written request in within the allotted timeframe above will be provided a debriefing.

Federally Funded Research and Development Contractors (FFRDC) and other government contractors, whom have signed Non-Disclosures Agreements, may be used in the evaluation of your proposal.
NGA typically provides a firm fixed price level of effort contract for Phase I awards. The type of contract is at the discretion of the Contracting Officer.

Phase I contracts will include a requirement to produce one-page monthly status reports and a more detailed interim report not later than 7½ months after award. These reports shall include the following sections:

- A summary of the results of the Phase I research to date
- A summary of the Phase I tasks not yet completed, with an estimated completion date for each task
- A statement of potential applications and benefits of the research.

The interim report (draft final report) shall be prepared single spaced in 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½" by 11" paper. The pages shall be numbered.

PHASE II GUIDELINES

Phase II is the demonstration of the technology found feasible in Phase I. All NGA SBIR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. To minimize the gap between the Phase I and Phase II, it is suggested that the vendor submit their proposal during month 7 of the Phase I award.

The NGA SBIR Program is committed to minimizing the funding gap between Phase I and Phase II activities. Phase I awardees may submit a Phase II proposal without invitation; However, it is strongly encouraged that an UNCLASSIFIED Phase II proposal not be submitted until sufficient Phase I progress can be evaluated and assessed based on results of the Phase I proof-of-concept/feasibility study Work Plan. Therefore, it is highly recommended to submit your UNCLASSIFIED proposal 60 days prior to the end date of their Phase I contract in order to be considered for funding. All NGA SBIR Phase II proposals will receive timely.

Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DoD SBIR/STTR Help Desk at (1-703-214-1333) or Help Desk email at dodsbirsupport@reisystems.com (9:00 am to 5:00 pm ET).

NGA SBIR Phase II Proposals have three UNCLASSIFIED Volumes: Proposal Cover Sheets, Technical Volume, and Cost Volume. The Technical Volume has a 40-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

Technical Volumes that exceed the 40-page limit will be reviewed only to the last word on the 40th page. Information beyond the 40th page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 40 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

The NGA SBIR Program will evaluate and select Phase II proposals using the evaluation criteria in Section 8.0 of the DoD SBIR Program BAA. Due to limited funding, the NGA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

NGA typically provides a firm fixed price contract as a Phase II award. The type of contract is at the discretion of the Contracting Officer.

Phase II proposals shall be limited to $1,000,000 over a two-year period with a Period of Performance not exceeding 24 months. A work breakdown structure that shows the number of hours and labor category broken out by task and subtask, as well as the start and end dates for each task and subtask, shall be included.

Phase II contracts shall include a requirement to produce one-page monthly status and financial reports, an interim report not later than 11 months after contract award, a prototype demonstration not later than 23 months after contract award and a final report not later than 24 months after contract award. These reports shall include the following sections:

- A summary of the results of the Phase II research to date
- A summary of the Phase II tasks not yet completed with an estimate of the completion date for each task
- A statement of potential applications and benefits of the research.

The interim and final report shall be prepared single spaced in 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½" by 11" paper. The pages shall be numbered.

USE OF FOREIGN NATIONALS

See the "Foreign Nationals" section of the DoD program announcement for the definition of a Foreign National (also known as Foreign Persons).

Due to the nature of our business, the use of foreign nationals on a NGA contract is PROHIBITTED. ALL offerors proposing to use foreign nationals on the effort will be ineligible for award. This includes the use at universities or any other subcontractor.

DISCLOSURE OF INFORMATION

(a) The Contractor shall not release to anyone outside the Contractor's organization any unclassified information, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract, unless—

> (1) The Contracting Officer has given prior written approval; or
> (2) The information is otherwise in the public domain before the date of release; or
> (3) **The information results from or arise during the performance of a project that has been scoped and negotiated by the contracting activity with the contractor and research performer and determined in writing by the Contracting Officer to be fundamental research*** in accordance with National Security Decision Directive 189, National Policy on the Transfer of Scientific, Technical and Engineering Information. In effect on the date of contract award, and the USD (AT&L) memoranda on Fundamental Research, dated May 24, 2010, and on Contracted Fundamental Research, dated June 26, 2008 (available at DFARS PGI 204.4).

(b) Requests for approval under paragraph (a)(1) shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Contractor shall submit its request to the Contracting Officer at least 10 business days before the proposed date for release.

***Note: This has to be negotiated prior to award of the contract. A request for determination after award will not be entertained and will result in the clause being pushed down to all subcontracts. Non-performance could result in cancelation of contract.**

5X52.227-9000 UNAUTHORIZED USE OF NGA NAME, SEAL AND INITIALS

(a) As provided in 10 U.S.C. Section 425, no person may, except with the written permission of the Director, National Geospatial-Intelligence Agency, knowingly use the words “National Geospatial-Intelligence Agency”, National Imagery and Mapping Agency” or “Defense Mapping Agency”, the initials “NGA”, “NIMA” or “DMA”, the seal of the National Geospatial-Intelligence Agency, National Imagery and Mapping Agency or the Defense Mapping Agency, or any colorable imitation of such words, initials, or seal in connection with any merchandise, retail product, impersonation, solicitation, or commercial activity in a manner reasonably calculated to convey the impression that such is approved, endorsed, or authorized by the Director, NGA.

(b) Whenever it appears to the U.S. Attorney General that any person is engaged or about to engage in an act or practice which constitutes or will constitute conduct prohibited by paragraph (a), the Attorney General may initiate a civil proceeding in a district court of the United States to enjoin such act or practice. Such court shall proceed as soon as practicable to hearing and determination of such action and may, at any time before such final determination, enter such restraining orders or prohibition, or take such other action as is warranted, to prevent injury to the United States, or to any person or class of persons whose protection the action is brought.

5X252.204-7000-90 PUBLIC RELEASE OF INFORMATION

Information pertaining to this contract shall not be released to the public except as authorized by the Contracting Officer in accordance with DFARS 252.204-7000, Disclosure of Information. Requests for approval to release information pertaining to this contract shall be submitted to the Contracting Officer by means of NGA Form 5230-1, National Geospatial-Intelligence Agency Request for Clearance for Public Release.

NGA SBIR 20.1 Topic Index

NGA SBIR 20.1 Topic Descriptions

NGA201-001 TITLE: Synthetic Data for Computer Vision in Remote Sensing

TECHNOLOGY AREA(S): Information Systems

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

OBJECTIVE: Develop novel techniques to identify and locate uncommon targets in overhead and aerial imagery, specifically by leveraging synthetic data to augment data classes for which minimal labeled data samples exist. Initial focus will on synthetic aperture radar (SAR) and panchromatic electro-optical (EO) imagery, with a subsequent extension to multi-spectral imagery (MSI).

DESCRIPTION: The National Geospatial Intelligence Agency (NGA) produces timely, accurate and actionable geospatial intelligence (GEOINT) to support U.S. national security. To continue to quickly and efficiently exploit the growing volume of imagery data and complexity of monitored objects, NGA must continue to improve its automated and semi-automated methods. Recent advances in computer vision will enable intelligence analysts to identify rare objects within large data volumes by leveraging AI tools. However, these approaches are data driven – presenting a challenge when few measured training samples exist. One approach to this problem is leveraging synthetic data for the sensor modality of interest (e.g. Xpatch, DIRSIG, Blender, IRMA).

However, when using synthetic data to train a network, one must address the tendency of the network to learn distinct synthetic features vs. the unique phenomenology representative of an object of interest. Architectures which seek to generate realistic data, as well as classification networks which are robust to the synthetic-measured gap are of interest.

PHASE I: Design and demonstrate methods that utilize synthetic SAR or EO data to augment a single few-shot class using government furnished SAR or EO image chips. Phase I will deliver a proof of concept algorithm suite, all data collected or curated, and thorough documentation of conducted experiments and results in a final report, with the goal of bolstering a strong Phase II proposal.

PHASE II: Develop enhancements to address identified deficiencies from Phase I. Extend Phase I capabilities by increasing the scale of the synthetic augmentation to include multiple few shot targets. This phase will also extend classification to include detection of objects of interest within a larger scene. Deliver updates to the proof of concept algorithm suite and technical reports. Phase II will result in a prototype end-to-end implementation of the Phase I few-shot detection system extended to process EO, SAR, and MSI imagery and a comprehensive final report.

PHASE III DUAL USE APPLICATIONS: Deep Learning, specifically Generative Adversarial Networks (GANs), have recently allowed the quick generation of convincing synthetic images and the refinement of simulated images to appear photorealistic. Applying these generative techniques to train computer vision classification and detection models in data-starved scenarios would have wide-spread applications across the government and commercial sectors.

REFERENCES:
1. Howe J; Pula K, and Reite A. “Conditional Generative Adversarial Networks for Data Augmentation and Adaptation in Remotely Sensed Imagery” arXiv:1908.13809

2. Andersh et al. “Xpatch 4: the next generation in high frequency electromagnetic modeling and simulation software", IEEE 2000 International Radar Conference.

3. Brown, S., Goodenough, A., “DIRSIG 5: core design and implementation”, SPIE 2012

4. Hess, R., 2010. “Blender Foundations: The Essential Guide to Learning Blender 2.6”, Focal Press.

5. Savage, J. et al, “Irma 5.2 multi-sensor signature prediction model”, SPIE 2008

6. Christopher Bowles et al, “GAN Augmentation: Augmenting Training Data using Generative Adversarial Networks”, arXiv preprint arXive:1810.1086

7. Kar, A. et al, “Meta-Sim: Learning to Generate Synthetic Datasets”, arXiv:1904:11621

8. Lau, F., ScarGAN: “Chained Generative Adversarial Networks to Simulate Pathological Tissue on Cardiovascular MR Scans”, arXiv:1808.04500

9. Lewis, B. et al, “A SAR dataset for ATR Development: the Synthetic and Measured Paired Labeled Experiment (SAMPLE)”, SPIE 2019

KEYWORDS: Computer Vision, Synthetic Data, Generative Adversarial Networks, Machine Learning, Deep Learning, Few Shot Learning, Image Processing

NGA201-002 TITLE: Hierarchical Computer Vision in Remote Sensing

TECHNOLOGY AREA(S): Information Systems

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

OBJECTIVE: Develop novel techniques that incorporate class ontologies into automated detection and classification algorithms. Initial focus will be on panchromatic electro-optical (EO) imagery with a subsequent extension to multi-spectral imagery (MSI) and/or synthetic aperture radar (SAR) imagery.

DESCRIPTION: The National Geospatial Intelligence Agency (NGA) produces timely, accurate and actionable geospatial intelligence (GEOINT) to support U.S. national security. Intelligence analysts are central to the success of the NGA. Recent advances in computer vision will enable intelligence analysts to identify rare objects within large data volumes by leveraging AI tools. Of specific interest to this solicitation are techniques to exploit target hierarchies to help characterize objects which have few labeled data samples. These approaches will leverage both functional based hierarchy and data clustering approaches to provide support for rare object identification.

Most classification and detection work has focused on a flat class structure despite known correlations amongst the classes, i.e. an object which is labelled a “truck” can also be labelled a “vehicle”. The NGA is seeking the development of innovative techniques that will not only detect objects for a given class but provide a class hierarchy and naturally produce a general class label when insufficient training samples exist to support more specific class labels. The government has established a hierarchical detection dataset, xView, to support this research; but other datasets containing well-defined hierarchical structures such as ImageNet may also be used.

PHASE I: Design and demonstrate methods that incorporate class hierarchies into object detection and classification, providing multiple labels per class at inference time using panchromatic EO remote sensing imagery with consideration for an extension to MSI and SAR imagery. Phase I will deliver a proof of concept algorithm suite, all data collected or curated, and thorough documentation of conducted experiments and results in a final report, with the goal of bolstering a strong Phase II proposal.

PHASE II: Extend Phase I capabilities by increasing the breadth and depth of hierarchies, incorporating unlabeled data with semi-supervised techniques, and automatically learning hierarchical structures from visual correlations in unlabeled data. Develop enhancements to address identified risks and deficiencies from Phase I. Deliver updates to the proof of concept algorithm suite and technical reports. Phase II will result in a prototype end-to-end implementation of the Phase I hierarchical detection and classification systems extended to process MSI and/or SAR imagery and a comprehensive final report.

PHASE III DUAL USE APPLICATIONS: Computer vision technology incorporating hierarchical structure in learning and inference would be widely applicable across the government and commercial sectors. Military applications include national security, targeting, and intelligence. Commercially, such technology would apply to online retail, social networking, and photo software: any domain requiring computer vision with a hierarchical ontology

REFERENCES:
1. Lam, Darius, et al. "xView: Objects in context in overhead imagery." arXiv preprint arXiv:1802.07856 (2018).

2. Sergievskiy, Nikolay, and Alexander Ponamarev. "Reduced focal loss: 1st place solution to xview object detection in satellite imagery." arXiv preprint arXiv:1903.01347 (2019).

3. Silla, Carlos N., and Alex A. Freitas. "A survey of hierarchical classification across different application domains." Data Mining and Knowledge Discovery 22.1-2 (2011): 31-72.

4. Redmon, Joseph, and Ali Farhadi. "Yolov3: An incremental improvement." arXiv preprint arXiv:1804.02767 (2018).

5. Kuznetsova, Alina, et al. "The open images dataset v4: Unified image classification, object detection, and visual relationship detection at scale." arXiv preprint arXiv:1811.00982 (2018).

6. Reite, Aaron, et al. “Unsupervised Feature Learning in Remote Sensing.” arXiv preprint arXiv:1908.02877 (2019).

KEYWORDS: Computer Vision, Machine Learning, Deep Learning, Image Processing

NGA201-003 TITLE: Semi-supervised Detection in Remote Sensing

TECHNOLOGY AREA(S): Information Systems

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

OBJECTIVE: Develop novel techniques to identify and locate uncommon targets in overhead and aerial imagery, specifically by leveraging unsupervised or semi-supervised machine learning. Initial focus will be on panchromatic electro-optical (EO) imagery with a subsequent extension to multi-spectral imagery (MSI) and/or synthetic aperture radar (SAR) imagery.

DESCRIPTION: The National Geospatial Intelligence Agency (NGA) produces timely, accurate and actionable geospatial intelligence (GEOINT) to support U.S. national security. To continue to quickly and efficiently exploit the growing volume of imagery data and complexity of monitored objects, NGA must continue to improve its automated and semi-automated methods.

Recent advances in deep learning have dramatically improved the state-of-the-art for techniques such as object detection and semantic segmentation, including scenarios where little data is available for training (i.e., few/low-shot learning). NGA seeks innovative approaches that leverage a relatively small amount of target and task specific labeled data in combination with unlabeled data to support object detection and semantic segmentation. These approaches should provide a capability to quickly identify new target subclasses and classes with little to no labels. The government has established a detection dataset, xView, to support this research.

PHASE I: Design and demonstrate methods that leverage unlabeled data in combination with small volumes of labeled data to advance the state-of-the-art detection performance in panchromatic EO with special consideration for few-shot classes. Phase I will deliver a proof of concept algorithm suite, all data collected or curated, and thorough documentation of conducted experiments and results in a final report, with the goal of bolstering a strong Phase II proposal.

PHASE II: Extend Phase I capabilities by increasing the scale of the unlabeled dataset, sub-category discovery, and hierarchical classification. Develop enhancements to address identified risks and deficiencies from Phase I. Deliver updates to the proof of concept algorithm suite and technical reports. Phase II will result in a prototype end-to-end implementation of the Phase I few-shot detection system extended to process MSI and/or SAR imagery and a comprehensive final report.

PHASE III DUAL USE APPLICATIONS: Technology enabling the automated search for uncommon objects in overhead imagery would be widely applicable across the government and commercial sectors. Military applications include national security, targeting, and intelligence. Commercially, such technology would apply to urban planning, geology, agriculture, economics, and search and rescue; and all other domains that benefit from identifying objects in overhead imagery.

REFERENCES:

1. Lam, Darius, et al. "xView: Objects in context in overhead imagery." arXiv preprint arXiv:1802.07856 (2018).

2. Sergievskiy, Nikolay, and Alexander Ponamarev. "Reduced focal loss: 1st place solution to xview object detection in satellite imagery." arXiv preprint arXiv:1903.01347 (2019).

3. Xie, Qizhe, et al. "Unsupervised data augmentation." arXiv preprint arXiv:1904.12848 (2019).

4. Wu, Zhirong, et al. "Unsupervised feature learning via non-parametric instance discrimination." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2018.

5. Reite, Aaron, et al. "Unsupervised Feature Learning in Remote Sensing." arXiv preprint arXiv:1908.02877 (2019).

KEYWORDS: Computer Vision, Machine Learning, Deep Learning, Detection, Segmentation, Few Shot Learning, Unsupervised Learning, Semi-supervised Learning, Image Processing

NGA201-004 TITLE: Improved analysis of overhead imagery using low-shot learning with spatio-temporal constraints

TECHNOLOGY AREA(S): Information Systems, Sensors

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

OBJECTIVE: Develop techniques to improve the detection, classification, and/or identification of objects in overhead imagery, as well as the characterization of any changes over time (including but not limited to appearance, orientation, and movement). Design a system that allows an image analyst to apply these techniques to multi-source sensor data to improve analysis products and/or accelerate current workflows.

DESCRIPTION: The National Geospatial-Intelligence Agency (NGA) and other Department of Defense (DoD) partners use geospatial intelligence (GEOINT) derived from still and full-motion overhead imagery to support U.S. national security. Imagery captured from satellite and airborne platforms and associated metadata can vary significantly in quality and frequency of collection. As a result, GEOINT analysis is a challenging task that typically involves analysis of multiple, independent data sources and correlation/fusion of results.

This topic seeks to explore innovative techniques for improving GEOINT analysis by explicitly leveraging spatio-temporal context. One of the most fundamental tasks in computer vision is to detect objects in an image, and several techniques have been described in the academic literature for training models with only few training samples [Ref 1-2]. However, these were developed for generic use cases (e.g., common household objects, commercial applications) but GEOINT data has some unique characteristics that can be exploited. In particular, GEOINT has both a spatial and a temporal component that provides additional context that can both inform and constrain the analysis problem. To use a concrete example, consider the task of object detection in a sequence of images with varying quality: if objects are identified with high confidence in a high-quality image, then this information could be used to bias (i.e., relax or constrain) the analysis of images taken over the same location with different resolutions, collection geometries, scale, illumination, seasonal variations, and sensor modality. Object identity/disambiguation across multiple images should be addressed with meaningful confidence estimates.

The proposed approach should have a mathematical basis and/or intuitive underpinning and be computationally tractable on modern hardware (i.e., CPU / GPU). The proposer should provide software and a detailed technical report.

PHASE I: Design a proof-of-concept system to incorporate spatio-temporal context into the GEOINT analysis process. Offerors should clearly detail anticipated challenges associated with collection from different times, geometries, and platforms and how to address those challenges with processing and/or mitigation strategies, together with methods to provide uncertainty estimates for the automated analysis to be produced. The technical approach should be described in the report and be accompanied with a demonstration and/or experimental results on sample data.

PHASE II: Implement Phase I capabilities in software and apply to operational imagery. Design and develop a user interface and/or integrate with existing tools to expose algorithm functionality to imagery analysts. Deliverables include a final report and software.

PHASE III DUAL USE APPLICATIONS: Phase III would extend Phase II capabilities to other sensors or modalities, e.g., infrared (IR) or synthetic aperture (SAR). The technology can also be applied to commercial motion imagery systems to improve the quality and information content of video products. The system has military and Intelligence Community application for still and motion imagery content exploitation.

REFERENCES:
1. L. Fei-Fei, R. Fergus and P. Perona. “One-Shot learning of object categories.” IEEE Transactions on Pattern Analysis and Machine Intelligence, 28(4), 594 - 611, 2006.

2. W. Wang, et al. “A Survey of Zero-Shot Learning: Settings, Methods, and Applications.” ACM Transactions on Intelligent Systems and Technology, 10(2), article 13, 2019.

KEYWORDS: GEOINT, machine learning, neural networks, low-shot learning, artificial intelligence, spatio-temporal data, imagery, uncertainty estimation

NGA201-005 TITLE: Learning traffic camera locations using vehicle re-identification

TECHNOLOGY AREA(S): Information Systems

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

OBJECTIVE: Learn the relationship between traffic cameras in order to infer geographical locations and orientations of an ensemble of traffic cameras.

DESCRIPTION: As cities continue to urbanize, surveillance cameras are increasingly used for the purpose of traffic monitoring and surveillance in intelligent transportation systems worldwide. As imagery and video technology has become more sophisticated and affordable, the quantity of these cameras have increased as well as the resolution and temporal frequency of collection, often approaching high-resolution video quality. This trend will only increase with the adoption of 5G technology, causing traffic camera imagery to become ever richer and more prevalent.

The precise location and orientation of a traffic camera are frequently not included in its imagery, often due to limited access. Thus, given feeds from an ensemble of traffic cameras from a region of interest (such as a neighborhood, city, or even broader parts of a country), the geographic relations between cameras are unknown. This makes the task of tracking or geo-locating a target or object of interest that may appear in camera imagery unfeasible.

However, there is information in the image content that can be leveraged to establish relations between cameras. Object detection (to include vehicle detection) is a well-studied computer vision problem. In particular, there have been advances deep learning research toward the problem of vehicle re-identification [1] across multiple cameras with different angles, illuminations, and resolutions.
The goal of this problem is to use computer vision techniques, including but not limited to vehicle re-identification, to model statistical correlations or similarities between pairs of cameras that correspond to geographical proximity. Given an ensemble of related traffic camera imagery, construct a proximal network among the cameras [2]. The induced network should approximate the physical road network thus providing estimates to camera location and

orientation.

PHASE I: Develop algorithms and demonstrate ability to perform multi-camera vehicle re-identification. Identify the statistical techniques used to correlate pairs of cameras based on computer vision capabilities developed.

PHASE II: Construct a working prototype that builds a network representing camera proximities using the technologies and tools identified in Phase I at scale. Demonstrate that this induced network provides geographical information by incorporating open source information such as physical road networks. Quantify estimates of geographic resolution and uncertainty.

PHASE III DUAL USE APPLICATIONS: Military Applications: Automated surveillance, Technical Intelligence, Photogrammetry, vehicle tracking and route prediction
Commercial Applications: Photogrammetry, Surveillance

REFERENCES:
1. Liu, Xinchen, et al. "Large-scale vehicle re-identification in urban surveillance videos." 2016 IEEE International Conference on Multimedia and Expo (ICME). IEEE, 2016.

2. Atanasov, Nikolay, et al. "Joint estimation and localization in sensor networks." 53rd IEEE Conference on Decision and Control. IEEE, 2014.

KEYWORDS: computer vision, deep learning, photogrammetry, pattern recognition

NGA201-006 TITLE: Automating tilt and roll in ground-based photos and video frames

TECHNOLOGY AREA(S): Information Systems

RESEARCH & TECHNOLOGY AREA(S):

ADVANCED CAPABILITIES:

ACQUISITION & SUSTAINMENT AOR:

OBJECTIVE: Fully automate the processes to recover camera orientation parameters in ground-based photos and video frames.

DESCRIPTION: NGA would like to better understand the earth using ground-based cameras and videos systems that are used at or close to the earth's surface. Analysts today use manual methods to recover orientation parameters by rotating them to adjust for roll displacement. Adjusting for pitch is also a manual process where analysts estimate the true horizon and add an upper and lower bound. We are looking to fully automate these techniques through advanced computer vision techniques. Due to the increasing resolution of consumer-grade cameras and video systems, it is now becoming possible to extract relevant image data from ground level photos and videos with high accuracy from a wide variety of sources. There have been several papers on this subject that describes research in these areas. This topic desires a fully automated batch processing module for use by government and commercial applications. The fully automated system will accept images in which a horizon has been labeled by computer vision techniques. The module will automatically estimate pitch and roll. Subsequently upper and lower error bounds for the horizon will be automatically estimated. By doing this it is possible to determine the pitch and roll of the camera to the ground-based photo or video frame without any examination of metadata. Offerors might want to suggest other ideas like a fully automated three point camera model solution established through using vanishing lines. This could help us automate other modules that we are currently looking at in our processing chain. Proposed evaluation criteria, and methods to obtain ground-truth imagery sets for both development and testing, should be specified in the proposal.

PHASE I: Identify potential solutions for estimating pitch and roll in ground based images when given an image and a previously extracted horizon line using advanced computer vision techniques. No metadata will be included in the image, but some government supplied testing data is available. The ground-based photos and video frames will need to have a pitch upper and lower bound identified and labeled. Design an approach to automate camera orientation parameters, with proof of concept demonstrations.

PHASE II: Obtain, develop, integrate, demonstrate and evaluate a prototype that incorporates real-world ground-based photos and video frames. Test and develop algorithmic methods to fully automate the extraction of camera orientation parameters while rigorously tracking error. Generate and/or collect a wide body of data for training and testing, and develop performance figures under varying operating conditions and varying sensor types, taking into account possible confounding factors.

PHASE III DUAL USE APPLICATIONS: Integrate a fully tested module as described above. Developers might consider licensing of software, but might also consider providing services against large databases of imagery supplied by commercial companies.

REFERENCES:
1. Detecting vanishing points using global image context in a non-manhattan world. Menghua Zhai, Scott Workman, and Nathan Jacobs. In CVPR, 2016.
https://www.cvfoundation.org/openaccess/content_cvpr_2016/papers/Zhai_Detecting_Vanishing_Points_CVPR_2016_paper.pdf

2. Horizon Lines in the Wild. Workman S., Zhai M., Jacobs N. In: British Machine Vision Conference (BMVC), 2016. http://www.bmva.org/bmvc/2016/papers/paper020/paper020.pdf

3. A machine learning approach to horizon line detection using local features. Touqeer Ahmad, George Bebis, Emma E Regentova, and Ara Nefian. In the International Symposium on Visual Computing, 2013.
https://www.cse.unr.edu/~bebis/ISVC13_Horizon.pdf

4. A global approach for the detection of vanishing points and mutually orthogonal vanishing directions. M. Antunes and J. P. Barreto. In CVPR, 2013.
https://www.cvfoundation.org/openaccess/content_cvpr_2013/papers/Antunes_A_Global_Approach_2013_CVPR_paper.pdf

5. Non-iterative approach for fast and accurate vanishing point detection. J.-P. Tardif. In ICCV, 2009.
http://www.cs.hunter.cuny.edu/~ioannis/JVPs.pdf

6. Vanishing point detection without any a priori information. A. Almansa, A. Desolneux, and S. Vamech. PAMI, volume 25(4):502–507, 2003. https://desolneux.perso.math.cnrs.fr/papers/ADV_vpoint_03.pdf

7. Automatic recovery of relative camera rotations for urban scenes. M. E. Antone and S. Teller. In CVPR, 2000.
https://people.csail.mit.edu/teller/pubs/AntoneTellerCVPR2000.pdf

KEYWORDS: Machine learning, horizon lines, vanishing point, rotation

Manufacturing Technology Program (ManTech)
Office of the Secretary of Defense (OSD)
20.1 Small Business Innovation Research (SBIR)
Direct to Phase II
Proposal Submission Instructions

INTRODUCTION

The Manufacturing Technology Program (ManTech) is participating under the OSD SBIR Program on this SBIR 20.1 Broad Agency Announcement (BAA).

Proposers responding to the ManTech topic listed in this Announcement must follow all instructions provided in the DoD SBIR 20.1 Broad Agency Announcement (BAA) posted on the DoD SBIR/STTR website at: https://sbir.defensebusiness.org/.

Firms with strong research and development capabilities in science or engineering in any of the topic areas described in this section, and with the ability to commercialize the results, are encouraged to participate. The OSD SBIR Program will support high quality research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector.

Objectives of the OSD SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DOD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DOD-supported research and development results. The guidelines presented in the solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD and the private sector.

CHART 1: Consolidated SBIR Topic Information

Applicable Topics	Direct to Phase II				
	Technical Volume (Vol 2)	Additional Info (Vol 5)	Award Amount	*Technical Duration	*Final Reporting Period
OSD201-D001	Not to exceed 10 pages	N/A	Not to exceed $1,650,000.00	18 months	1 month

DIRECT TO PHASE II

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows the Department of Defense to make an award to a small business concern under Phase II of the SBIR program with respect to a project, without regard to whether the small business concern was provided an award under Phase I of an SBIR program with respect to such project. OSD is conducting a "Direct to Phase II" implementation of this authority for this 20.1 SBIR Announcement and does not guarantee Direct to Phase II opportunities will be offered in future Announcements. Each eligible topic requires documentation to determine that Phase I feasibility described in the Phase I section of the topic has been met.

The OSD SBIR Program reserves the right to not make any awards under this Direct to Phase II solicitation. The Government is not responsible for expenditures by the offeror prior to award of a contract. All awards are subject to availability of funds and successful negotiations.

The OSD/ManTech SBIR Direct to Phase II Proposals are different than traditional SBIR Phase I topics and proposals.

Offerors must create a Cover Sheet using the DoD Proposal submission system (follow the DoD Instructions for the Cover Sheet located in section 5.4.a. Offerors must provide documentation that satisfies the Phase I feasibility requirement that will be included as an Appendix to the Phase II proposal. Offerors must demonstrate that they have completed research and development through means other than the SBIR/STTR program to establish the feasibility of the proposed Phase II effort based on the criteria outlined in the topic description.

The Cover Sheet and applicable documentation must be submitted to the DOD SBIR/STTR website submission website at https://www.dodsbirsttr.mil/submissions/ by no later than 8:00 p.m. EDT on 12 February, 2020.

Offerors are required to provide information demonstrating that the scientific and technical merit and feasibility has been established. OSD will not evaluate the offeror's related Phase II proposal if it determines that the offeror has failed to demonstrate that technical merit and feasibility has been established or the offeror has failed to demonstrate that work submitted in the feasibility documentation was substantially performed by the offeror and/or the principal investigator (PI).

Refer to the Phase I description (within the topic) to review the minimum requirements that need to be demonstrated in the feasibility documentation. None of the feasibility documentation should be based on work performed under prior or ongoing federally funded SBIR or STTR work.

PROPOSAL SUBMISSION

The complete proposal, i.e., DoD Cover Sheet, Technical Volume, and Cost Proposal must be submitted electronically at https://www.dodsbirsttr.mil/submissions/. Only one Phase II proposal file can be uploaded to the DoD Submission Site. Ensure your complete technical volume and additional cost volume information is included in this sole submission. The required submission format is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. Please remember to virus-check all proposal submissions.

DIRECT TO PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND PROPOSAL REQUIREMENTS

The Technical Volume is limited to 10 pages, which includes the feasibility documentation. The Cover Sheet, Cost Volume and Commercialization Report do not count toward the 10-page limitation. Technical Volumes that exceed the 10-page limit will be reviewed only to the last word on the 10^{th} page. Information beyond the 10^{th} page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 10 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

Phase II proposals require a comprehensive, detailed submission of the proposed effort. The period of performance for the OSD Direct to Phase II award is for an 18-month base period for topic OSD201-D001.

OSD Direct to Phase II efforts are awarded up to a maximum value of the dollar amounts listed in Chart 1. Commercial and military potential of the technology under development is extremely important. Proposals emphasizing dual-use applications and commercial exploitation of resulting technologies are sought.

A. Proposal Requirements. A Phase II proposal should provide sufficient information to persuade the OSD that the proposed advancement of the technology represents an innovative solution to the scientific or engineering problem and is worthy of support under the stated criteria. All sections below count toward the page limitation, unless otherwise specified.

B. Proprietary Information. Information constituting a trade secret, commercial or financial information, confidential personal information, or data affecting national security must be clearly marked. It shall be treated in confidence to the extent permitted by law. Be advised, in the event of proposal selection it is likely the Work Plan or Statement of Work (SOW) will be incorporated into the resulting contract, in whole or part, by reference or as an attachment. Therefore, segregate any information to be excluded from public release pursuant to the Freedom of Information Act (FOIA). See Section 5.3 of the DOD Solicitation regarding marking of proprietary information.

C. General Content. Proposals should be direct, concise, and informative. Type shall be no smaller than 11-point on standard 8 ½ x 11 paper, with one-inch margins and pages consecutively numbered. Offerors are discouraged from including promotional and non-programmatic items.

D. Feasibility Documentation

a) Page length for feasibility documentation is included in the overall 10-page limit. If you have references, include a reference list or works cited list as the last page of the feasibility documentation. This will count towards the page limit.
b) Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Technology in the feasibility documentation is subject to intellectual property (IP) rights, the offeror must provide IP rights assertions. Provide a good faith representation that you either own or possess appropriate licensing rights to all IP that will be utilized under your proposal. Additionally, proposers shall provide a short summary for each item asserted with less than unlimited rights that describes the nature of the restriction and the intended use of the intellectual property in the conduct of the proposed research. Please see section 11.5 of the DOD instructions for information regarding technical data rights.

E. Cost Proposal: A detailed cost proposal must be submitted. Cost proposal information will be treated as proprietary. Proposed costs must be provided by both individual cost element and contractor fiscal year (FY) in sufficient detail to determine the basis for estimates, as well as the purpose, necessity, and reasonableness of each. This information will expedite award of the resulting contract if the proposal is selected for award.

METHOD OF SELECTION AND EVALUATION CRITERIA

Other factors considered during the selection process include technical approach, appropriate demonstration of feasibility of the technology, equivalent to that resulting from Phase I type efforts; commitment for Phase III funding; possible duplication with other R/R&D; program balance; budget limitations; and potential, if successful, of leading to a product of continuing interest to DoD. Where technical evaluations are essentially equal in merit, and as cost and/or price is a substantial factor, cost to the Government will be considered in determining the successful offeror. OSD anticipates pricing will be based on adequate price competition. The next tie-breaker on essentially equivalent proposals is the inclusion of manufacturing considerations and/or the utilization and/or collaboration with a Department of Defense sponsored Manufacturing Innovation Institute and/or their component members. Phase II evaluations may include on-site assessment of the offeror's research results to date, or of the Contractor's facility, by Government personnel. The reasonableness of proposed costs for the Phase II effort will be examined to determine proposals offering the best value to the Government.

CERTIFICATIONS

In addition to the standard Federal and DoD procurement certifications, the SBA SBIR/STTR Policy Directives require the collection of certain information from firms at the time of award and during the award life cycle. Each firm must provide this additional information at the time of the Phase II award, prior to receiving 50% of the total award amount for a Phase II award, and prior to final payment on the Phase II award.

TECHNICAL INQUIRIES

During the Pre-release Period of the DoD 20.1 SBIR Broad Agency Announcement (BAA), any questions should be limited to specific information that improves the understanding of a particular topic's requirements. All questions must be submitted in writing either by email to the TPOC listed or posted in the online SBIR/STTR Interactive Topic Information System (SITIS) – all questions and answers will be released to the general public. All inquiries must include the topic number in the subject line of the e-mail.

After the Pre-release period, all questions must be posted in the online SITIS System. Please follow the instructions in section 4.15.d of the DoD 20.1 SBIR BAA Instructions.

PROPOSAL SUBMISSION

In order to participate in the ManTech SBIR Program, all potential proposers should register on the DoD SBIR/STTR Web site at https://www.dodsbirsttr.mil/submissions/ as soon as possible. This site contains step-by-step instructions for the preparation and submission of the complete proposal. It is required that all proposers submit their proposal electronically through the DoD SBIR/STTR Proposal Submission Web site at https://www.dodsbirsttr.mil/submissions/. For general inquiries or questions about the proposal electronic submission process, contact the DoD SBIR Help Desk at 703.214.1333 (9:00 a.m. to 5:00 p.m. ET).

Proposals shall be submitted in response to the specific ManTech topic identified in the topic description section following these instructions.

ManTech does not provide Direct Technical and Business Assistance (TABA).

ManTech SBIR Program Point of Contact:

General inquiries concerning the DoD ManTech SBIR Program should be addressed to:

Ms. Tracy Frost, OSD ManTech SBIR Program Manager
Tracy.g.frost.civ@mail.mil

OSD SBIR 20.1 Topic Index

OSD SBIR 20.1 Topic Descriptions

OSD 201-D001 TITLE: Applied machine learning optimized cloud environment with end-to-end encryption utilizing identity based security with polymorphic encryption

TECHNOLOGY AREA(S): Electronics

RESEARCH & TECHNOLOGY AREA(S): Cybersecurity

ACQUISITION PROGRAM: Manufacturing Technology Program

OBJECTIVE: A key component of securing data is securely moving it from the environment, which has the most risks into a controlled environment. DoD is seeking development of a that applies machine learning to cloud infrastructure utilization to identify optimization patterns and security anomalies.

DESCRIPTION: The Defense Industrial Base (DIB) needs to implement secure environments to be able to innovate and be highly resistant to modern cyber threats. Utilizing both identity-based encryption in a zero-trust network with advanced encryption algorithms in an single solution would allow the industrial base the advantages of a repeatable model with best-practice configurations in a quickly deployable public cloud environment to operate securely and effectively in conjunction with greatly improved on-premise security and encryption mechanisms.

Security of classified and CUI data is critical to the mission of the DoD. The DIB requires a way to secure their data both in motion and at rest to support the DoD's mission. Current solutions for technology innovators working with the DoD require significant operational complexity, additional manpower, infrastructure, and significant cost which increases time-to-market and often leaves gaps in security of confidential, classified and proprietary data. DoD is seeking data in motion hardware devices, that support the polymorphic encryption and decryption of data. The use of both hardware implementations that support the polymorphic encryption and decryption of data increases the cryptographic strength to protect the data beyond what is readily available in the market today.

PHASE I: Explore and determine the fundamental technology, systems integration, and commercialization limitations in implementing and distributing the technology. Phase I deliverables are a final report and proof of concept demonstration. The final report should describe the analysis of access and utilization patterns over time as an indication of ways to optimize spending and identify behaviors that might be abnormal which could trigger alerts or take immediate actions based on predefined playbooks.

PHASE II: Develop a fully operational proof-of-concept demonstration of the key components and functional systems and/or prototype along with all design documents and complete specifications along with documentation of committed sources and service providers for the fabrication of the device to be produced in Phase II. Develop software drivers and libraries with built-in encryption to secure data going to/from a popular database and within file systems with polymorphic encryption. Demonstrate capability to determine what data is stored where via automated assessment. Phase II is expected to collaborate with relevant DOD Manufacturing Innovation Institute or Manufacturing USA Manufacturing Innovation Institute and/or their component members as a resource to develop manufacturing readiness of the proposed solution.

For Direct to Phase II topics, OSD ManTech is expecting that the submitting firm will have:
- Determined the technical feasibility of developing the encryption device.
- Demonstrated ability of critical infrastructure modeling and simulation approaches.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e. the small business must have performed Phase I-type research and development related to the topic, but from non-SBIR funding sources) and describes the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI).

PHASE III DUAL USE APPLICATIONS: Refine and mature cyber-physical models relating to installation management and manufacturing technologies, as well as integration of analytics into operational cyber defenses for government or commercial payors.

KEYWORDS: cyber security, data analytics, critical infrastructure

UNITED STATES SPECIAL OPERATIONS COMMAND
20.1 Small Business Innovation Research (SBIR)
Phase I Proposal Submission Instructions

Introduction:

The United States Special Operations Command (USSOCOM) seeks small businesses with strong research and development capabilities to pursue and commercialize technologies needed by Special Operations Forces through the Department of Defense (DoD) SBIR 20.1 Program Broad Agency Announcement (BAA). A thorough reading of the "Department of Defense Small Business Innovation Research (SBIR) Program, SBIR 20.1 Program Broad Agency Announcement (BAA)" prior to reading these USSOCOM instructions is highly recommended.

These USSOCOM instructions explain USSOCOM specific aspects that differ from the DoD Announcement and its instructions.

Table 1: Consolidated SBIR Topic Information

Topic	Technical Volume (Vol 2)	Additional Info. (Vol 5)	Period of Performance	Award Amount	Contract Type
Phase I SOCOM20-001	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 6 months	Typically $150,000	Firm-Fixed-Price
Phase I SOCOM20-003	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 6 months	Typically $150,000	Firm-Fixed-Price

Technical Inquiries:

During the Pre-release Period of the DoD SBIR 20.1 Program BAA, all questions must be submitted in writing either by e-mail to sbir@socom.mil or to the online SBIR/STTR Interactive Topic Information System (SITIS). All questions and answers submitted to SITIS will be released to the general public. USSOCOM does not allow inquirers to talk directly or communicate in any other manner to the topic authors (differs from Section 4.15.c. of the DoD SBIR 20.1 Program BAA instructions). **All inquiries must include the topic number in the subject line of the e-mail.**

During the Open Period, follow the instructions in section 4.15.d of the DoD SBIR 20.1 Program BAA Instructions.

Site visits will not be permitted during the Pre-release and Open Periods of the DoD SBIR 20.1 Program BAA.

Proposal Volumes:

Volume 1: Cover page required per DoD instructions.

Volume 2: Technical Volume
The Technical Volume page count will include all the required items under section 5.4.c of the DoD SBIR 20.1 instructions and shall not exceed 5 pages. Offerors shall also submit a slide deck not to exceed 15 PowerPoint slides in Volume 5 and there is no set format requirements for the two documents. It is recommended (but not required) that more detailed information is included in the technical volume and

higher level information is included in the slide deck. The Cost Volume (Volume 3) for the Special Topics will cover the total effort.

The identification of foreign national involvement in a USSOCOM SBIR topic is needed to determine if a firm is ineligible for award on a USSOCOM topic that falls within the parameters of the United States Munitions List, Part 121 of the International Traffic in Arms Regulation (ITAR). A firm employing a foreign national(s) (as defined in paragraph 3.5 entitled "Foreign Nationals" of the DoD SBIR 20.1 Announcement) to work on a USSOCOM ITAR topic must possess an export license to receive a SBIR Phase I contract.

Volume 3: Cost Volume
Companies submitting a Phase I proposal under this BAA must complete the DoD Phase I simplified Cost Volume using the DOD on-line form, with a base cost typically $150,000 not to exceed $225,000 plus Technical and Business Assistance (TABA) cost (if applicable) not to exceed $6,500 over a period of up to six months.

USSOCOM may provide TABA funds in Phase I awards to firms to meet Cybersecurity Maturity Model Certification (CMMC) Level 1 certification requirements. Draft of the CMMC is located at [site is down - contact sbir@socom.mil].

The TABA information must be included in the firm's cost proposal specifically identified as "Discretionary Technical and Business Assistance" and cannot be subject to any profit or fee by the requesting SBIR firm. In addition, the provider of the TABA may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider). Proposed TABA will be evaluated by the USSOCOM SBIR Program office. The proposed amount is in addition to the award amount for Phase I and cannot exceed $6,500. The firm's proposal must (1) clearly identify the need for assistance (purpose and objective of required assistance); (2) provide details on the provider of the assistance (name and point of contact for performer and unique skills/specific experience to carry out the assistance proposed); and (3) the cost of the required assistance (costs and hours proposed or other details on arrangement that would justify the proposed expense).

A minimum of two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing firm. The percentage of work is measured by both direct and indirect costs as a percentage of the total contract cost.

Volume 4: Company Commercialization Report – not in use for 20.1 BAA
Required by DoD but not evaluated by USSOCOM.
Volume 5: Supporting Documents
Potential Offerors shall submit a slide deck not to exceed 15 PowerPoint slides.
Volume 6: Fraud, Waste and Abuse Training
Not required by USSOCOM.

Phase I proposals shall NOT include:

1) Any travel for Government meetings. All meetings with the Government will be conducted via electronic media.
2) Government furnished property or equipment.
3) Priced or Unpriced Options.
4) A Technical Volume exceeding five pages. USSOCOM will only evaluate the first five pages of the Technical Volume. Additional pages will not be considered or evaluated.

5) “Basic Research” (or “Fundamental Research”) defined as a “Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind.”
6) Human or animal studies.

Phase I Evaluations:

USSOCOM evaluates Phase I proposals using the evaluation criteria specified in section 6.0 of the DoD 20.1 SBIR Announcement except for:

The Technical Volume and slide deck will be reviewed holistically. Proposals missing the slide deck will not be evaluated. The two-part evaluation process is explained below:

Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided in Section 6.0 of the DoD SBIR 20.1 BAA. Once the evaluations are complete, all Offerors will be notified as to whether they were selected to present the slide deck portion of their proposal.

Part II: Selected Offerors will receive an invitation to present their slide deck (30 minute presentation time / 30 minute question and answer), in a technical question and answer forum, to the USSOCOM evaluation team, on 10-11 March 2020 at the SOFWERX facility. All selected firms will be reimbursed $2,000 to offset presentation costs. This presentation will be evaluated by a panel against the criteria listed under Section 6.0 of the DoD SBIR 20.1 BAA. Notifications of selection/non-selection will be completed within the following five business days.

Additionally, input on technical aspects of the proposals may be solicited by USSOCOM from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements. Non-Government personnel will not establish final assessments of risk, rate, or rank Offeror’s proposals. These advisors are expressly prohibited from competing for USSOCOM SBIR awards. All administrative support contractors, consultants, and advisors having access to any proprietary data will certify that they will not disclose any information pertaining to this announcement, including any submission, the identity of any submitters, or any other information relative to this announcement; and shall certify that they have no financial interest in any submission. Submissions and information received in response to this announcement constitutes the Offeror’s permission to disclose that information to administrative support contractors and non-Government consultants and advisors.

Selection Notifications:

The Government Contracting Officer will notify each Offeror by e-mail whether they have been selected for award. The e-mail notification will be sent to the Corporate Official (Business) identified by the Offeror.

Informal Feedback:

A non-selected Offeror can make a written request, within 30 calendar days of receipt of notification of non-selection, for informal feedback. USSOCOM will provide informal feedback within 30 calendar days of an Offeror’s written request rather than a debriefing as specified in paragraph 4.10, entitled "Debriefing," of the DoD SBIR 20.1 Announcement.

USSOCOM SBIR Program Point of Contact:

Inquiries concerning the USSOCOM SBIR Program should be addressed to sbir@socom.mil.

USSOCOM SBIR 20.1 Topic Index

USSOCOM SBIR 20.1 Topic Descriptions

SOCOM20-001 TITLE: Platform Agnostic Data Storage Infrastructure

TECHNOLOGY AREA(S): Battlespace, Information Systems

RESEARCH & TECHNOLOGY AREA(S):

ACQUISITION PROGRAM: Mission Support Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the Announcement.

OBJECTIVE: The objective of this topic is to develop a scalable platform agnostic data storage system that will allow cross indexing of layered data via the implementation of a common data standard employed through the minimum number of data translations of incoming data streams for the purposes of advanced big data analytics in a dynamic tool environment. Standard data will enable machine-to-machine communication required for advanced technologies including artificial intelligence and deep learning.

DESCRIPTION: USSOCOM is looking to explore options that provide Special Operations Force (SOF) Analysts with a common data standard driven database that can cross index layers based on any data point. The data repository can be utilized to support multiple tool suites allowing the data to be platform agnostic. This will enable SOF analysts to reduce the storage costs incurred by replicating data storage in different tool suites. At full capacity, this system will enable analysts to rapidly identify and extract information of value across all available data sources, significantly reducing the resources allocated to data mining.

Database key features shall include but not limited to the following:
1. Systems architecture must be able to process data from multiple sources, identify the data type, and label it according to the identified Common Data Standard for storage in the database.
2. Database must support multiple tables of data covering all data types common to the analytical work flow.
3. Employ graph database capability to support the cross-table research capability.
4. System must support field level classification and/or classification backed access control.
5. Database must be scalable from disconnected local resources up to fully integrated cloud solution.
6. Depict a potential hardware layout with volumetric estimates.
7. As part of this feasibility study, the offeror shall address all viable overall system design options with respective specifications.

Key Military applications: Multi-INT Processing, Exploitation, and Dissemination, Information Operations, Large Scale Analytics
Research/Analysis:
1. Significantly reduce analyst efficiency and effectiveness while simultaneously increasing the value of returned

results through automated correlations.
2. Create feeds into any available tool suite using an application program interface (API), allowing all intelligence disciplines to use current or emerging technologies without restrictions
3. Signature Identification and analysis of Big Data
4. Operational Adaptability and Decision-Making
5. AI assisted research and analysis.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraph entitled “Description.” To stimulate advances in technology and innovation, solutions including reusable code should be considered as well as re-use of open source code and potential integrations with fielded systems utilizing existing open interfaces and standards.

The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. Incorporate user input received during quarterly hands on assessments and evaluations in operationally realistic environments including a government test bed.

PHASE III DUAL USE APPLICATIONS: This data storage infrastructure could be used in a broad range of military applications where SOF and general-purpose forces require large scale common standards data storage for exploitation on virtually all intelligence and operations systems. This capability could also be adopted by first responders, federal law enforcement (Secret Service), and for organizations that require a need to geospatially depict big data sets in common standard format.

REFERENCES:

1. Multi-Cloud Strategy Fuels Need for Agnostic Platforms, https://www.networkcomputing.com/data-centers/multi-cloud-strategy-fuels-need-agnostic-platforms, accessed 30 May 2019

2. Large Scale Data Storage, https://www.sbir.gov/sbirsearch/detail/1308647, accessed 30 May 2019

3. “The Hyper Enabled Operator,” Small Wars Journal, https://smallwarsjournal.com/jrnl/art/hyper-enabled-operator#_edn2, accessed 30 May 2019

4. Next Generation Graph, https://www.sbir.gov/sbirsearch/detail/1532125, accessed 30 May 2019

5. “How Mobility Solutions are Transforming Military Tactical Operations and Driving Better Mission Outcomes,” https://insights.samsung.com/2018/12/13/how-mobility-solutions-are-transforming-military-tactical-operations-driving-better-mission-outcomes/, accessed 30 May 2019

6. Improving on the Lambda Architecture for streaming analysis, https://www.oreilly.com/ideas/improving-on-the-lambda-architecture-for-streaming-analysis, accessed 30 May 2019

KEYWORDS: Quantum Computing, Big Data, Data Science, Artificial Intelligence, Deep Learning, Lambda Architecture

SOCOM20-003 TITLE: Multi-FMV Fusion 3D Capability

TECHNOLOGY AREA(S): Air Platform, Battlespace, Human Systems, Information Systems, Sensors

RESEARCH & TECHNOLOGY AREA(S):

ACQUISITION PROGRAM: Program Executive Office - Special Reconnaissance, Surveillance and Exploitation

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the Announcement.

OBJECTIVE: The objective of this topic is to develop an Artificial Intelligence capability to aggregate multiple FMV sensor feeds into a single optimized and geo-rectified 3D FMV feed that can be shared by Special Operations Forces (SOF) operating in forward deployed areas of military operations. The capability will reduce distractions from multiple-FMV feeds and integrate with future 3D Virtual Reality and Augmented Reality visual augmentation systems at the tactical edge.

DESCRIPTION: USSOCOM is exploring options that provide SOF Operators with a “multi-FMV fused and optimized 3D visualization” capability that assimilates multiple UAV feeds into a single georeferenced 3D feed with continuous change detection to provide constant situational awareness of tactical areas. This aggregated single-FMV feed on handheld tactical devices will have the immediate effect of reducing warfighters cognitive burden from visualizing multiple FMV feeds. The single aggregated FMV feed will allow for transmission of the highest resolution 3D into software applications on various handheld devices such as the Android, Windows, and other SOF mobile devices employed in operational environments. The reduction of multi-feed operator distraction while enhancing FMV to 3D with continuous change detection is critical to effectively leverage tactical UAV sensors on the battlefield.

Operating system key features shall include but not limited to the following:
1. Systems architecture must be able to process georeferenced imagery from both commercial Unmanned Aerial Systems (UAS) and U.S. DoD group classified one (1) and two (2) UAS.
2. Assimilate multiple FMV feeds and stream fused and optimized single-FMV depiction in 3D in Open Geospatial Consortium (OGC) compliant formats such as CDB and GeoPackage.
3. Assess the feasibility of prototyping as FMV 3D streaming capability in combination with other emerging capabilities with lower Technology Readiness Levels.
4. Assess feasibility of combining optimized 3D FMV with the AI feature extraction (people, vehicles, weapons) with augmented GEOINT into a fully integrated 3D environment to de-clutter FMV feeds and provide optimal real-time situational awareness via a single FMV depiction for both TOC and warfighter.
5. Determine an accuracy estimate of optimized FMV data in relation to actual position/s on the ground.
6. Assess resolution of single optimized FMV relative to multiple input camera resolution. Provide potential UAS camera recommendations for greater fidelity and resolution in the optimized 3D FMV depiction.
7. As part of this feasibility study, the offeror shall address all viable overall system design options with respective specifications.

Key Military applications: Mission Rehearsal, Exercise, Tactical Operations, Mission Command Planning/Action Mission and Command:
1. Create Common Situational Understanding, Mission Command On-The-Move, Enable Unified Action Partner Collaboration
2. Create, Communicate, and Rehearse Orders
3. Airspace Control in Unified Action Mission Command
4. Operational Adaptability and Decision-Making

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraph entitled “Description.” To stimulate advances in technology and innovation, solutions including reusable code should be considered as well as re-use of open source code and integrations with fielded SOF systems utilizing existing open standards.

The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. Incorporate user input received during quarterly hands on assessments and evaluations in operationally realistic environments.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where SOF and general purpose forces can de-clutter the view of multiple use organic UAS assets to collect and exploit tactical data to plan operations, conduct rehearsals, and remotely coordinate actions on the objective with organizations that are not collocated with the ground tactical commander. This capability could also be adopted by first responders, federal law enforcement (Secret Service), and for organizations that require a need to simplify their organic FMV data for a specific area prior to and during execution of a task.

REFERENCES:

1. Ball, J. E., Anderson, D. T., & Chan, C. S. (2017). Comprehensive survey of deep learning in remote sensing: theories, tools, and challenges for the community. Journal of Applied Remote Sensing, 11(4), 042609.

2. Global Integrated ISR Operations, https://www.doctrine.af.mil/Doctrine-Annexes/Annex-2-0-Global-Integrated-ISR-Ops/, accessed 30 May 2019

3. Advanced Hyperspectral Exploitation Using 3D Spatial Information, https://sbir.defensebusiness.org/topics?topicId=30462, accessed 1 Jun 2019

4. "The Hyper Enabled Operator," Small Wars Journal, https://smallwarsjournal.com/jrnl/art/hyper-enabled-operator#_edn2, accessed 30 May 2019

5. Zhang, Liangpei, Lefei Zhang, and Bo Du. "Deep learning for remote sensing data: A technical tutorial on the state of the art." IEEE Geoscience and Remote Sensing Magazine 4.2 (2016): 22-40.

6. Integrated Sensor Architecture, https://www.cerdec.army.mil/news_and_media/Integrate_Sensor_Architecture/, accessed 30 May 2019

7. Mobile Awareness GEOINT Environment, http://ngageoint.github.io/MAGE/, accessed 30 May 2019

8. "How Mobility Solutions are Transforming Military Tactical Operations and Driving Better Mission Outcomes," https://insights.samsung.com/2018/12/13/how-mobility-solutions-are-transforming-military-tactical-operations-driving-better-mission-outcomes/, accessed 30 May 2019

KEYWORDS: Tactical Sensor, Austere Environment, Virtualized Data, virtual and augmented reality, artificial intelligence, deep learning, neural networks, human machine interface, surveillance and reconnaissance, Georeferenced Imagery

UNITED STATES SPECIAL OPERATIONS COMMAND
20.1 Small Business Innovation Research (SBIR)
Direct to Phase II Proposal Submission Instructions

Introduction:

The United States Special Operations Command (USSOCOM) 20.1 Direct to Phase II proposal submission instructions cover Direct to Phase II proposals only and change/append the Department of Defense (DoD) instructions for Phase II submissions as they apply to USSOCOM Direct to Phase II requirements. All Direct to Phase II proposals must be prepared and submitted through the DoD SBIR/STTR electronic submission site: https://www.dodsbirsttr.mil/submissions/.

A thorough reading of the "Department of Defense Small Business Innovation Research (SBIR) Program, SBIR 20.1 Program Broad Agency Announcement (BAA)" prior to reading these USSOCOM instructions is highly recommended. These USSOCOM instructions explain certain unique aspects of the USSOCOM SBIR Program that differ from the DoD Announcement and its instructions. The Offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of these instructions. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

These USSOCOM instructions explain USSOCOM specific aspects that differ from the DoD Announcement and its instructions.

Table 1: Consolidated SBIR Topic Information

Topic	**Technical Volume (Vol 2)**	**Additional Info. (Vol 5)**	**Period of Performance**	**Award Amount**
Direct to Phase II SOCOM20-D002	Not to exceed 10 pages not including Feasibility Appendix	15-page PowerPoint	Typically 18 months	Typically $1,000,000 to $1,500,000

SBIR Phase II awards may be issued under the authority of 10 United States Code § 2371b as a Prototype Other Transaction Agreement (OTA) rather than a contract under the Federal Acquisition Regulations (FAR). Successful completion of the prototype under an OTA may result in a follow-on production OTA or contract. Firms interested in having an OTA may download the template at https://www.socom.mil/SOF-ATL/Pages/sbir-20-1.aspx

Technical Inquiries:

During the Pre-release Period of the DoD SBIR 20.1 Program BAA, all questions must be submitted in writing either by e-mail to sbir@socom.mil or to the online SBIR/STTR Interactive Topic Information System (SITIS). All questions and answers submitted to SITIS will be released to the general public. USSOCOM does not allow inquirers to talk directly or communicate in any other manner to the topic authors (differs from Section 4.15.c. of the DoD SBIR 20.1 Program BAA instructions). **All inquiries must include the topic number in the subject line of the e-mail.**

During the Open Period, follow the instructions in section 4.15.d of the DoD SBIR 20.1 Program BAA Instructions.

Site visits will not be permitted during the Pre-release and Open Periods of the DoD SBIR 20.1 Program BAA.

USSOCOM does not provide Discretionary Technical and Business Assistance funds in its Direct to Phase II awards.

Proposal Volumes:

Volume 1: Cover page required per DoD instructions.

Volume 2: Technical Volume

The Technical Volume shall not exceed 10 pages and will include all required items under section 7.0 of the DoD SBIR 20.1 instructions. Any additional pages will be deleted from the proposal prior to evaluation.

Offerors must provide documentation to satisfy the Phase I feasibility requirement as specified in the direct to Phase II topic. The documentation shall be included as a Feasibility Appendix in the technical proposal volume; however, it is not included in the 10-page limit. Offerors are required to provide sufficient information to determine, to the extent possible, the scientific, technical, and commercial merit and feasibility of ideas submitted, and that this work was performed by the Offeror and/or the Principal Investigator. **If the Offeror fails to demonstrate the scientific and technical merit, feasibility, and/or the source of the work, USSOCOM will not continue to evaluate the Offeror's proposal.** Refer to the topic's Phase I description under the Direct to Phase II topic to review the minimum requirements needed to demonstrate feasibility.

The technical proposal shall include a Statement of Work (SOW) with the planned tasks and descriptions to meet the Statement of Objectives (SOO) and Contract Data Requirement Lists (CDRLs) DD Forms 1423. Do not upload the SOO or CDRLs with your proposal. The SOO, CDRLs, and Section K will be provided upon e-mail request sent to sbir@socom.mil or may be downloaded from https://www.socom.mil/SOF-ATL/Pages/sbir-20-1.aspx. These are provided to help the Offerors consider the required work/deliverables when developing the proposal. If an Offeror is selected for award, the Offeror will be required to submit a separate non-proprietary SOW with the planned tasks and descriptions from the proposal and all other sections of the SOO to attach to the resulting contract. The SOW attached to the contract shall include no proprietary information, data, or markings.

The identification of foreign national involvement in a USSOCOM SBIR topic is needed to determine if a firm is ineligible for award on a USSOCOM topic that falls within the parameters of the United States Munitions List, Part 121 of the International Traffic in Arms Regulation (ITAR). A firm employing a foreign national(s) (as defined in paragraph 3.5 entitled "Foreign Nationals" of the DoD SBIR 20.1 Announcement) to work on a USSOCOM ITAR topic must possess an export license to receive a SBIR Phase II contract.

Volume 3: Cost Volume

Offerors must complete the cost volume using the Phase II Cost Proposal Form posted on the USSOCOM section of the submission site. Offerors can contact the SBIR Help Desk at dodsbirsupport@reisystems.com or 703-214-1333 for assistance in obtaining the Cost Proposal Form or may be downloaded from https://www.socom.mil/SOF-ATL/Pages/sbir-20-1.aspx. The Cost Proposal information (PDF format) shall be appended to and submitted in Volume 3. Those recommended for award shall submit the original cost proposal in Excel format.

Phase II proposal base cost is typically $1,000,000 not to exceed $1,600,000 plus Technical and Business Assistance (TABA) cost (if applicable) not to exceed $50,000 over the period of performance.

USSOCOM may provide TABA funds in Phase II awards to firms to meet Cybersecurity Maturity Model Certification (CMMC) Level 3 certification requirements. Draft of the CMMC is located at [this site is currently down – contact sbir@socom.mil].

The TABA information must be included in the firm's cost proposal specifically identified as "Discretionary Technical and Business Assistance" and cannot be subject to any profit or fee by the requesting SBIR firm. In addition, the provider of the TABA may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider). Proposed TABA will be evaluated by the USSOCOM SBIR Program office. The proposed amount is in addition to the award amount for Phase II and cannot exceed $50,000. The firm's proposal must (1) clearly identify the need for assistance (purpose and objective of required assistance); (2) provide details on the provider of the assistance (name and point of contact for performer and unique skills/specific experience to carry out the assistance proposed); and (3) the cost of the required assistance (costs and hours proposed or other details on arrangement that would justify the proposed expense).

Cost proposal information should include the itemized listing (a-h) specified below. The cost proposal information must be at a level of detail that would enable contracting personnel to determine the purpose, necessity, and reasonability of each cost element. The itemized listing may be placed in the "Explanatory Material" section of the on-line Cost Proposal form, or as the last page(s) of the Cost Proposal Upload. The Contracting Officer may request additional information to support cost analysis in accordance with Federal Acquisition Regulation (FAR) 15.404-1(c) if needed.

a. Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment.

b. Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list that includes item description, part number, quantities, and price.

c. Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, and costs incurred in obtaining temporary use of specialized equipment. Proposals that include leased hardware must provide an adequate lease vs. purchase justification or rationale.

d. Direct Labor: For each individual, include the number of hours, hourly rate, and labor overhead and/or fringe benefits. Identify key personnel by name if possible and labor category.

e. Travel: Travel costs must relate to the needs of the project. Travel must be in accordance with the Federal Travel Regulation (FTR).

1. Per Diem Rates can be obtained at: http://www.gsa.gov/perdiem
2. Costs shall be allowable only if the following information is documented –

(i) Date and place (city, town, or other similar designation) of the expenses;

(ii) Purpose of the trip; and

(iii) Name of person on trip and that person's title or relationship to the contractor.

f. Cost Sharing: Cost sharing is permitted. However, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal. Please note that cost share contracts do not allow fees.

g. Subcontracts: Involvement of university or other consultants in the planning and/or research stages of the project may be appropriate. If the Offeror intends such involvement, describe in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-half of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer.

Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e., cost proposal) or provide a statement of work with a corresponding detailed cost proposal for each planned subcontract.

h. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required and hourly rate.

Volume 4: Company Commercialization Report – not in use for 20.1 BAA.
Not evaluated by USSOCOM.
Volume 5: Supporting Documents
Potential Offerors shall submit a slide deck not to exceed 15 PowerPoint slides.
Volume 6: Fraud, Waste and Abuse Training
Not required by USSOCOM.

Direct to Phase II Evaluations:

USSOCOM evaluates Direct to Phase II proposals using the evaluation criteria specified in section 8.0 of the DoD 20.1 SBIR Announcement with the following exceptions:

1. Proposals missing technical volume, feasibility appendix, cost volume, or slide deck will not be evaluated.

2. Feasibility determination. The Feasibility Appendix to the Phase II proposal will be evaluated first to determine that the Offerors demonstrated they have completed research and development to establish the feasibility of the proposed Phase II effort based on the criteria outlined in the topic description**. USSOCOM will not continue evaluating the Offeror's related Phase II proposal if it determines that the Offeror failed to demonstrate that feasibility** has been established **or** the Offeror failed to demonstrate work submitted in the feasibility documentation was substantially performed by the Offeror and/or the Principal Investigator. Refer to the Phase I Topic description included in the Direct to Phase II topic to review the minimum requirements that need to be demonstrated in the feasibility documentation.

3. The technical evaluation will utilize the Evaluation Criteria provided in Section 8.0 of the DoD SBIR 20.1 BAA. The Technical Volume and slide deck will be reviewed holistically. The technical evaluation is performed in two parts:

Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided in Section 8.0 of the DoD SBIR 20.1 BAA. Once the evaluations are completed, all Offerors will be notified as to whether they were selected to present their slide deck portion of their proposal.

Part II: Selected Offerors will receive an invitation to present their slide deck (30-minute presentation time / 30-minute question and answer) to the USSOCOM evaluation team, on 10-11 March 2020 at the SOFWERX facility. All selected firms will be reimbursed $2,000 to offset presentation costs. This presentation will be evaluated by a panel against the criteria listed under Section 8.0 of the DoD SBIR 20.1 BAA. Notifications of selection/non-selection for Phase II award will be completed within the following five business days.

4. The Cost Volume (Volume3) evaluation:

   USSOCOM evaluates Phase II proposals using the evaluation criteria specified in section 8.0 of the DoD 20.1 SBIR Announcement. USSOCOM's Phase II SBIR contracts are typically $1 million - $1.5 million. Resulting awards may be a fixed price OTA prototyping agreements and a successful prototype may lead to follow on production. Resulting awards may also be FAR based Cost-Plus Fixed Fee contracts. A Defense Contracts Audit Agency approved accounting system will be required to issue a Cost-Plus Fixed Fee contract.

Additionally, input on technical aspects of the proposals may be solicited by USSOCOM from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements. Non-Government personnel will not establish final assessments of risk, rate, or rank Offeror's proposals. These advisors are expressly prohibited from competing for USSOCOM SBIR awards. All administrative support contractors, consultants, and advisors having access to any proprietary data will certify that they will not disclose any information pertaining to this announcement, including any submission, the identity of any submitters, or any other information relative to this announcement; and shall certify that they have no financial interest in any submission. Submissions and information received in response to this announcement constitutes the Offeror's permission to disclose that information to administrative support contractors and non-Government consultants and advisors.

Selection Notifications:

The Government Contracting Officer notifies the Offeror by e-mail of selection/non-selection for award. The e-mail notification will only be sent to the Corporate Official (Business) identified by the Offeror.

Informal Feedback:

A non-selected Offeror can make a written request, within 30 calendar days of receipt of notification of non-selection, for informal feedback. USSOCOM will provide informal feedback within 30 calendar days of an Offeror's written request rather than a debriefing as specified in paragraph 4.10, entitled "Debriefing," of the DoD SBIR 20.1 Announcement.

USSOCOM SBIR Program Point of Contact:

Inquiries concerning the USSOCOM SBIR Program should be addressed to sbir@socom.mil.

USSOCOM SBIR 20.1 Direct to Phase II Topic Index

USSOCOM SBIR 20.1 Direct to Phase II Topic Descriptions

SOCOM20-D002 TITLE: Human Geography 3D (HG3D) Street View

TECHNOLOGY AREA(S): Battlespace, Human Systems, Information Systems, Sensors

ACQUISITION PROGRAM: Program Executive Office - Special Reconnaissance, Surveillance and Exploitation

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the Announcement.

OBJECTIVE: The objective of this topic is to develop an automation algorithm for extracting 3D geospatial data from crowd-sourced imagery and fusing it with human geography to deliver a street level view of complex terrain in denied areas. Dynamic processing of crowdsourced imagery allows users to obtain near-real-time information about locations, events, people, and places. The open standards nature of this capability will enable greater horizontal integration between Special Operations Forces (SOF) operators, Mission Planners, and partner nations across limited bandwidth tactical environments. The capability will extend SOF reach to rehearse and exercise with tagged imagery based on pre-defined classes that support SOF-unique missions. This geospatial situational awareness enables SOF to pivot quickly to relevant areas to support operations.

DESCRIPTION: USSOCOM is exploring options that provide Special Operations Force operators with a near-real-time 3D street level view of areas from crowd-sourced imagery. The capability to automate extraction of 3D geospatial data from crowd-sourced imagery and fuse the data with human geography will expand mission rehearsal and operations in denied areas. The open standards streaming capability will further enable integration of the crowd-sourced data into handheld devices. The tactical open standard will provide a data format for integration of synthetic intelligence during mission rehearsal and exercise engagements with partner nations.

Operating system key features shall include but not limited to the following:

1. Render crowd-sourced imagery in open standards format(s).
2. Assess the feasibility of combining crowdsourced 3D imagery with other 3D human terrain data.
3. Assess the feasibility of combining crowdsourced 3D imagery with handheld devices.
4. As part of this feasibility study, the offeror shall address all viable overall system design options with respective specifications.

Key Military applications: Imagery, Execution of Tactical Operations, Mission Planning, Tactical System Integration, Mission Command, Sensor Integration
Planning/Action Mission and Command:
1. Create Common Situational Understanding, Mission Command On-The-Move, Enable Unified Action Partner Collaboration

2. Unify Tactical and Operational Common Operational Picture
3. Create, Communicate, and Rehearse Orders during Exercises
4. Operational Adaptability and Decision-Making

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraph entitled "Description."

The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: SMALL BUSINESS INNOVATION RESEARCH

PHASE II STATEMENT OF OBJECTIVES
FOR
HUMAN GEOGRAPHY 3D (HG3D) STREET VIEW

TOPIC SOCOM20-D002

16 September 2019

I. INTERNATIONAL TRAFFIC AND ARMS REGULATION: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

II. BACKGROUND:

This is a Direct to Phase II Small Business Innovation Research project to prototype a software tool for creating a "Human Geography 3D Street View" from crowd-sourced and commercial geospatial data. The automation tool will fuse high resolution 3D terrain data with human geography and volunteered geographic information such as aerial imagery, photos, point clouds and consolidated meshed data that can be correctly georeferenced to the earth's surface and segmented into appropriate Open Geospatial Consortium (OGC) CDB-compliant data layers.

III. OVERALL OBJECTIVE:

This Phase II project will develop an automation algorithm for extracting 3D geospatial data from crowd-sourced imagery and fusing it with human geography to deliver a street level view of complex terrain in denied or semi-permissive areas. This Statement of Objectives describes the requirements to develop the prototype software capable of fusing multi-source geographic data into a Human Geography 3D street view to enhance shared situational awareness in areas where data is sparse.

IV. Requirements

A. General: The Contractor shall deliver a prototype software tool for automating the creation of OGC CDB-compliant geospatial data layers from crowd-sourced and commercial geospatial data in non-traditional formats for government testing, evaluation, and demonstration.

1. Detailed Tasks: The Contractor shall design, develop, test, demonstrate, and deliver a software tool capable of: 1) fusing multi-source geographic and non-traditional data into a Human Geography 3D Street View, and 2) segmenting the data into the appropriate OGC CDB compliant data layers.

a. To stimulate advances in technology and innovation, solutions including reusable code should be considered as well as re-use of open source code and integrations with fielded SOF systems utilizing existing open standards.
b. To the maximum extent possible, intelligent automation shall be used to improve the algorithms and reduce the need for manual intervention over time.
c. The desired system will co-register disparate data sources including imagery (both satellite and aerial), FMV, photos, point clouds, human geography data layers, and crowd-sourced or commercial geographic information.
d. The system must be able to correlate and conflate data at the most accurate coordinate possible with trade-offs for simplicity, accuracy and error estimation. Speed is generally a higher priority than absolute accuracy.
e. Most of the crowd-sourced and volunteered geographic information has some geo-referencing data to get it close to where the data exists in the real world. The non-traditional data also has good relative accuracy but needs to be georeferenced to existing geospatially accurate, globally correlated data.
f. Once the fused data is in the correct location, then it needs to be segmented to provide a good Digital Terrain Model (DTM) and Digital Elevation Model (DEM). 3D features must be extracted into OGC CDB-compliant 3D models.
g. To improve the data for simulation-ready applications such as Unity and Unreal, CDB raster material data and/or multi-spectral or hyper spectral signatures shall be used to improve the segmentation and apply material codes to the polygonal surfaces.
h. HG3D products shall be optimized for dissemination and operational use on mobile devices using OGC-compliant formats.
i. Meet a Technology Readiness Level 7 which is defined as "System prototyping demonstration in an operational environment (ground or space): System prototyping demonstration in operational environment. System is at or near scale of the operational system, with most functions available for demonstration and test. Well integrated with collateral and ancillary systems. Limited documentation available."

2. UNIQUE ITEM IDENTIFICATION: The Contractor shall include the DoD unique item identifications or a DoD recognized unique identification equivalent for the prototypes delivered. This includes a description and cost breakout as applicable. Information on unique item identifier types is at http://www.acq.osd.mil/dpap/UID/uid_types.html. The guide is at http://www.acq.osd.mil/dpap/UID/guides.htm. This is in accordance with DFARS 252.211-7003.

3. SHIP TO ADDRESS: The Contractor shall deliver all prototypes systems under this contract to the following address:

USSOCOM SOF AT&L (DoDAAC: F2VUQ0)
Attn: Susan Raymie, PEO SRSE
7701 Tampa Point Blvd.
MacDill AFB, FL 33621
(813) 826-7486

4. SHIPPING COSTS: The Contractor shall pay all costs to ship all product deliverables to and from the validation

testing /demonstration sites and to the final delivery location.

B. DOCUMENT DELIVERABLES: The Contractor shall provide the following documents to the respective specified addresses during the Phase II Period of Performance:

1. Kick-Off/System Requirements Review: See CDRL A001.
2. Monthly Progress Reports: See CDRL A002.
3. Financial Status Report: See CDRL A003.
4. Developmental Test Plan for Performance Validation: See CDRL A004.
5. Developmental Test Report for Performance Validation: See CDRL A005.
6. Business Plans: See CDRL A006.
7. Final Technical Report: See CDRL A007.
8. Preliminary Design Review: See CDRL A008.
9. Critical Design Review: See CDRL A009.

V. TESTS AND DEMONSTRATIONS: The Contractor shall conduct tests, demonstrations and hands-on workshops with users to validate that the prototype software tool meets or exceeds all the requirements specified in this Statement of Objectives. (See CDRL A004 and CDRL A005).

A. The Contractor shall demonstrate that the prototype software tool meets or exceeds the technical performance requirements above.
B. The Contractor shall participate in quarterly hands-on workshops with SOF users and incorporate user input received in contractor's development efforts.
C. Contractor shall support test and evaluation in an operationally realistic environment including a test bed or other location determined by the COR.

VI. ENVIRONMENTAL AND SAFETY: Not applicable

VII. GOVERNMENT FURNISHED PROPERTY (GFP) / GOVERNMENT FURNISHED PROPERTY (GFE) / GOVERNMENT FURNISHED INFORMATION (GFI):

A. Contractor requests for GFP, GFE or GFI shall be included in the proposal for consideration. Any materials delivered by the government to the contractor shall be listed here.

B. Government will provide representative data and GFI with Limited Distribution (LIMDIS), For Official Use Only, for development, testing, experimentation, and evaluation. Release of LIMDIS shall be in accordance with 48 CFR Section 252.245.7000, "Government-Furnished Mapping, Charting, and Geodesy Property." All LIMDIS data will be returned to the Government or destroyed during contract close out.

VIII. MEETINGS AND REVIEWS: The Contractor shall attend the following meetings and reviews.

A. Phase II Kick-Off meeting shall be conducted in Tampa, Florida not later than thirty (30) calendar days after contract award. The Contractor shall provide the Government:

1. A Phase II Kick-Off Meeting Read-Ahead no less than ten (10) calendar days prior to the Phase II Kick-Off Meeting / System Requirements Review Meeting (See CDRL A001).

2. An initial Program Management Plan / Financial Status Report for accomplishing all objectives specified in this Statement of Work. (See CDRLs A002 and A003).

3. Conceptual Design Drawings no less than ten (10) calendar days prior to the Phase II Kick-Off/System

Requirements Review Meeting (See CDRL A001).

B. Preliminary Design Review (PDR) - This meeting shall be conducted at the Contractor's facility no more than one hundred and eighty (180) calendar days after Phase II contract award. The Contractor shall provide teleconference capability for those participants unable to travel. The Contractor shall provide the Government:

1. A Preliminary Design Review and Materials Read-Ahead Briefing no less than fourteen (14) calendar days prior to the PDR (See CDRL A008).

2. A Detailed Design Report (See CDRL A008).

3. Trade off considerations for the design. (See CDRL A008).

4. Results of any testing to date. (See CDRL A005).

5. Resolution to any Contractor/Government issues or concerns.

6. An assessment of other potential benefits / impacts including total cost of ownership, software data rights, and a recommendation of any changes for consideration / incorporation into the subsequent design that will be provided to the Government at the follow-on Critical Design Review. (See CDRL A008).

C. Critical Design Review (CDR): This teleconference meeting shall be arranged by the Contractor two (2) weeks prior to the end of the contract completion date. The Contractor shall provide the Government:

1. A Critical Design Review and Materials Read-Ahead Briefing no less than fourteen (14) calendar days prior to the CDR (See CDRL A009).

2. A Detailed Design Report (See CDRL A009).

3. Trade off considerations for the design. (See CDRL A009).

4. Results of any testing to date. (See CDRL A005).

5. Resolution to any Contractor/Government issues or concerns.

D. Phase II Close-Out Meeting: The Phase II Close-Out Meeting shall be conducted in Tampa, Florida no earlier than seven (7) calendar days prior to the conclusion of the Phase II Period of Performance. The Contractor shall provide the Government:

1. A briefing on the test verification (See CDRL A005).

2. An update of the progress to date. (See CDRL A002)

3. Resolution to any Contractor/Government issues or concerns.

IX. NOTIFICATION: The Contractor shall notify USSOCOM no less than thirty (30) calendar days prior to tests, demonstrations and reviews at the Contractor's facilities to ensure USSOCOM representatives can attend should they desire to do so.

X. TRAVEL REQUIREMENTS: The costs associated with the below travel requirements will be included in a separate Contract Line Item Number as a cost reimbursable expense. The Contractor shall comply with the Federal

Acquisition Regulation 31.205-46 (http://www.gsa.gov/perdiem) on proposing all travel related costs. The Contractor shall include the costs associated with the following travel requirements in the proposal:

A. Phase II Kick-Off Meeting: Tampa, FL; one (1) overnight, no more than two (2) Contractor representatives.

B. Phase II Close-Out Meeting: Tampa, FL; one (1) overnight, no more than two (2) Contractor representatives.

C. Quarterly Workshops with Users: Tampa, FL, or Fort Bragg, NC; two (2) overnights, no more than two (2) contractor representatives. As part of the Phase II proposal, the Contractor shall include the most expensive trip.

XI. MANDATORY REPORTING:

A. The Contractor shall report ALL contractor labor hours (including subcontractor labor hours) required for performance of services provided under this contract for the U.S. Special Operations Commands via a secure data collection site. The Contractor is required to completely fill in all required data fields using the following web address: http://www.ecmra.mil/.

B. Reporting inputs will be for the labor executed during the period of performance during each Government fiscal year (FY), which runs October 1 through September 30. While inputs may be reported any time during the FY, all data shall be reported no later than October 31 of each calendar year, beginning with 2014. Contractors may direct questions to the help desk at help desk at: http://www.ecmra.mil.

XIII. DISCLOSURE OF UNCLASSIFIED INFORMATION:

A. On September 21, 2001, the Department of Defense designated Headquarters US Special Operations Command (USSOCOM) a sensitive unit, as defined by Title 10 United States Code (USC) Section 552 (10 USC 552). In keeping with this designation, unclassified information related to USSOCOM military technology acquisitions managed by USSOCOM or any of its component commands, will be designated Controlled Unclassified Information (CUI). As such, the contractor hereby unequivocally agrees that it shall not release to anyone outside the Contractor's organization any unclassified information, regardless of medium (e.g., film, tape, document, Contractor's external website, newspaper, magazine, journal, corporate annual report, etc.), pertaining to any part of this contract or any program related to this contract, unless the Contracting Officer has given prior written approval. Furthermore, any release of information which associates USSOCOM, Special Operation Forces (SOF), or any component command with an acquisition program, contractor, or this contract is prohibited unless specifically authorized by USSOCOM.

B. Requests for approval shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Contractor shall submit its request to the Contracting Officer at least 45 days before the proposed date for release for approval. No release of any restricted information shall be made without specific written authorization by the Contracting Officer.

C. The Contractor shall include a similar requirement in each subcontract under this contract. Subcontractors shall submit requests for authorization to release through the prime contractor to the Contracting Officer.

D. The Contractor further understands that Title 18 USC Section 701 specifically prohibits the use of the USSOCOM emblem or logo in any medium (e.g., corporate website, marketing brochure, newspaper, magazine, etc.) unless authorized in writing by USSOCOM. Forward any requests to use the USSOCOM emblem or logo through the Contracting Officer.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where SOF and general purpose forces require 3D geospatial data at a street level view of complex terrain in denied areas. This 3D view will allow SOF to exploit tactical data to plan operations, conduct rehearsals, and remotely coordinate actions on the objective with organizations that are not collocated with the ground tactical commander. This capability could also be adopted by first responders, federal law enforcement (Secret Service), and for organizations that require a need to conduct a “walk through” of a specific area prior to execution of a task.

REFERENCES:

1. Special Operations Forces in Unlit Spaces: Understanding the World’s Dark Spots in the Context of SOF Operational Planning, 2014. https://www.ausa.org/sites/default/files/LWP-101-Special-Operations-Forces-in-Unlit-Spaces-Understanding-the-Worlds-Dark-Spots-in-the-Context-of-SOF-Operational-Planning.pdf

2. Large-Scale Semantic 3D Reconstruction http://www.grss-ieee.org/community/technical-committees/data-fusion/data-fusion-contest/

3. List of Street View Services https://en.wikipedia.org/wiki/List_of_street_view_services

4. Data and Analytics Platform that measures Ground Truth https://www.premise.com/sentiment-and-surveys/

5. Integrating Terrain Surface and Street Network for 3D Routing, Lee, Jiyeong & Zlatanova, Sisi. (2009). 3D Geo-Information Sciences. 10.1007/978-3-540-87395-2

6. The Future of Data Collection, https://spatialnetworks.com/assets/downloads/SNI_DGI_2018_Final.pdf

7. “Urban 3D challenge: building footprint detection using orthorectified imagery and digital surface models from commercial satellites,” Goldberg, Wang, Christie, Brown. SPIE (2018), https://doi.org/10.1117/12.2304682

KEYWORDS: Crowd Source, Austere Environment, 3D Data, artificial intelligence, surveillance and reconnaissance, Georeferenced Imagery