DEPARTMENT OF DEFENSE
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SBIR 21.2 Program Broad Agency Announcement (BAA)

April 21, 2021: DoD BAA issued for pre-release
May 19, 2021: DoD begins accepting proposals
June 17, 2021: Deadline for receipt of proposals no later than **12:00 p.m. ET**

Participating DoD Components:

- Department of the Navy
- Department of the Air Force
- Chemical and Biological Defense (CBD)
- Defense Logistics Agency (DLA)
- Defense Threat Reduction Agency (DTRA)
- Missile Defense Agency (MDA)
- National Geospatial-Intelligence Agency (NGA)
- United States Special Operations Command (USSOCOM)

IMPORTANT

Deadline for Receipt: Complete proposals must be certified in DSIP no later than **12:00 PM** ET on **June 17, 2021**. Proposals submitted after 12:00 p.m. will not be evaluated. The final proposal submission includes successful completion of all firm level forms, all required volumes, and electronic corporate official certification. Please plan to submit proposals as early as possible in order to avoid unexpected delays due to high volume of traffic during the final hours before the BAA close. DoD is not responsible for missed proposal submission due to system latency.

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

This BAA and the Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. Firms are required to register for a Login.gov account and link it to their DSIP account. See section 4.14 for more information regarding registration.

The Small Business Administration (SBA), through its SBIR/STTR Policy Directive, purposely departs from normal Government solicitation formats and requirements, thus authorizing 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 by visiting https://www.dodsbirsttr.mil/submissions/login and clicking “DSIP Listserv” located under Quick Links.

Questions: Visit the Learning & Support section of DSIP at https://www.dodsbirsttr.mil/submissions/learning-support/faqs for DoD SBIR or STTR program-related information. Email the DSIP Help Desk at DoDSBIRSupport@reisystems.com only for assistance with using DSIP. Questions regarding DSIP may be emailed to the DSIP Help Desk and will be addressed in the order received during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET). See section 4.13 for information on where to direct other BAA and topic-related questions.

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ATTACHMENTS

1.0 INTRODUCTION

Navy, Air Force, CBD, DLA, DTRA, MDA, NGA, 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 this BAA and to commercialize the results of that R&D are encouraged to participate.

This BAA is for Phase I proposals only unless the Component is participating in the **Direct to Phase II Program**. Navy, Air Force, and USSOCOM are offering Direct to Phase II topics for the SBIR 21.2 BAA – see the Component-specific instructions for more information.

This BAA is for Phase I proposals only. A separate BAA will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All firms that receive a Phase I award 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.

2.2 Technology and Program Protection to Maintain Technological Advantage

In accordance with DoD Instruction 5000.83, Technology and Program Protection to Maintain Technological Advantage, dated July 20, 2020, and as a means to counter the threat from strategic competitor nations, the DoD will employ risk-based measures to protect systems and technologies from adversarial exploitation and compromise of U.S. military vulnerabilities and weaknesses in: (1) systems, (2) components, (3) software, (4) hardware, and (5) supply chains. Any offeror submitting a proposal under this BAA will be required to disclose via self-report any foreign ownership or control. Offerors shall also require any proposed subcontractors included in their proposal under this BAA to disclose via self-report any foreign ownership or control. Reporting and disclosing such information will enable the DoD to identify national security risks posed by foreign participation, through investment, ownership, or influence, in the defense industrial base. This information will be used by DoD program offices to determine risks posed by SBIR contract awardees and their subcontractors to the DoD and the defense industrial base.

OUSD(R&E) Modernization Priorities

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/STTR Programs follow the policies and practices of the Small Business Administration (SBA) SBIR/STTR Policy Directive updated on May 2, 2019. The guidelines presented in this BAA incorporate and make use of the flexibility of the SBA SBIR/STTR 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/STTR Policy Directive is available at: https://www.sbir.gov/sites/default/files/SBIR-STTR_Policy_Directive_2019.pdf.

2.3 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 made in accordance with the SBA Policy Directive guidelines, current version. 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 made in accordance with the SBA Policy Directive guidelines, current version. 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, the Federal Acquisition Regulation (FAR), and other cited regulations apply for the purposes of this BAA:

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.

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.

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.

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/ddtc_public.

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.

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.

Foreign Entity

Foreign entity means any branch, partnership, group or sub-group, association, estate, trust, corporation or division of a corporation, non-profit, academic institution, research center, or organization established, directed, or controlled by foreign owners, foreign investors, foreign management, or a foreign government.

Foreign Government

Foreign government means any government or governmental body, organization, or instrumentality, including government owned-corporations, other than the United States Government or United States state, territorial, tribal, or jurisdictional governments or governmental bodies. The term includes, but is not limited to, non-United States national and subnational governments, including their respective departments, agencies, and instrumentalities.

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.

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 4.17 for reporting Fraud, Waste and Abuse.

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.

Historically Black Colleges and Universities and Minority Institutions (HBCU/MI)

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.

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).

Performance Benchmark Requirements for Phase I

Companies with multiple SBIR/STTR awards must meet minimum performance requirements to be eligible to apply for a new Phase I or Direct-to-Phase II award. The purpose of these requirements is to ensure that Phase I applicants that have won multiple prior SBIR/STTR awards are making progress towards commercializing the work done under those awards. The Phase I to Phase II Transition Rate addresses the extent to which an awardee progresses a project from Phase I to Phase II. The Commercialization Benchmark addresses the extent to which an awardee has moved past Phase II work towards commercialization. Additional information on performance benchmarking for Phase I applicants can be found at https://www.sbir.gov/performance-benchmarks.

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.

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.

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/.

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.

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.

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 DoDI 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 (DoDI 3216.02), recruitment of military research subjects (DoDI 3216.02), and informed consent and surrogate consent (10 U.S.C. § 980) and chemical and biological agent research (DoDI 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 DoDI 3216.02 for definitions of these terms and more information about the applicability of DoDI 3216.02 to research involving human subjects.

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/2016/05/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.

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).

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.)

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.

Subcontractor

Subcontractor means any supplier, distributor, vendor, firm, academic institution, research center, or other person or entity that furnishes supplies or services pursuant to a subcontract, at any tier.

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.

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

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:

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.

Please note, **this BAA is for Phase I proposals only** unless the Component is participating in the **Direct to Phase II Program**. Refer to the Component-specific Direct to Phase II instructions for more information on eligibility, performance requirements and proposal submission.

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 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 two-thirds 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 primary employment 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 one-half 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) Phase I to Phase II Transition Rate: For all proposers with greater than 20 Phase I awards over the past five fiscal years excluding the most recent year, the ratio of Phase II awards to Phase I awards must be at least 0.25.

(2) Commercialization Benchmark: For all proposers with greater than 15 Phase II awards over the last ten fiscal years excluding the last two years, the proposer must have received, to date, an average of at least $100,000 of sales and/or investments per Phase II award received or 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 or Direct to Phase II award for a period of one year from that date.
- Because this requirement only affects a company's eligibility for new Phase I or Direct to Phase II 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.
- More detail is available at https://www.sbir.gov/performance-benchmarks.

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. Proposers must disclose joint ventures with existing (or planned) relationships/partnerships with any foreign entity or any foreign government-controlled companies.

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. Component instructions will specify if participation by a small business majority owned in part by VCOCs, hedge funds, or private equity funds is allowable for a specific topic in the BAA. If a Component authorizes such participation, any proposer that is owned, in whole in or in part, by any VCOC, hedge fund, and/or private equity fund must identify each foreign national, foreign entity, or foreign government holding or controlling greater than a 5% equity stake in the proposer, whether such equity stake is directly or indirectly held. The proposer must also identify any and all of its ultimate parent owner(s) and any other entities and/or individuals owning more than a 5% equity stake in its chain of ownership.

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 Organizational Conflicts of Interest

FAR 9.5 Requirements

In accordance with FAR 9.5, proposers are required to identify and disclose all facts relevant to potential OCIs involving the proposer's organization and any proposed team member (subawardee, consultant). Under this Section, the proposer is responsible for providing this disclosure with each proposal submitted to the BAA. The disclosure must include the proposer's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposer has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposer's judgment and to prevent the proposer from having unfair competitive advantage. The OCI mitigation plan will specifically discuss the disclosed OCI in the context of each of the OCI limitations outlined in FAR 9.505-1 through FAR 9.505-4.

Agency Supplemental OCI Policy

In addition, DoD Components may have a supplemental OCI policy that prohibits contractors/performers from concurrently providing Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS) or similar support services and being a technical performer. Therefore, as part of the FAR 9.5 disclosure requirement above, a proposer must affirm whether the proposer or any proposed team member (subawardee, consultant) is providing SETA, A&AS, or similar support to any DoD Component office(s) under: (a) a current award or subaward; or (b) a past award or subaward that ended within one calendar year prior to the proposal's submission date.

If SETA, A&AS, or similar support is being or was provided to any DoD Component office(s), the proposal must include:

- The name of the DoD Component office receiving the support;
- The prime contract number;
- Identification of proposed team member (subawardee, consultant) providing the support; and
- An OCI mitigation plan in accordance with FAR 9.5.

Government Procedures

In accordance with FAR 9.503, 9.504 and 9.506, the Government will evaluate OCI mitigation plans to avoid, neutralize or mitigate potential OCI issues before award and to determine whether it is in the Government's interest to grant a waiver. The Government will only evaluate OCI mitigation plans for proposals that are determined selectable under the BAA evaluation criteria and funding availability.

The Government may require proposers to provide additional information to assist the Government in evaluating the proposer's OCI mitigation plan.

If the Government determines that a proposer failed to fully disclose an OCI; or failed to provide the affirmation of Government support as described above; or failed to reasonably provide additional information requested by the Government to assist in evaluating the proposer's OCI mitigation plan, the Government may reject the proposal and withdraw it from consideration for award.

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).

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. Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

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).

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. Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

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/Technical Evaluation Narrative

After final award decisions have been announced, the technical evaluations of the submitter's proposal may be provided to the submitter. Please refer to the Component-specific instructions of your topics of interest for Component debriefing processes.

4.11 Pre-Award and Post Award BAA Protests

Interested parties have the right to protest as prescribed in FAR 33.106(b) and FAR 52.233-2. For purposes of pre-award protests related to the terms of this BAA, protests should be served to the Contracting Officer (listed below).

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

NOTE: CONTACT FOR PROTESTS ONLY. All other inquiries will not be answered or considered.

Washington Headquarters Services (WHS)
Acquisition Directorate
1155 Defense Pentagon
Washington, DC 20301-1155

For the purposes of a protest related to a selection or award decision, protests should be served to the point-of-contact (POC) listed in the instructions of the DoD Component that authored the topic.

For protests filed with the Government Accountability Office (GAO), a copy of the protest shall be submitted to the Contracting Officer listed above (pre-award ONLY) or DoD Component POC (selection/award decision ONLY) within one day of filing with the GAO. Protests of small business status of a selected firm may also be made to the Small Business Administration.

4.12 Phase I Award Information

All Phase I proposals will be evaluated and judged on a competitive basis. Proposals will be initially screened to determine responsiveness. Proposals passing this initial screening will be technically evaluated by engineers or scientists to determine the most promising technical and scientific approaches. Each proposal will be judged on its own merit. DoD is under no obligation to fund any proposal or any specific number of proposals in a given topic. It also may elect to fund several or none of the proposed approaches to the same topic.

a. **Number of Phase I Awards**. The number of Phase I awards will be consistent with the Component’s RDT&E budget. 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 review Component-specific instructions regarding award size.

d. **Timing**. Proposing firms will be notified of selection or non-selection status for a Phase I award by the DoD Component that originated the topic within 90 days of the closing date for this BAA. Please refer to the Component-specific instructions for details.

The SBA SBIR/STTR 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.

This BAA is for Phase I proposals only unless the Component is participating in the **Direct to Phase II Program**. Refer to the Component-specific Direct to Phase II instructions for award information.

4.13 Questions about this BAA and BAA Topics

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

(1) **DSIP Help Desk**:
Email the DSIP Help Desk at DoDSBIRSupport@reisystems.com for assistance with using DSIP. Questions regarding DSIP can be emailed to the DSIP Help Desk and will be addressed in the order received, during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET).

The DSIP Help Desk cannot provide updates to proposal status after submission, such as proposal selection/non-selection status or contract award status. Contact the DoD Component that originated the topic in accordance with the Component-specific instructions given at the beginning of that Component's topics.

(2) **Websites**:
The Defense SBIR/STTR Innovation Portal (DSIP) at https://www.dodsbirsttr.mil/submissions/login, which provides the following resources:

- SBIR and STTR Program Opportunities
- Topics Search Engine
- Topic Q&A
- All 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.

DoD SBIR/STTR website at https://rt.cto.mil/rtl-small-business-resources/sbir-sttr/, which provides the following resources:

- SBIR and STTR Program Opportunities
- Dates for Current and Upcoming Opportunities

- Past SBIR and STTR Program Opportunities

(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, subscribe to the Listserv by selecting “DSIP Listserv” under Quick Links on the DSIP login page.

b. **General Questions about a DoD Component.** General questions pertaining to a particular DoD Component and the Component-specific BAA instructions 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 **April 21, 2021 to May 19, 2021**, 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 Topic Q&A. After this period questions must be asked through Topic Q&A as described below.

d. **Topic Q&A.** Once DoD begins accepting proposals on **May 19, 2021**, 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 Topic Q&A at https://www.dodsbirsttr.mil/submissions/login. In Topic Q&A, all questions and answers are posted electronically for general viewing. Identifying information for the questioner and respondent is not posted.

Questions submitted through the Topic Q&A 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, or administrative questions, such as SBIR or STTR program eligibility, technical proposal/cost proposal structure and page count, budget and duration limitations, or proposal due date WILL NOT receive a response. Refer to the Component-specific instructions given at the beginning of that Component's topics for help with an administrative question.

Proposing firms may use the Topic Search feature on DSIP to locate a topic of interest. Then, using the form at the bottom of the topic description, enter and submit the question. Answers are generally posted within seven (7) business days of question submission (answers will also be e-mailed directly to the inquirer).

The Topic Q&A for this BAA opens on **April 21, 2021** and closes to new questions on **June 03, 2021 at 12:00 PM ET**. Once the BAA closes to proposal submission, no communication of any kind with the topic author or through Topic Q&A regarding your submitted proposal is allowed.

Proposing firms are advised to monitor Topic Q&A during the BAA period for questions and answers. Proposing firms should also frequently monitor DSIP for updates and amendments to the topics.

4.14 Registrations and Certifications

Proposing firms must be registered in the Defense SBIR/STTR Innovation Portal (DSIP) in order to prepare and submit proposals. All users will be required to register for a login.gov account and link it to their DSIP account. To register in Login.gov, click the Login/Register button in the top right corner on the DSIP Submissions homepage and follow the steps to register. If you already have a Login.gov account, you can link your existing Login.gov account with your DSIP account. Job Aids and Help Videos to walk you through the process are in the Learning & Support section of DSIP, here: https://www.dodsbirsttr.mil/submissions/learning-support/training-materials.

Please note that the email address you use for Login.gov should match the email address associated with your existing DSIP account. If you do not recall the email address associated with your DSIP account, or if you already have an existing Login.gov account using a different email address, you will need your Firm's DUNS number and your Firm PIN in order to link your Login.gov account with your DSIP account. If the email address associated with your existing DSIP account has been used for multiple DSIP accounts within your Firm, you will also need your Firm's DUNS number and your Firm PIN in order to link your Login.gov account with your DSIP account. The Firm PIN can be obtained from your Firm Admin. You can view the Firm Admin's contact information by entering your Firm's DUNS number when prompted. If you are the Firm Admin, please ensure that you contact all DSIP users in your Firm and provide them with the Firm PIN.

It is recommended that you complete your Login.gov setup as soon as possible to avoid any delays in your proposal submissions.

Before the DoD Components can award a contract, proposing firms must be registered in the System for Award Management (SAM). SAM allows firms interested in conducting business with the federal government to provide basic information on business structure and capabilities as well as financial and payment information. To register, visit www.sam.gov. It is in the firm's interest to visit SAM and ensure the firm's registration is active and representations and certifications are up-to-date to avoid delay in award.

SAM.gov will be merged into the modernized beta.SAM.gov environment on May 24, 2021. Once integrated, legacy SAM.gov will be decommissioned and the new environment will retire the "beta" and be renamed SAM.gov. Once the integration occurs, the system will provide a modern portal for entities to register, update, renew, and check the status of their registration in the rebranded SAM.gov. Core functions of SAM and core data will not change. Entities with an active registration do not need to take action and the process to register to do business with the government will not change.

Follow instructions found during SAM registration 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 Defense SBIR/STTR Innovation Portal (DSIP) 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.

4.15 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.

4.16 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) 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).

4.17 Fraud and Fraud Reporting

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.

4.18 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.

4.19 Discretionary Technical and Business Assistance (TABA)

DoD has not mandated 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 Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. It is recommended that firms register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process.

This BAA is for Phase I proposals only unless the Component is participating in the **Direct to Phase II Program**. Refer to the Component-specific Direct to Phase II instructions for more information on proposal preparation.

Guidance on allowable proposal content may vary by Component. Accordingly, it is the proposing firm's responsibility to consult the Component-specific instructions for detailed guidance, including required proposal documentation, cost and duration limitations, budget structure, TABA allowance and proposal page limits.

DSIP provides a structure for providing the following proposal volumes:

Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report (REQUIRED)
Volume 5: Supporting Documents

a. Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment (REQUIRED)
b. Foreign Ownership or Control Disclosure (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability.)
c. Other supporting documentation (Refer to Component-specific instructions for additional Volume 5 requirements)

Volume 6: Fraud, Waste and Abuse Training (REQUIRED)

NOTE: All proposers are required to submit Volume 4: Company Commercialization Report (CCR), Volume 5(a): Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment, Volume 5(b): Foreign Ownership or Control Disclosure (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability), and Volume 6: Fraud, Waste and Abuse training.

A Phase I Proposal Template is available to provide helpful guidelines for completing each section of your Phase I technical proposal. This can be found at https://www.dodsbirsttr.mil/submissions/learning-support/firm-templates.

Detailed guidance on registering in DSIP and using DSIP to submit a proposal can be found at https://www.dodsbirsttr.mil/submissions/learning-support/training-materials. If the proposal status is "In Progress" or "Ready to Certify" it will NOT be considered submitted, even if all volumes are added prior to the BAA close date. The proposer may modify all proposal volumes prior to the BAA close date.

Although signatures are not required on the electronic forms at the time of submission the proposal must be certified electronically by the corporate official for it to be considered submitted. If the proposal is selected for award, the DoD Component program will contact the proposer for signatures at the time of award.

5.2 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 Defense SBIR/STTR Innovation Portal (DSIP) may be handled, for administrative purposes only, by support contractors. All support contractors are bound by appropriate non-disclosure agreements.

5.3 Phase I Proposal Instructions

a. **Proposal Cover Sheet (Volume 1)**

On the Defense SBIR/STTR Innovation Portal (DSIP) 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**: It is the proposing firm's responsibility to verify that the Technical Volume does not exceed the page limit after upload to DSIP. 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 Defense SBIR/STTR Innovation Portal (DSIP) 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). **Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

(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:

a. Short description,
b. Client for which work was performed (including individual to be contacted and phone number), and
c. 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). All resumes will count toward the page limitations for Volume 2.

(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 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 by using the on-line cost volume form on the Defense SBIR/STTR Innovation Portal (DSIP). 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, such as labor, travel, equipment, materials, must be detailed at the same level as prime contractor costs. Provide detailed substantiation of subcontractor costs in your cost proposal. Volume 5, Supporting Documents, 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 (CCR) allows companies to report funding outcomes resulting from prior SBIR and STTR awards. Completion of Volume 4: Company Commercialization Report in DSIP is required for all proposal submissions. During proposal submission, proposing firms with no prior DoD or non-DoD SBIR/STTR awards can select "No" for the question "Do you have a new or revised Company Commercialization Report to upload?".

Proposing firms with prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards must complete the CCR, regardless of whether the project has any commercialization to date, by logging into their account at https://www.sbir.gov/. To view or print the information currently contained in the Company Registry Commercialization Report, navigate to My Dashboard > My Documents. To create or update the commercialization record, from the company dashboard, scroll to the "My Commercialization" section, and click the create/update Commercialization tab under "Current Report Version". Please refer to the "Instructions" and "Guide" documents contained in this section of the Dashboard for more detail on completing and updating the CCR.

Once the report is certified and submitted on SBIR.gov, click the "Company Commercialization Report" PDF under the My Documents section of the dashboard to download a PDF of the CCR. This PDF of the CCR must be uploaded to Volume 4: Company Commercialization Report in the Firm Information section of DSIP by the Firm Admin. All other firm users will have read-only access to the CCR from the proposal submission page, in order to confirm that the CCR has been uploaded by the Firm Admin to complete the Volume 4 requirement. The most recent version of the CCR that has been uploaded by the Firm Admin will be included in the proposal submission.

WARNING: Uploading a new Company Commercialization Report (CCR) under the Firm Information section of DSIP or clicking "Save" or "Submit" in Volume 4 of one proposal submission is considered a change for ALL proposals under any open BAAs or CSOs. If a proposing firm has previously certified and submitted any Phase I or Direct to Phase II proposals under ***any*** BAA or CSO ***that is still open***, those proposals will be automatically reopened. Proposing firms will have to recertify and resubmit such proposals. If a proposing firm does not recertify or resubmit such proposals, they will not be considered fully submitted and will not be evaluated.

f. **Supporting Documents (Volume 5)**

Volume 5 is provided for proposers to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3).

Beginning with the DoD 21.2 SBIR BAA, all proposers are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment (REQUIRED)
2. Foreign Ownership or Control Disclosure (BAA Attachment 2) (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability)

Any of the following documents may be included in Volume 5 if applicable to the proposal. Refer to Component-specific instructions for additional Volume 5 requirements.

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

g. **Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment**

The DoD must comply with Section 889(a)(1)(B) of the National Defense Authorization Act (NDAA) for Fiscal Year 2019, and is working to reduce or eliminate contracts with entities that use any equipment, system, or service that uses covered telecommunications equipment or services (as defined in BAA Attachment 1) as a substantial or essential component of any system, or as critical technology as part of any system.

All proposals must include certifications in Federal Acquisition Regulation clauses 52.204-24, 52-204-25, and 52-204-26, executed by the proposer's authorized company representative. These Federal Acquisition Regulation clauses may be found in BAA Attachment 1. **These certifications must be signed by the authorized company representative and uploaded as a separate PDF file in the supporting documents sections of Volume 5 for all proposal submissions.**

The effort to complete the required certification clauses includes due diligence on the part of the proposer and for any contractors that may be proposed as a part of the submission including research partners and suppliers. Therefore, proposers are strongly encouraged to review the requirements of these certifications early in the proposal development process. Failure to submit or complete the required certifications as a part of the proposal submission process may be cause for rejection of the proposal submission without evaluation.

h. **Foreign Ownership or Control Disclosure**

Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability. If applicable, an authorized firm representative must complete the Foreign Ownership or Control Disclosure (BAA Attachment 2). The completed and signed disclosure must be uploaded to Volume 5 of the proposal submission.

i. **Fraud, Waste and Abuse Training (Volume 6)**

The Fraud, Waste and Abuse (FWA) training is **required** for Phase I and Direct to Phase II proposals. FWA training provides information on what represents FWA in the SBIR/STTR program, the most common mistakes that lead to FWA, as well as the penalties and ways to prevent FWA in your firm. This training material can be found in the Volume 6 section of the proposal submission module in DSIP and must be thoroughly reviewed once per year. Plan ahead and leave ample time to complete this training based on the proposal submission deadline. FWA training must be completed by one DSIP firm user with read/write access (Proposal Owner, Corporate Official or Firm Admin) on behalf of the firm.

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 or budget data submitted with the proposals will be considered during evaluation.

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 included based on requirements provided in Component-specific instructions.

7.0 PHASE II PROPOSAL INFORMATION

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/STTR Policy Directive provides 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 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.). After Phase II award, the company is required to report actual sales and investment data in its SBA Company Commercialization Report via "My Dashboard" on SBIR.gov at least annually. For information on formatting, page count and other details, please refer to the Component-specific instructions.

7.4 Phase II Evaluation Criteria

Phase II proposals will be evaluated based on the criteria outlined above in section 6.0, unless otherwise specified in the Component-specific instructions.

7.5 Phase II Award Information

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.

7.6 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."

7.7 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.

See component instructions for more details on Phase II Enhancement opportunities.

7.8 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. Please check the Component instructions for further information.

The Small Business and Technology Partnerships Office has established the OSD Transitions SBIR Technology (OTST) Pilot Program. The OTST pilot program is an interim technology maturity phase (Phase II), inserted into the SBIR development.

For more information contact osd.ncr.ousd-r-e.mbx.sbir-sttr@mail.mil.

8.0 CONTRACTUAL REQUIREMENTS

8.1 Additional Contract Requirements

Small Business Concerns (SBCs) are strongly encouraged to engage with their Contracting/Agreements Office to determine what measures can be taken in the event contract performance is affected due to the COVID-19 situation. SBCs are encouraged to monitor the CDC Website, engage with your employees to share information and discuss COVID-19 concerns employees may have. Please identify to your Contracting/Agreements Officer potential impacts to the welfare and safety of your workforce and any contract/OT performance issues. Most importantly, keep in mind that only your Contracting/Agreements Officer can affect changes to your contract/OT.

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. Copies of complete general provisions will be made available prior to award.

Examples of general provisions:

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.

Applicable Federal Acquisition Regulation (FAR) and/or Defense Federal Acquisition Regulation Supplement (DFARS) Clauses:

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. **Disclosure of Information.** In accordance with FAR 252.204-7000, Government review and approval will be required prior to any dissemination or publication, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract except within and between the Contractor and any subcontractors, of unclassified 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 https://www.govinfo.gov/content/pkg/CFR-2013-title48-vol3/pdf/CFR-2013-title48-vol3-sec252-225-7048.pdf.
w. **Cybersecurity**. Any SBC receiving an SBIR/STTR award is required to provide adequate security on all covered contractor information systems. Specific security requirements and cyber incident reporting requirements are listed in DFARS 252.204.7012. Compliance is mandatory.
x. **Safeguarding Covered Defense Information Controls.** As prescribed in DFARS 252.204-7008, for covered contractor information systems that are not part of an information technology service or system operated on behalf of the Government, the SBC represents that it will implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, "Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations".
y. **Limitations on the Use or Disclosure of Third- Party Contractor Reported Cyber Incident Information.** As required in DFARS 252.204-7009, the Contractor must agree that certain conditions apply to any information it receives or creates in the performance of a resulting contract that is information obtained from a third-party's reporting of a cyber incident pursuant to DFARS clause 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting (or derived from such information obtained under that clause).

z. **Notice of NIST SP 800-171 DoD Assessment Requirements.** As prescribed by DFARS 252.204-7019, in order to be considered for award, the SBC is required to implement NIST SP 800-171. The SBC shall have a current assessment (see 252.204-7020) for each covered contractor information system that is relevant to the offer, contract, task order, or delivery order. The Basic, Medium, and High NIST SP 800-171 DoD Assessments are described in the NIST SP 800-171 DoD Assessment Methodology located at https://www.acq.osd.mil/dpap/pdi/cyber/strategically_assessing_contractor_implementation_of_NIST_SP_800-171.html. In accordance with DFARS 252.204-7020, the SBC shall provide access to its facilities, systems, and personnel necessary for the Government to conduct a Medium or High NIST SP 800-171 DoD Assessment, as described in NIST SP 800-171 DoD Assessment Methodology, linked above. Notification of specific requirements for NIST SP 800-171 DoD assessments and assessment level will be provided as part of the component instructions, topic, or award.

aa. **Disclosure of Ownership or Control by a Foreign Government**. DFARS 252.209-7002, Disclosure of Ownership or Control by a Foreign Government (JUN 2010), is incorporated into this solicitation. In accordance with DFARS 252.209-7002, any SBC submitting a proposal in response to this solicitation is required to disclose, by completing Attachment 2 to this solicitation, Foreign Ownership or Control Disclosure, any interest a foreign government has in the SBC when that interest constitutes control by a foreign government, as defined in DFARS provision 252.209-7002. If the SBC is a subsidiary, it is also required to disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the SBC's immediate parent, intermediate parents, and the ultimate parent.

8.2 Basic Safeguarding of Covered Contractor Information Systems

FAR 52.204-21, Basic Safeguarding of Covered Contractor Information Systems, is incorporated into this solicitation. In accordance with FAR 52.204-21, the contractor shall apply basic safeguarding requirements and procedures when the contractor or a subcontractor at any tier may have Federal contract information residing in or transiting through its information system.

FAR 52.204-21 Basic Safeguarding of Covered Contractor Information Systems (JUN 2016)

(a) Definitions. As used in this clause -

Covered contractor information system means an information system that is owned or operated by a contractor that processes, stores, or transmits Federal contract information.

Federal contract information means information, not intended for public release, that is provided by or generated for the Government under a contract to develop or deliver a product or service to the Government, but not including information provided by the Government to the public (such as on public Web sites) or simple transactional information, such as necessary to process payments.

Information means any communication or representation of knowledge such as facts, data, or opinions, in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audiovisual (Committee on National Security Systems Instruction (CNSSI) 4009).

Information system means a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information (44 U.S.C. 3502).

Safeguarding means measures or controls that are prescribed to protect information systems.

(b) Safeguarding requirements and procedures.

(1) The Contractor shall apply the following basic safeguarding requirements and procedures to protect covered contractor information systems. Requirements and procedures for basic safeguarding of covered contractor information systems shall include, at a minimum, the following security controls:

(i) Limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems).

(ii) Limit information system access to the types of transactions and functions that authorized users are permitted to execute.

(iii) Verify and control/limit connections to and use of external information systems.

(iv) Control information posted or processed on publicly accessible information systems.

(v) Identify information system users, processes acting on behalf of users, or devices.

(vi) Authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to organizational information systems.

(vii) Sanitize or destroy information system media containing Federal Contract Information before disposal or release for reuse.

(viii) Limit physical access to organizational information systems, equipment, and the respective operating environments to authorized individuals.

(ix) Escort visitors and monitor visitor activity; maintain audit logs of physical access; and control and manage physical access devices.

(x) Monitor, control, and protect organizational communications (i.e., information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems.

(xi) Implement subnetworks for publicly accessible system components that are physically or logically separated from internal networks.

(xii) Identify, report, and correct information and information system flaws in a timely manner.

(xiii) Provide protection from malicious code at appropriate locations within organizational information systems.

(xiv) Update malicious code protection mechanisms when new releases are available.

(xv) Perform periodic scans of the information system and real-time scans of files from external sources as files are downloaded, opened, or executed.

(2) **Other requirements**. This clause does not relieve the Contractor of any other specific safeguarding requirements specified by Federal agencies and departments relating to covered contractor information systems generally or other Federal safeguarding requirements for controlled unclassified information (CUI) as established by Executive Order 13556.

(c) ***Subcontracts***. The Contractor shall include the substance of this clause, including this paragraph (c), in subcontracts under this contract (including subcontracts for the acquisition of commercial items, other than commercially available off-the-shelf items), in which the subcontractor may have Federal contract information residing in or transiting through its information system.

8.3 Prohibition on Contracting with Persons that have Business Operations with the Maduro Regime

Section 890 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2020 prohibits entering into a contract for the procurement of products or services with any person that has business operations with an authority of the government of Venezuela that is not recognized as the legitimate government of Venezuela by the United States Government, unless an exception applies. See provision 252.225-7974 Class Deviation 2020-O0005 "Prohibition on Contracting with Persons that have Business Operations with the Maduro Regime.

8.4 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.

8.5 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 8.6.

8.6 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 twenty 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 Class Deviation 2020-O0007. Upon expiration of the twenty-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 Class Deviation 2020-O0007 "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 Class Deviation 2020-O0007, 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.

8.7 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.

8.8 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 https://discover.dtic.mil/submit-documents/. 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 Class Deviation 2020-O0007 (see Section 8.5, 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: https://discover.dtic.mil/wp-content/uploads/2018/09/distribution_statements_and_reasonsSept2018.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 Class Deviation 2020-O0007.

ATTACHMENT 1

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

CONTRACTOR CERTIFICATION REGARDING
PROVISION OF PROHIBITED VIDEO SURVEILLANCE AND
TELECOMMUNICATIONS SERVICES AND EQUIPMENT

Contractor's Name	
Company Name	
Office Tel #	
Mobile #	
Email	

Name of person authorized to sign: ______________________________

Signature of person authorized: ______________________________

Date: ____________________

The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

FAR CLAUSES INCORPORATED IN FULL TEXT:

52.204-24 REPRESENTATION REGARDING CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT (AUG 2020)

The Offeror shall not complete the representation at paragraph (d)(1) of this provision if the Offeror has represented that it "does not provide covered telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument" in the provision at 52.204-26, Covered Telecommunications Equipment or Services—Representation, or in paragraph (v) of the provision at 52.212-3, Offeror Representations and Certifications-Commercial Items.

(a) *Definitions.* As used in this provision-

Backhaul, covered telecommunications equipment or services, critical technology, interconnection arrangements, reasonable inquiry, roaming, and *substantial or essential component* have the meanings provided in the clause 52.204-25, Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.

(b) *Prohibition.* (1) Section 889(a)(1)(A) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2019, from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. Nothing in the prohibition shall be construed to—

(i) Prohibit the head of an executive agency from procuring with an entity to provide a service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or

(ii) Cover telecommunications equipment that cannot route or redirect user data traffic or cannot permit visibility into any user data or packets that such equipment transmits or otherwise handles.

(2) Section 889(a)(1)(B) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2020, from entering into a contract or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. This prohibition applies to the use of covered telecommunications equipment or services, regardless of whether that use is in performance of work under a Federal contract. Nothing in the prohibition shall be construed to—

(i) Prohibit the head of an executive agency from procuring with an entity to provide a service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or

(ii) Cover telecommunications equipment that cannot route or redirect user data traffic or cannot permit visibility into any user data or packets that such equipment transmits or otherwise handles.

(c) *Procedures.* The Offeror shall review the list of excluded parties in the System for Award Management (SAM) (*https://www.sam.gov*) for entities excluded from receiving federal awards for “covered telecommunications equipment or services.”

(d) *Representations.* The Offeror represents that—

(1) It [] will, [] will not provide covered telecommunications equipment or services to the Government in the performance of any contract, subcontract or other contractual instrument resulting from this solicitation. The Offeror shall provide the additional disclosure information

required at paragraph (e)(1) of this section if the Offeror responds “will” in paragraph (d)(1) of this section; and

(2) After conducting a reasonable inquiry, for purposes of this representation, the Offeror represents that—

It [] does, [] does not use covered telecommunications equipment or services, or use any equipment, system, or service that uses covered telecommunications equipment or services. The Offeror shall provide the additional disclosure information required at paragraph (e)(2) of this section if the Offeror responds “does” in paragraph (d)(2) of this section.

(e) *Disclosures.* (1) Disclosure for the representation in paragraph (d)(1) of this provision. If the Offeror has responded “will” in the representation in paragraph (d)(1) of this provision, the Offeror shall provide the following information as part of the offer:

(i) For covered equipment—

(A) The entity that produced the covered telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the original equipment manufacturer (OEM) or a distributor, if known);

(B) A description of all covered telecommunications equipment offered (include brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); and

(C) Explanation of the proposed use of covered telecommunications equipment and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(1) of this provision.

(ii) For covered services—

(A) If the service is related to item maintenance: A description of all covered telecommunications services offered (include on the item being maintained: Brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); or

(B) If not associated with maintenance, the Product Service Code (PSC) of the service being provided; and explanation of the proposed use of covered telecommunications services and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(1) of this provision.

(2) Disclosure for the representation in paragraph (d)(2) of this provision. If the Offeror has responded “does” in the representation in paragraph (d)(2) of this provision, the Offeror shall provide the following information as part of the offer:

(i) For covered equipment—

(A) The entity that produced the covered telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the OEM or a distributor, if known);

(B) A description of all covered telecommunications equipment offered (include brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); and

(C) Explanation of the proposed use of covered telecommunications equipment and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(2) of this provision.

(ii) For covered services—

(A) If the service is related to item maintenance: A description of all covered telecommunications services offered (include on the item being maintained: Brand; model number, such as OEM number, manufacturer part number, or wholesaler number; and item description, as applicable); or

(B) If not associated with maintenance, the PSC of the service being provided; and explanation of the proposed use of covered telecommunications services and any factors relevant to determining if such use would be permissible under the prohibition in paragraph (b)(2) of this provision.

(End of provision)

52.204-25 PROHIBITION ON CONTRACTING FOR CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT (AUG 2020)

(a) *Definitions.* As used in this clause—

Backhaul means intermediate links between the core network, or backbone network, and the small subnetworks at the edge of the network (*e.g.,* connecting cell phones/towers to the core telephone network). Backhaul can be wireless (*e.g.,* microwave) or wired (*e.g.,* fiber optic, coaxial cable, Ethernet).

Covered foreign country means The People's Republic of China.

Covered telecommunications equipment or services means—

(1) Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities);

(2) For the purpose of public safety, security of Government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation,

Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities);

(3) Telecommunications or video surveillance services provided by such entities or using such equipment; or

(4) Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

Critical technology means—

(1) Defense articles or defense services included on the United States Munitions List set forth in the International Traffic in Arms Regulations under subchapter M of chapter I of title 22, Code of Federal Regulations;

(2) Items included on the Commerce Control List set forth in Supplement No. 1 to part 774 of the Export Administration Regulations under subchapter C of chapter VII of title 15, Code of Federal Regulations, and controlled—

(i) Pursuant to multilateral regimes, including for reasons relating to national security, chemical and biological weapons proliferation, nuclear nonproliferation, or missile technology; or

(ii) For reasons relating to regional stability or surreptitious listening;

(3) Specially designed and prepared nuclear equipment, parts and components, materials, software, and technology covered by part 810 of title 10, Code of Federal Regulations (relating to assistance to foreign atomic energy activities);

(4) Nuclear facilities, equipment, and material covered by part 110 of title 10, Code of Federal Regulations (relating to export and import of nuclear equipment and material);

(5) Select agents and toxins covered by part 331 of title 7, Code of Federal Regulations, part 121 of title 9 of such Code, or part 73 of title 42 of such Code; or

(6) Emerging and foundational technologies controlled pursuant to section 1758 of the Export Control Reform Act of 2018 (50 U.S.C. 4817).

Interconnection arrangements means arrangements governing the physical connection of two or more networks to allow the use of another's network to hand off traffic where it is ultimately delivered (*e.g.*, connection of a customer of telephone provider A to a customer of telephone company B) or sharing data and other information resources.

Reasonable inquiry means an inquiry designed to uncover any information in the entity's possession about the identity of the producer or provider of covered telecommunications equipment or services used by the entity that excludes the need to include an internal or third-party audit.

Roaming means cellular communications services (*e.g.*, voice, video, data) received from a visited network when unable to connect to the facilities of the home network either because signal coverage is too weak or because traffic is too high.

Substantial or essential component means any component necessary for the proper function or performance of a piece of equipment, system, or service.

(b) *Prohibition.* (1) Section 889(a)(1)(A) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2019, from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. The Contractor is prohibited from providing to the Government any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless an exception at paragraph (c) of this clause applies or the covered telecommunication equipment or services are covered by a waiver described in FAR 4.2104.

(2) Section 889(a)(1)(B) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232) prohibits the head of an executive agency on or after August 13, 2020, from entering into a contract, or extending or renewing a contract, with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless an exception at paragraph (c) of this clause applies or the covered telecommunication equipment or services are covered by a waiver described in FAR 4.2104. This prohibition applies to the use of covered telecommunications equipment or services, regardless of whether that use is in performance of work under a Federal contract.

(c) *Exceptions.* This clause does not prohibit contractors from providing—

(1) A service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or

(2) Telecommunications equipment that cannot route or redirect user data traffic or permit visibility into any user data or packets that such equipment transmits or otherwise handles.

(d) *Reporting requirement.* (1) In the event the Contractor identifies covered telecommunications equipment or services used as a substantial or essential component of any system, or as critical technology as part of any system, during contract performance, or the Contractor is notified of such by a subcontractor at any tier or by any other source, the

Contractor shall report the information in paragraph (d)(2) of this clause to the Contracting Officer, unless elsewhere in this contract are established procedures for reporting the information; in the case of the Department of Defense, the Contractor shall report to the website at *https://dibnet.dod.mil.* For indefinite delivery contracts, the Contractor shall report to the Contracting Officer for the indefinite delivery contract and the Contracting Officer(s) for any affected order or, in the case of the Department of Defense, identify both the indefinite delivery contract and any affected orders in the report provided at *https://dibnet.dod.mil.*

(2) The Contractor shall report the following information pursuant to paragraph (d)(1) of this clause:

(i) Within one business day from the date of such identification or notification: The contract number; the order number(s), if applicable; supplier name; supplier unique entity identifier (if known); supplier Commercial and Government Entity (CAGE) code (if known); brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.

(ii) Within 10 business days of submitting the information in paragraph (d)(2)(i) of this clause: Any further available information about mitigation actions undertaken or recommended. In addition, the Contractor shall describe the efforts it undertook to prevent use or submission of covered telecommunications equipment or services, and any additional efforts that will be incorporated to prevent future use or submission of covered telecommunications equipment or services.

(e) *Subcontracts.* The Contractor shall insert the substance of this clause, including this paragraph (e), in all subcontracts and other contractual instruments, including subcontracts for the acquisition of commercial items.

(End of clause)

52.204-26 COVERED TELECOMMUNICATIONS EQUIPMENT OR SERVICES-REPRESENTATION (DEC 2019)

(a) *Definitions.* As used in this provision, “covered telecommunications equipment or services” has the meaning provided in the clause 52.204-25, Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.

(b) *Procedures.* The Offeror shall review the list of excluded parties in the System for Award Management (SAM) (https://www.sam.gov) for entities excluded from receiving federal awards for “covered telecommunications equipment or services”.

(c) *Representation.* The Offeror represents that it □ does, □ does not provide covered telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument.

(End of provision)

ATTACHMENT 2

OMB No. 0704-0187
OMB approval expires
August 31, 2021

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

DISCLOSURE OF OFFEROR'S OWNERSHIP OR CONTROL BY A FOREIGN GOVERNMENT

In accordance with DFARS provision 252.209-7002, an offeror is required to disclose, by completing this form (and adding additional pages, as necessary), any interest a foreign government has in the offeror when that interest constitutes control by a foreign government, as defined in DFARS provision 252.209-7002. If the offeror is a subsidiary, it is also required to disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the offeror's immediate parent, intermediate parents, and the ultimate parent.

DISCLOSURE		
Offeror's Point of Contact for Questions about Disclosure	Name:	
	Phone Number:	
Offeror	Name:	
	Address:	
Entity Controlled by a Foreign Government	Name:	
	Address:	
Description of Foreign Government's Interest in the Offeror		
Foreign Government's Ownership Percentage in Offeror		
Identification of Foreign Government(s) with Ownership or Control		

DFARS 252.209-7002 Disclosure of Ownership or Control by a Foreign Government (JUN 2010)

(a) Definitions. As used in this provision—

(1) "Effectively owned or controlled" means that a foreign government or any entity controlled by a foreign government has the power, either directly or indirectly, whether exercised or exercisable, to control the election, appointment, or tenure of the Offeror's officers or a majority of the Offeror's board of directors by any means, e.g., ownership, contract, or operation of law (or equivalent power for unincorporated organizations).

(2) "Entity controlled by a foreign government"—

(i) Means—

(A) Any domestic or foreign organization or corporation that is effectively owned or controlled by a foreign government; or

(B) Any individual acting on behalf of a foreign government.

(ii) Does not include an organization or corporation that is owned, but is not controlled, either directly or indirectly, by a foreign government if the ownership of that organization or corporation by that foreign government was effective before October 23, 1992.

(3) "Foreign government" includes the state and the government of any country (other than the United States and its outlying areas) as well as any political subdivision, agency, or instrumentality thereof.

(4) "Proscribed information" means—

(i) Top Secret information;

(ii) Communications security (COMSEC) material, excluding controlled cryptographic items when unkeyed or utilized with unclassified keys;

(iii) Restricted Data as defined in the U.S. Atomic Energy Act of 1954, as amended;

(iv) Special Access Program (SAP) information; or

(v) Sensitive Compartmented Information (SCI).

(b) Prohibition on award. No contract under a national security program may be awarded to an entity controlled by a foreign government if that entity requires access to proscribed information to perform the contract, unless the Secretary of Defense or a designee has waived application of 10 U.S.C. 2536(a).

(c) Disclosure. The Offeror shall disclose any interest a foreign government has in the Offeror when that interest constitutes control by a foreign government as defined in this provision. If the Offeror is a subsidiary, it shall also disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the Offeror's immediate parent, intermediate parents, and the ultimate parent. Use separate paper as needed, and provide the information in the following format:

Offeror's Point of Contact for Questions about Disclosure
(Name and Phone Number with Country Code, City Code and Area Code, as applicable)

Name and Address of Offeror

Name and Address of Entity Controlled by a Foreign Government

Description of Interest, Ownership Percentage, and Identification of Foreign Government

(End of provision)

VERSION 5

DEPARTMENT OF THE NAVY (DON)
21.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to SBIR topics only:**
  - **N212-101 through N212-139**

- **The information provided in the DON Proposal Submission Instruction document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**

- **DON Phase I Technical Volume (Volume 2) page limit is not to exceed 10 pages.**

- **Proposers that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF) or any combination of these are eligible to submit proposals in response to DON topics advertised in this BAA. Information on Majority Ownership in Part and certification requirements at time of submission for these proposers are detailed in the section titled ADDITIONAL NOTES.**

- A Phase I Technical Volume (Volume 2) proposal template, specific to DON topics, is available at https://www.navysbir.com/links_forms.htm; use this template to meet Volume 2 requirements.

- 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 Supporting Documents Volume (Volume 5) is available for the SBIR 21.2 BAA cycle. The 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.

INTRODUCTION

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	**When**	**Contact Information**
Program and administrative	Always	Program Managers list in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to section 4.13 of the DoD BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to section 4.13 of the DoD BAA for details.

Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DoD Help Desk via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	Navy-sbir-sttr.fct@navy.mil

TABLE 2: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N212-101 to N212-102	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	jeffrey.a.kent@usmc.mil
N212-103 to N212-118	Ms. Donna Attick	Naval Air Systems Command (NAVAIR)	navair.sbir@navy.mil
N212-119	Mr. Shadi Azoum	Naval Information Warfare Systems Command (NAVWAR)	shadi.azoum@navy.mil
N212-120 to N212-129	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	loreanne.ponirakis@navy.mil
N212-130 to N212-139	Mr. Michael Pyryt	Strategic Systems Programs (SSP)	michael.pyryt@ssp.navy.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. 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.

PHASE I GUIDELINES

Follow the instructions in the DoD SBIR/STTR Program BAA on the DoD SBIR/STTR Innovation Portal (DSIP), https://www.dodsbirsttr.mil/submissions, 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 use the Phase I proposal template, specific to DON topics, at https://navysbir.com/links_forms.htm to meet Phase I Technical Volume (Volume 2) requirements. Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.

Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. It is recommended that firms register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process. Proposals that are not successfully certified in DSIP prior to BAA Close will NOT be considered submitted. Please refer to section 5.1 of the DoD SBIR/STTR Program BAA for further information.

VERSION 5

PHASE I PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the proposal will be deemed noncompliant and shall be REJECTED.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR Program BAA section 5.4(a).

- **Technical Proposal (Volume 2).** Technical Proposal (Volume 2) must meet the following requirements:
    - Content is responsive to evaluation criteria as specified in DoD SBIR/STTR Program BAA section 6.0
    - 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. Phase I Options are exercised upon selection for Phase II.

  *For headers, footers, and imbedded tables, figures, images, or graphics that include text, a font size smaller than 10-point is allowable; however, proposers are cautioned that if the text is too small to be legible it will not be evaluated.

  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 $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 be exactly six (6) months and the Phase I Option Period of Performance must be exactly six (6) months.

- **Company Commercialization Report (Volume 4)**. DoD requires Volume 4 for submission to the 21.2 Phase I BAA. Please refer to instructions provided in section 5.4.e of the DoD SBIR/STTR Program BAA.

- **Supporting Documents (Volume 5)**. Volume 5 is available for use when submitting Phase I and Phase II proposals.

  The DoD must comply with Section 889(a)(1)(B) of the FY2019 National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. **As such, all proposals must include as a part of their submission a written certification in response to the NDAA clauses (Federal Acquisition Regulation clauses 52.204-24, 52-204-25 and 52-204-26).** The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume 5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to instructions provided in section 5.4.g of the DoD SBIR/STTR Program BAA.

  In accordance with DFARS provision 252.209-7002, a proposer is required to disclose any interest a foreign government has in the proposer when that interest constitutes control by foreign government. Proposers must review the Foreign Ownership or Control Disclosure information to determine applicability. If applicable, an authorized firm representative must complete the Disclosure of Offeror's Ownership or Control by a Foreign Government (found in Attachment 2 of the DoD SBIR/STTR Program BAA) and upload as a separate PDF file in Volume 5. Please refer to instructions provided in section 5.4.h of the DoD SBIR/STTR Program BAA.

  Volume 5 is available for small businesses to submit additional documentation to support the Technical Proposal (Volume 2) and the Cost Volume (Volume 3). A template is available on https://navysbir.com/links_forms.htm. DON will not be using any of the information in Volume 5 during the evaluation.

  - Additional Cost Information
  - SBIR/STTR Funding Agreement Certification
  - Data Rights
  - Allocation of Rights between Prime and Subcontractor
  - Disclosure of Information (DFARS 252.204-7000)
  - Prior, Current, or Pending Support of Similar Proposals or Awards
  - Foreign Citizens
  - Majority-Owned VCOC, HF, and PEF Certification, if applicable

  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 requires Volume 6 for submission to the 21.2 Phase I BAA. Please refer to instructions provided in section 5.4.i of the DoD SBIR/STTR Program BAA.

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. 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. The "Additional Cost Information" of Volume 5 may be used if additional space is needed to detail these costs. 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 included in Volume 5 as "Additional Cost Information". Failure to include the required information in Volume 5 will result in the denial of TABA. The total value of TABA must 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 $1,700,000 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. A TABA Report, detailing the results and benefits of the service received, will be required annually by October 30.

Approval of direct funding for TABA will be evaluated by the DON SBIR/STTR Program Office.
If the TABA request does not include the following items the TABA request will be denied.

- 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 requests must be included as follows:

- Phase I:
    - Online DoD Cost Volume (Volume 3) – the value of the TABA request.
    - Supporting Documents Volume (Volume 5) – a detailed request for TABA (as specified above) specifically identified as "Discretionary Technical and Business Assistance".
- Phase II:
    - DON Phase II Cost Volume (provided by the DON SYSCOM) - the value of the TABA request.
    - Volume 5 – a detailed request for TABA (as specified above) specifically identified as "Discretionary Technical and Business Assistance".

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

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 7.0 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. 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 2. 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.

Protests to this BAA and proposal submission must be directed to the DoD SBIR/STTR Program BAA Contracting Officer, or filed with the GAO. Contact information for the DoD SBIR/STTR Program BAA Contracting Officer can be found 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 4.12.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 $1,700,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of less than $1,700,000 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

Majority Ownership in Part. Proposers which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DON topics advertised within this BAA.

For proposers that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:

a. Prior to submitting a proposal concerns must register with the SBA Company Registry Database.
b. The proposer within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm. Include the SBIR VC Certification in the Supporting Documents Volume (Volume 5).
c. Should a proposer become a member of this ownership class after submitting its application and prior to any receipt of a funding agreement, the proposer must immediately notify the Contracting Officer, register in the appropriate SBA database, and submit the required certification which can be found on https://navysbir.com/links_forms.htm.

System for Award Management (SAM). It is strongly encouraged that proposers register in SAM, https://beta.sam.gov, by the Close date of this BAA, or verify their registrations are 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.

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).

Support Contract Personnel for Administrative Functions. Proposers are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.

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 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 21.2 SBIR PHASE I TOPIC INDEX

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N212-120	Development of Non-Toxic but BioFouling Deterrent Marine Coatings
N212-121	Improved Marx Pulse Generator for High Power Microwave (HPM) Systems
N212-122	Characterizing 5G vulnerabilities in an expeditionary environment
N212-123	External Payload Deployment System for Cylindrical UUVs
N212-124	Low-cost Mid-wave Infrared Focal-Plane Arrays through Direct-on-Read Out Integrated Circuit Detector Fabrication
N212-125	Mobile Electrocardiogram Monitor for Bottlenose Dolphins in the Marine Environment
N212-126	GHz Optical Underwater Detection Receiver
N212-127	High-Temperature Fuel Coking Mitigation Frangible Coatings for Fuel Nozzles and Screens
N212-128	Publicly Available Information Analysis Curation Tool
N212-129	Components for a Deep Operating Unmanned Underwater Vehicle
N212-130	Integrated Sensor Technologies for Composites
N212-131	Innovative Manufacturing/Materials for Structural Insulators in Hypersonic Flight Body Thermal Protection Systems
N212-132	Large Footprint Silicon Leadless Chip Carrier (LCC)
N212-133	Microfabricated Noble Gas Vacuum Pump
N212-134	Moderate Spectral Resolution Spectrometer
N212-135	Development of a Widely Applicable Supporting Optical Circuit in Micro Optics
N212-136	Development of Predictive Aero-Optical Models of the Hypersonic Environment
N212-137	High Efficiency, Low Size Weight and Power (SWaP) Solid State Power Amplifiers (SSPAs) for Sensor Applications
N212-138	Advanced Persistent-Surveillance Sky Camera
N212-139	Radiation Hard Mid-Wave Infrared Imagers

N212-101 TITLE: Broadband Counter-Electronics Weapon (BCEW) for Long-Range Non-Lethal Vehicle/Vessel Stopping Capabilities

RT&L FOCUS AREA(S): Autonomy;Directed Energy (DE);Microelectronics

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 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/lightweight low-cost broadband/wideband high-power microwave (HPM) source to support intermediate force capabilities, i.e., a long-range vehicle and/or vessel engine stopping system. Provide wideband (100 MHz to 2 GHz) HPM sources with pulse widths of 1 nanosecond (ns) to 200 nanoseconds; pulse repetition frequencies of a few pulses per second to 100 kHz; HPM waveform rise times of 0.25 ns to 100 ns; Electronic Field Strengths of 1kV/meter to 100 kV/meter; polarizations of horizontal or vertical; overall system size and weight of less than 100 lbs threshold (T), 50 lbs objective (O); and a low overall system cost of < $100K (T); $50K (O); effective ranges of 100’s of meters (T) and a few kilometers (3-5km) (O).

DESCRIPTION: This SBIR topic seeks to develop a more compact and lightweight long-range counter-electronic vehicle/vessel stopping system to support long range non-lethal vehicle/vessel stopping missions; and to mitigate codified joint non-lethal weapon capability gaps. There is Service transition interest in both the Maritime (U.S. Navy and U.S. Coast Guard) and Ground (U.S. Army and USMC) domains as each Service currently desires long-range threat vehicle/vessel stopping capabilities with significant reduced overall system size, weight, power consumption, thermal cooling and lower system costs (SWAP/C2). Existing Radio Frequency (RF) Vehicle and Vessel Stopping systems have known range and overall system size and weight limitations; the current commercial off-the-shelf (COTS) solutions only mitigate a very small portion of the codified JROC-approved long-range vehicle/vessel stopping capability-gap [Refs 1-4]. The intended system is to replace current RF Vehicle/Vessel Stopper technologies with sizes of ~ 160 cu ft and ~1000 pounds and costs of ~$1M with a prototype wideband-based HPM source/system that is ~ 3 cu ft; 50-100 pounds and costs only $50-100K; low overall system power consumption of < 25kW of prime power. System must operate commensurate with and compliant with MIL Standard 810H environmental performance/operating standards. See Objective section for specific performance specifications required under this SBIR topic.

Specifically this SBIR topic is seeking wideband (100 MHz to 2 GHz) high power microwave sources with pulse widths of 1 nanosecond (ns) to 200 nanoseconds; pulse repetition frequencies of a few pulses per second to 100 kHz; HPM waveform rise times of 0.25 ns to 100 ns; Electronic Field Strengths of 1kV/meter to 100 kV/meter; polarizations of horizontal or vertical; overall system size and weight of less than 100 lbs (T), 50 lbs (O); and a low overall system cost of <$100K (T); $50K (O).

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 Counterintelligence Security Agency (DCSA). The selected contractor 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 DCSA and 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 advanced phases of this contract.

PHASE I: Develop concepts for an improved (more compact/lightweight and longer range) broadband/wideband high power microwave (HPM) source to support intermediate force capabilities, i.e., a long-range vehicle and/or vessel engine stopping system.

Demonstrate the feasibility/effectiveness of the wideband HPM source against relevant threat vehicle and vessel engine targets. Collect RF Target Susceptibility data corresponding to the source's RF-HPM waveform against a broad relevant set of (currently available commercial vehicle and vessel engines, e.g., COTS-available threat vehicle and vessel engine) targets. Demonstrate HPM weapon effectiveness and performance in meeting JNLWD/JIFCO/Marine Corps needs and establish that the HPM weapon concept can be employed throughout the Joint Services. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction and define the development of a Phase II non-lethal wideband HPM Vehicle/Vessel Stopping prototype weapon.

PHASE II: Develop a next-generation wideband HPM Vehicle/Vessel Stopping prototype weapon. The prototype will be evaluated via rigorous RF Target Susceptibility testing at both the contractor's facilities and at the Naval Surface Warfare Center - Dahlgren Division (NSWC- Dahlgren) test ranges. The JNLWD-JIFCO maintains a set of relevant threat vehicle and vessel engines at NSWC- Dahlgren. The contractor's Phase II SBIR prototype weapon will be independently assessed and evaluated at these government lab facilities with minimal cost to the performer. The objective of this independent testing is to determine the weapon's capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for a RF-HPM Vehicle/Vessel Stopper. The full wideband RF-HPM weapons systems to include integration to a high-gain RF-HPM antenna system will be prototyped and tested. System performance will be demonstrated through the evaluation of the HPM weapon system's ability to upset, neutralize, and kill (soft and hard) relevant threat vehicle and vessel engines. Confirm and verify the modeling and analytical methods developed in Phase I to include measuring the required full range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet the JIFCO/JNLWD/Marine Corps non-lethal vehicle/vessel stopping requirements. Prepare a Phase III development plan to transition the technology to Joint Service 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 JIFCO/JNLWD/Marine Corps in transitioning the technology for Joint Service use. Develop this next-generation wideband RF-HPM weapon system for evaluation to determine its effectiveness in an operationally relevant environments, e.g., exercised in Limited Military User Assessments (LMUAs) held by various Services. Support the JIFCO/JNLWD/Marine Corps for test and validation to certify and qualify the system for Joint Service use.

A compact – lightweight long range RF-HPM 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) to include Customs and Border Patrol, have actively been researching these types of non-lethal counter-electronic effects. Local civilian law enforcement has these type of missions to support both vehicle/vessel interdiction missions as well as to mitigate vehicle/vessel-borne terrorism. 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 overall system cost all while drastically improving RF-HPM Vehicle/Vessel Stopping weapon performance.

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3. "Directed-energy weapon." 18 July 2020. https://en.wikipedia.org/wiki/Directed-energy_weapon.
4. Glasmacher, Mathias. "High-Power Electro-Magnetics Effector Systems for Vehicle Stopping." Diehl Defence Group; Diehl Stiftung & Co, KG, 2020. https://www.diehl.com/group/en/technology/innovation/hpem/.

KEYWORDS: Wideband High Power Microwave Sources; HPM; Broadband HPM Sources; Mesoband Vehicle/Vessel Stopping; HPM Vehicle/Vessel Stopping technologies; Non-Lethal Counter-Electronic Attack

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N212-102 TITLE: Portable Hydroelectric Generators

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Microelectronics

TECHNOLOGY AREA(S): Materials / Processes

OBJECTIVE: Develop a personnel-portable ruggedized hydroelectric generator that will provide power from hydrokinetic water sources and has the ability to be dropped in a stream or other area of moving water and provide a level of power needed to recharge a unit's batteries or meet other low-power requirements.

DESCRIPTION: There is a need within the DoD to reduce the dependence on fossil fuel power generation. Bulk fuel movement is expensive, presents a high safety risk to personnel, and will become less reliable in distributed operations. Renewable energy is one way to reduce costs, increase safety, and provide more reliable power. Unfortunately, renewable energy systems can be heavy, bulky, difficult to deploy, and have a significant footprint during transport and operation and high cost.

The intent of this SBIR topic is to develop a pico-hydro power (micro-hydropower) energy system that is personnel-portable, low volume during transport/operation, efficient, reliable, and cost-effective. The system will be capable of being transported on a vehicle to the hydro resource. It shall be offloaded, carried, and deployed by hand. Water flow and Multi-axes kinetic generation are potential solutions. This SBIR topic seeks innovative scientific and engineering solutions. Proposals should specifically describe the technology that will be applied to solve the problem, how it will be developed, what the estimated benefits will be and how it might be transitioned into the DoD.

Definitions:
System must meet Threshold requirements = (T)
It is highly desirable for the system to meet Objective requirements = (O)

The proposed system must address the following requirements, at a minimum:

1. Capable of producing from 500 W (T) to 1500 W (O) (500W continuous, 5kW peak).
2. Capable of producing 500W using a water flow that has a velocity of 0.5 m/sec (O) or 1 m/sec (T).
3. Operable in rivers or streams with a minimum depth of 0.5 m (O) or 1 m (T).
4. Capable of optimizing electrical power output for any range of water velocities and minimum depths (O).
5. Capable of making use of input water velocity, kinetic energy, or pressure from any direction to generate required and additional electrical power. (O)
6. Component weight of no more than 88 lbs (two-person portable).
7. Total system transport volume/cube not to exceed 1 m3, which includes electrical cables, connectors, ropes/tethering/anchoring (if applicable).
8. Ability to meet the requirements of the Marine Corps in all of its operating environments (MIL-STD 810).
9. 24VDC output (MIL-STD-1275D, Ref 3).
10. Operated with little or no human intervention.
11. Capable of repair in the field with plug-and-play line replaceable units or parts produced by expeditionary advanced manufacturing (additive manufactured 3D printed / subtractive manufactured CNC milling or lathing parts).
12. Capable of operation in fresh and brackish water.
13. Able to withstand debris fouling without degrading performance.
14. Capable of being quickly and easily interconnected to produce power in excess of the 500 – 1500 W range of an individual system. (See #1 above.)

15. Able to be deployed and operational by 2 people, after reading quick card instructions, within 30 minutes (T), less than 5 minutes (O), starting from its transport configuration.
16. Retrievable and ready for transport within 30 minutes (T), less than 5 minutes (O).

PHASE I: Develop concepts for an improved hydro-electric generator that meets the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs. Establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by 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 to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the hydro-electric generator. Demonstrate system performance through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements and develop hydro-electric generator for evaluation to determine its effectiveness in an operationally relevant environment. 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. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

Commercial applications include recreational use, humanitarian aid/disaster relief, and “off-grid” home designs. The recreational industry has seen a significant increase in the last few years specifically with off grid application. This application is directly applicable to this market segment. This recreational market is seen as having the highest potential for commercialization and sales. Support for disaster relief and humanitarian aid are other applications. Additionally, there is application in developing countries and areas underserved by electrical power distribution.

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KEYWORDS: Hydropower; hydro-electricity; pico-hydro; portable; turbine; micro-hydro; renewable

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N212-103 TITLE: Multispectral Target and Scene Projector

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Air 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 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 multispectral scene projector capable of presenting a scene to a gimbaled sensor under test.

DESCRIPTION: The U.S. Navy currently operates a number of legacy spectral scene generators to test a number of single and dual band sensors. The background comprises a Visible (VIS) band projected onto a blocking target that is opaque to all VIS wavelengths, prior to entering a collimating optic and presented to the gimbaled sensor. A number of blocking targets with various angular sizes exist on a filter wheel allowing the system to characterize sensor resolution.

A target beam, maintained at the center of the scene, represents the Mid-Wave Infrared (MWIR) signature of an air platform, generated by an IR source with an aperture to control angular extent and a variable Neutral Density (ND) filter to rapidly change intensity. These two collimated sources, the MWIR target and VIS background, are combined by an optic with the MWIR target aligned to the collimated blocked portion of the background. Finally, a pickoff mirror allows 90% of the combined beam to pass to the sensor under test, while reflecting 10% toward a camera used for scene awareness.

The scene projected and presented to the sensor under test is comprised of a collimated background of VIS light, a negative target of blocked VIS light with MWIR superimposed on the negative target.

This is a simplistic static system allowing for investigation of target resolution and sensor sensitivity. However, this system lacks the required dynamics of other targets in the scene, required for investigating tracking algorithms.

This SBIR topic is seeking to extend the technology of legacy generators by adding additional targets with the ability to move within the scene and change their spectral content. An example scene may comprise a mixture of Ultra-Violet (UV)/VIS intensities as a background; a static target that blocks the background but retains a signature with Long Wave Infrared (LWIR), MWIR, Short-Wave Infrared (SWIR), VIS, and UV components; and three other moving dynamic targets comprised of a mixture of LWIR, SWIR, MWIR, VIS, and UV emissions.

This system will evaluate a gimbaled sensor and the performance of tracking algorithms in a spectrally complex environment having dynamic targets with signatures comprised of LWIR, MWIR, SWIR, VIS, and UV bands, combined with an illuminated background emitting in the UV and/or VIS bands (Ref 5). This system should reside on one or two optical tables in which the scene is generated and allow for positioning the sensor under test.

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The background presented to the sensor under test must provide an illuminated background emitting in the UV and/or VIS bands. The background represents the sky as seen by a sensor. The sensor under test will typically be banded, but that defined band may be anywhere from the UV to VIS portions of the spectrum. The intensity of the background should have a comparable intensity to that of the sky and be adjustable to simulate differing intensities, such as a sunny day, overcast, and heavy cloud cover; as well as time of day, such as morning, noon, and evening.

The bands described in this document are defined as follows:

a. UV: 300-400 nm
b. VIS: 400-700 nm
c. SWIR: 1-3 µm
d. MWIR 3-5 µm
e. LWIR: 8-12 µm

A single primary target source represents an air-platform in a scene as a spot, blocking the UV and VIS portions of the background as an aircraft traveling across the sky. However, while blocking the background, the Primary Target may be emitting in any of the UV, VIS, SWIR or MWIR, and LWIR bands and overlay on the blocked spot. The mixture of bands, angular extent, and intensities must be variable as a function of time to simulate platforms operating at different ranges at different headings.

The secondary targets represent other emitters in the spectrally rich scene such as other air-platforms, munitions, or countermeasures. These sources have variable intensities and emit in the UV, VIS, SWIR, MWIR, and LWIR bands. However, these sources do not block the UV and VIS emissions of the background. These sources must also have the ability to vary the mixture of LWIR, SWIR, MWIR, VIS, and UV emissions, intensities in each band, angular size, and following a pre-programmed trajectory, dynamically move in relation to the primary target. The projector should present three or four secondary targets.

There is a requirement to provide awareness of the scene presented to the sensor under test, in real time, as the scene develops. This imagery output is used to create a data product that overlays a sensor's gimbaled track-point on the scene as it develops. For more simplistic projectors involving only two adjacent bands, a beam splitter is used to capture a portion of the energy and present it to a camera. This is a more difficult problem since a single camera cannot capture the spectral data across the spectrum and will require multiple cameras, each with a fused spectral output. Just as in the legacy system, a camera(s) must capture and display the scene presented to the sensor under test.

Software is required to control the many elements of the scene projector and has two main functions. First is designing and planning the scene as it evolves in time, including the spectral content, intensities of the different bands, angular size, and motion of each source. The second function is the control of the optical components as the test occurs.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor 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 DCSA 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.

VERSION 5

PHASE I: Develop, design, and demonstrate the feasibility to build a scene projector, employing beam combining/mixing optics that have previously been built, combining two neighboring spectral bands such as MWIR and SWIR, and methods for controlling the motion in the scene, including moving combining mirrors and sending the image into a collimating optic. The Phase I demonstration will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype multispectral scene projector capable of presenting a scene to a gimbaled sensor under test. Provide schematic and layout of optics, emitters and other components. Develop a method for viewing the entire scene in all bands presented to the sensor. Develop a controlling Graphical User Interface (GUI) and identify variables. Demonstrating the multispectral projector is capable of giving similar results to more simplistic legacy system, while considering radiometric measurement of spectral components of the scene.

It is probable that the work under this effort, particularly in the sensor portion, will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Finalize the prototype and provide demonstration of the multispectral projector on an advanced sensor. Perform final testing and validation. Transition to applicable naval platforms and/or naval laboratories.

The multispectral scene generator will be suitable for testing hardware-in-the-loop systems incorporating multiple sensors across multiple EO/IR bands, such as missile seekers, ISR camera systems, and targeting systems. The scene projector will also provide a critical laboratory-based pathway for the development of EO/IR algorithms employing sensor fusion and the merging of information across multiple bands to achieve increased accuracy. Industries include Intelligence, Surveillance and Reconnaissance (ISR), and Missile Defense.

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KEYWORDS: Scene Projector; Target Projector; Sensors; Spectral; Multispectral; Missile Seeker

VERSION 5

N212-104 TITLE: Multimode-Coupled High-Frequency Photoreceiver

RT&L FOCUS AREA(S): Autonomy;General Warfighting Requirements (GWR);Networked C3

TECHNOLOGY AREA(S): Air 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 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 package a multimode, pigtailed, high-frequency, high-current, optical photodetector operating at a wavelength near 1.5 µm for radio-frequency (RF) photonic link applications on military platforms.

DESCRIPTION: Current airborne military communications and electronic warfare systems require ever-increasing bandwidth, while simultaneously requiring reductions in space, weight, and power (SWaP). The replacement of the coaxial cable used in various onboard radio frequency (RF)/analog applications with RF/analog fiber-optic links will provide increased immunity to electromagnetic interference, reduction in size and weight, and an increase in bandwidth. However, it requires the development of high-performance, high-linearity optoelectronic components that can meet extended temperature range requirements (-40 °C to 100 °C). Additionally, avionic platforms pose stringent requirements on the SWaP consumption of components for avionic fiber communications applications [Ref 4]. To meet these requirements, new optical component technology will need to be developed.

Typical microwave photonic links for 20 GHz and higher frequencies utilize single-mode fiber between transmitter and receiver. Single-mode fiber eliminates modal dispersion associated with multimode fiber, which reduces bandwidth in long fiber lengths [Ref 1]. Many links on airborne platforms however are short in length and can utilize multimode fiber, yielding installation, maintenance, and durability advantages. A standard 50 µm core multimode fiber is easily coupled to photodiodes larger than 50 µm in diameter, but 50 µm photodiodes are limited to bandwidths below 20 GHz due to capacitive limitations. If the light from a 50 µm multimode fiber could be focused onto high-current photodiodes with diameters of 25, 15, or even 10 µm using a high-numerical aperture optical system [Ref 2], while still capturing a majority of the light in the fiber, link bandwidths can be pushed to over 50 GHz. With a typical 1 GHz-Km graded index 50 µm fiber, this allows for link lengths upwards of 50 and 20 m at 20 and 50 GHz, respectively, when all modes contain energy. This will negate standard butt-coupling approaches and will require optical lenses to be utilized with higher numerical apertures. This, combined with the fact that many high-current photodiodes are rear illuminated through the substrate, leads to long optical path lengths, a challenge for compact packaging. One additional challenge is the speckle pattern that will appear within the image of the output of the fiber on the photodiode surface. If too large of a fraction of this reduced image falls outside the photodiode active area, speckle variations will result in variations in the detected photocurrent that will be unavoidable and cause deleterious link gain variations. These current variations must be kept below +/- 5% to limit link gain variations to +/- 0.5 dB.

The packaged photoreceiver must perform over the specified temperature range and maintain hermeticity and optical alignment upon exposure to typical Navy air platform vibration, humidity, thermal shock, mechanical shock, and temperature cycling environments [Ref 3], and which can include unpressurized wingtip or landing gear wheel well (with no environmental control) to an avionics bay (with environmental control).

PHASE I: Develop, demonstrate feasibility, and package (non-hermetic) a sub-35 µm diameter photodiode (> 12 GHz bandwidth) with a 50 µm graded-index multimode fiber pigtail. The detected photocurrent should maintain +/- 5% current variation as the input modal pattern is varied. Provide calculations to support the development of 20, 35, and 50 GHz versions for development during Phase II. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype design and package hermetic prototypes at 15, 20, 35, and 50 GHz. Test prototype receivers to meet the above photocurrent variation specification over input modal conditions, and over temperature, to meet design specifications in a Navy air platform representative of a relevant application environment, which can include unpressurized wingtip or landing gear wheel well (with no environmental control) to an avionics bay (with environmental control). The packaged receivers should be tested in an RF photonic link over temperature with the objective performance levels reached. Demonstrate a prototype fully packaged receiver for direct insertion into analog fiber optic links.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype. Perform extensive operational reliability and durability testing, while optimizing manufacturing capabilities. Transition the demonstrated technology to naval aviation platforms and interested commercial applications.

Commercial sector telecommunication systems, fiber optic networks, and data centers could benefit from the development of a Multimode Coupled High Frequency Photoreceiver.

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KEYWORDS: Photodetector; Photodiode; Radio Frequency; Wideband; Fiber Optic; Multimode.

VERSION 5

N212-105 TITLE: Zero Foreign Object Damage (FOD): Inlet Debris Monitoring System (IDMS)

RT&L FOCUS AREA(S): Artificial Intelligence (AI)/Machine Learning (ML);Autonomy

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 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 an Inlet Debris Monitoring System (IDMS) to detect when jet engines ingest Foreign Object Damage (FOD) [Ref 1] and quantify its sensitivity to typical Navy/Marine Corps flight and environmental operating conditions.

DESCRIPTION: Foreign Object Damage (FOD) is a top engine removal driver for nearly every platform in naval aviation. Debris ingestion causes unacceptable readiness and safety levels for a variety of fixed- and rotary-wing platforms. FOD is responsible for seven Class A mishaps (i.e., an accident that leads to fatality, dismemberment, or greater than $2 million in damages) (Ref 4) and cost the Naval Aviation Enterprise (NAE) over $400 million in the past three years. The FOD Program, which applies research to understand, quantify, and prescribe solutions to FOD that require coordination across commands and installations, projects FOD will cost the NAE > $2 billion over the next five years.

The FOD Program is developing a method for synthesizing and analyzing data from novel sensing technologies to quantify the risk of operating aircraft in an environment with a dynamic debris field. The prototype, known as the FOD System-of-Systems Approach (SOSA), enables the integration of multiple sensor suites, data logistics, data fusion, data analysis, and automation. The purpose of the FOD system is to calculate and remediate the risk of engine FOD strikes.

The FOD Program requires an on-wing, Inlet Debris Monitoring System (IDMS) capable of detecting when an engine ingests debris and particulate. The IDMS will act as feedback to the FOD SOSA to continually refine the FOD SOSA's predictive analytical capability and improve the FOD SOSA's ability to reduce FOD events.

Topic requirements include, but are not limited to:

1. The design and build of a flight qualified prototype IDMS
2. An established system interface and interface control document (ICD) for the IDMS
3. Determination of which factors limit or affect its Probability of Detection (Pd) and Probability of False Alarm (Pfa)
4. Quantification of how those factors limit or affect its Pd and Pfa
5. A mathematical model to represent the IDMS's Pd and Pfa as a function of IDMS configurable elements, environmental conditions, and FOD related variables.

Flight and environmental conditions an IDMS may experience, and thus affect a Pd and Pfa, include (*Note the following conditions are not a comprehensive list of factors):

1. Operationally relevant environmental factors (Ref 2):
    (a) Temperature

    (b) Temperature distortion (steam ingestion)
    (c) Humidity
    (d) Rain
    (e) Snow
    (f) Ice
    (g) Fog
    (h) High and Low ambient light conditions
    (i) Non-uniform airflow
    (j) Dusty/Sandy conditions
    (k) Non-pristine airflow consisting of oil, insects, etc. which deposit on airflow boundaries
2. Operationally representative inlet velocities at all phases of the flight envelope:
    (a) Ground maneuvers
    (b) Takeoff/Descent maneuvers
    (c) Flight maneuvers
3. Operationally representative flight noise [Ref 3]:
    (a) General aircraft noise
    (b) Vibrations
    (c) Acoustics
    (d) Electromagnetic Interferences

Common examples of discrete events, consisting of both hard and soft debris, include (*Note the following materials are not a comprehensive list of FOD):
(a) Sand
(b) Bolts
(c) Nuts
(d) Concrete
(e) Carrier decking material
(f) Lock wire
(g) Pavement
(h) Plastic
(i) Cloth
(j) Organics

A Minimum Viable Product (MVP) of an IDMS should be flight qualified and integrated into at least one test aircraft and possess the ability to:
1. Demonstrate the sensitivity of the IDMS prototype to detect a FOD event in a relevant Navy/Marine Corps environment that includes:
    (a) Quantifiable Pd and Pfa of the prototype
    (b) Identify factors that affect the Pd and Pfa
    (c) Degree that each factor affects the Pd and Pfa
2. Detect when an engine ingests debris during conditions typical of Navy/Marine Corp idle, taxi, take-off, and landing (these include inlet velocities of 0–600 ft/s (0–183 m/s)
    (a) Produce a time stamped data log indicating when an engine ingests debris
    (b) Tag the timestamped data log with where the engine ingests debris; for example, land-based operations could include GPS coordinates while ship-based operations could include a location on the carrier deck (the IDMS may use external data sources to achieve this objective)
3. Integrate with the FOD Program's SOSA
4. Possess well-defined system interfaces with an interface control document

The IDMS should:

1. Integrate with other inlet debris monitoring technologies.
2. Quantify details of the FOD event such as:
   (a) The physical attributes of the debris such as its type, volume, mass, density, material composition, etc.
   (b) The velocity of the debris
   (c) Where, within the engine, the debris strikes and/or damages
3. Operate in all areas of the flight envelope. Detect when an engine ingests debris during typical Navy/Marine Corp flight (an MVP already includes idle, taxi, take-off, and landing).
4. Be capable of optimizing along the following parameters:
   (a) Adaptability/Modularity: The system should be able to integrate into various military and commercial aircraft.
   (b) Spatial Footprint: The system should fit within an engine/airframe.
   (c) Maintainability: Maintainers should be able to access and maintain the IDMS
   (d) Robustness: The IDMS should not fail and create FOD itself.
   (e) Safety: The IDMS should not pose a safety risk to people, including pilots, maintainers, airfield personnel, bystanders, etc.

PHASE I: Demonstrate the feasibility of the technology through a series of Technology Readiness Level (TRL) maturation events. Demonstrate the technology's basic scientific principles. Demonstrate the feasibility of applying the technology to an IDMS by designing, testing, and validating a basic breadboard laboratory experiment. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop, demonstrate, and validate the breadboard and test it in an environment that represents the speed and particulate size/material typical of a Navy/Marine Corps environment; begin studying Pd and Pfa.

Produce a prototype system that consolidates the breadboard into an operationally representative IDMS configuration; increase the testing rigor to include representative mechanical effects such as engine acoustics and vibrations and aerodynamic effects such as temperature, pressure, and non-uniform airflow. Characterize the prototype's performance when exposed to these mechanical and aerodynamic effects.

Refine the prototype to be worthy of flight qualification. Quantify the Pd and Pfa under varying operational and environmental conditions (see Description section for details) before exiting this stage and the IDMS does not pose a safety of flight risk to an aircraft.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype for a selected Navy and/or Marine Corps aircraft. Integrate the prototype into the select aircraft and the SOSA. Support flight-testing. Work to enable the retrofit of operational aircraft with the IDMS.

FOD costs the commercial aviation industry over $2 billion per year [Ref 4] and an average of $43 million per year at major U.S. hubs. The FOD Program projects that the FOD SOSA's risk remediation techniques, enabled by the IDMS subject to this topic, will increase commercial aircraft availability by between 15 and 30 aircraft per airfield per year and reduce cost of ownership for airlines by between $20 million and $50 million per airfield per year where the SOSA is operational.

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KEYWORDS: FOD; IDMS; PHM; CBM; EHM; SOSA; Inlet Debris Monitoring System; Foreign Object Damage; Probability of Detection; Pd; Probability of False Alarm; Pfa

VERSION 5

N212-106 TITLE: Fast Low Loss Uninterrupted Optical Switch

RT&L FOCUS AREA(S): Autonomy;General Warfighting Requirements (GWR);Networked C3

TECHNOLOGY AREA(S): Air 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 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 package a 2 x 2 single mode optical switch operating at 1.55 µm wavelength capable of switching speeds below 1 µs with a directivity of 50 dB and an excess loss of less than 1.0 dB with a continuous intensity change from port-to-port.

DESCRIPTION: Current airborne military communications and electronic warfare systems require ever increasing bandwidths while simultaneously requiring reductions in size, weight, and power (SWaP). The replacement of the coaxial cable used in various onboard Radio Frequency (RF)/analog applications with RF/analog fiber optic links will provide increased immunity to electromagnetic interference, reduction in size and weight, and an increase in bandwidth. However, routing these signals to different locations within the airframe with high efficiency, or for routing/reconfiguring within the front end of an RF processor, requires the development of low-loss optical switches that can meet extended temperature range requirements (-40 °C to 100 °C). Additionally, avionic platforms pose stringent requirements on the SWaP consumption of components for avionic fiber communications applications. To meet these requirements, new optical component technology will need to be developed.

Typical microwave photonic links for 20 GHz and higher frequencies utilize single-mode fiber between transmitter and receiver. Many antennas on airborne platforms will be required to send their signals to a plurality of RF processors at different locations on the platform, which will require low-loss optical switching devices. In addition, for some RF front ends and processors, re-configurability in the front end is needed that will require optical path reconfiguration. Optical switches for these applications require continuous power transfer from two inputs to two outputs with continuous optical connectivity (without dead time) so RF information is not lost during the switching process. Switching speed will also need to be below 1.55 µs for these applications to minimize the transition time. Electro-optic [Ref 1] or magneto-optic technologies [Ref 2] offer the potential for fast switching if optical losses can be minimized. Other technologies, including integrated photonics platforms, may also be promising so long as the above specifications are met.

The packaged 2 x 2 optical switch in single, dual, and quad switch packages must perform over the specified temperature range and maintain hermeticity and optical alignment upon exposure to typical Navy air platform vibration, humidity, thermal shock, mechanical shock, and temperature cycling environments [Refs 3, 4], which can include unpressurized wingtip or landing gear wheel well (with no environmental control) to an avionics bay (with environmental control).

PHASE I: Demonstrate the feasibility of a 2-input, 2-output 1.55 µm optical switch that can switch at microsecond or better speeds. The switch must be capable of continuously variable coupling ratios between the two inputs/outputs so that no dead time results during switching. Provide detailed design and packaging plan to support the development during Phase II. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Optimize Phase I design, develop, and package prototype 2 x 2 switches in single, dual, and quad switch packages. Test prototype switches to meet the loss and switching speed specifications over temperature to meet design specifications in a Navy air platform representative of a relevant application environment, which can include unpressurized wingtip or landing gear wheel well (with no environmental control) to an avionics bay (with environmental control). Demonstrate a prototype fully packaged switch for direct insertion into single-mode analog fiber optic links.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype. Perform extensive operational reliability and durability testing, as well as optimize manufacturing capabilities. Transition the demonstrated technology to naval aviation platforms and interested commercial applications.

Commercial sector data centers, industries utilizing local area networks and telecommunication systems, as well as companies that install networks and telecommunications systems would benefit from the development of this fast, low-loss, uninterrupted optical switch technology.

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KEYWORDS: Optical Switch; Fiber Optic; Single Mode; Dead Time; Switching Speed; uninterrupted

N212-107 TITLE: Novel Feedstock Production System for Metallic Additive Manufactured Structural Parts and Repairs

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Air Platforms;Materials / Processes;Weapons

OBJECTIVE: Develop a novel low-cost, high-yield metallic-powder production system capable of rapidly producing small batches (i.e., tens of grams to hundreds of kilograms) of feedstock for Additive Manufactured (AM) structural parts and repairs.

DESCRIPTION: Current production systems are capital and labor intensive, making the powders inordinately expensive, especially for small batches. The AM powders are also very costly with limited availability due to low yield and the needs for specific, high-quality, narrow particle size distributions (PSD) that are optimal for each AM process. For instance, the powder particles are usually specified with a size range of 15-45 µm diameter (dia.) for Laser Beam Melted (LBM)/Powder Bed Fusion (PBF) process, 45-106 µm dia. for Electron Beaming Melting (EBM)/PBF, and 45-75 µm dia. for Directed Energy Deposition (DED)/Laser Engineered Net Shaping (LENS).

In the academic and research arena, the lack of willing powder producers, long lead time, and high cost for low-quantity orders severely hinder the ability to rapidly validate and optimize the chemical compositions, microstructures, and mechanical performance for various material designs. To accelerate the performance optimization and verification of new alloy designs, high-quality feedstock in affordable small batches needs to be readily obtained for build trials.

As AM is adopted by more and more manufacturers, part designs will become more diversified and customized. There will be lower manufacturing volume of custom designed parts and assemblies as compared to the traditional mass production. A similar trend will also develop for new alloys used for different future applications. There will be more demand for alloys that are specifically designed for specific applications and less for standard alloys. This will drive the production of feedstock toward smaller scales and perhaps distributed where it is needed.

In the Maintenance, Repair and Overhaul (MRO), and fleet sustainment communities, the availability of small quantity supply with short-turnaround time without the needs for provisioning and storage is essential for timely part replacement and repairs.

A low-cost, small-batch, high-yield feedstock production system for AM processing is required. The targeted cost for a production unit should be in the range of $10K’s to low $100K’s. The system must be user-friendly, and provide sufficient adjustable controls, coupled with integrated internal monitoring sensors, to assure consistent and uniform high-quality powders (Refs. 10-13) (e.g., particle size distribution, sphericity, internal porosity, surface roughness, oxygen level, amount of satellite particles that adhere to spherical powders, flowability). It must also be capable of making high-yield (50% or greater), small batches (tens of grams to hundreds of kilograms) of traditional metallic powders (e.g., Ti64, 17-4PH SS, IN718, AlSi10Mg), as well as specialty designed alloys. Integrated Computational Material Engineering (ICME)-based modeling & simulation (M & S) of the powder fabrication process should be utilized to support the system design and development.

PHASE I: Develop and design a low-cost, small-batch, high-yield powder production system for metal AM applications. Perform system design, M & S, and associated experimental testing to validate the concept (Refs. 14 & 15). Generate preliminary performance and system specifications for the proposed design including powder handling, storage, and disposal procedures. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop, design and prototype a complete powder production system for AM applications. Demonstrate that the metallic powders can be successfully used for AM of aircraft components. Update performance and system specifications and special handling procedures including powder handling, storage, and disposal procedures.

PHASE III DUAL USE APPLICATIONS: Conduct final system checkout and acceptance testing. Perform production demonstration for multiple types of materials and alloys. Finalize performance and system specifications and special handling procedures.

This topic has a great and widespread potential benefit to commercial sectors ranging from academic research arena to the automobile industry.

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KEYWORDS: Additive Manufacturing; Powders; Metals; Feedstock Production; Small Batch

N212-108 TITLE: Low-Inclusion Content for High-Grade Steel Material Used in Gear-and-Bearing Components

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

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 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 steel processing method to dramatically reduce the inclusion content of steel bar stock for current gear material X-53 double vacuum melt (AMS 6308) beyond levels currently available commercially in steel intended for use in aerospace-level gear-and-bearing components.

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 the current gear material X-53 double vacuum melt (AMS 6308). Developing a cost-neutral manufacturing technology that would allow higher grade steel material with dramatically lower inclusion content would increase fatigue life, improve safety, and lower sustainment costs for a steel component. The goal is a lower inclusion content level of 90% objective (75% threshold) than is documented in the current inclusion standard in the material standard AMS 6308. This would result in a decrease in cost to the Government and/or original equipment manufacturers (OEMs), while improving homogenous performance of the material in production creation of components and use of those components. Transmission components, such as gears and bearings, are made from steel in the 4 to 14 inch diameter bar sizes. Determination of the size, type, distribution, and location of inclusions within the created material is the desired output. Comparison to current gear material X-53 double vacuum melt with ASTM E45 inspection standard is required to verify improvement.

PHASE I: Develop, design, and demonstrate feasibility of an analytical concept of technology allowing lower level of inclusion content. Projection of size, type, distribution, and location of inclusions within the bar stock are desired identifiable characteristics of a material. Exogenous inclusions such as refractory material are the primary concern, but indigenous inclusions are also a concern. Reduction in both types of inclusions is desired. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop and demonstrate a prototype production process with creation of sample material. Determination of the size, type, distribution, and location of inclusions within the created material are the desired output. Comparison to current gear material X-53 double vacuum melt with ASTM E45 standard is required to verify improvement.

PHASE III DUAL USE APPLICATIONS: Finalize and demonstrate a larger scale production process with creation of a heat lot of steel material. Determine the size, type, distribution, and location of inclusions within the created material output. Comparison to current gear material X-53 double vacuum melt with ASTM E45 standard and fatigue test transverse created specimens to verify improvement.

VERSION 5

Material failure due to inclusions limits the useful life of gear-and-bearing components. Commercial gear-and-bearing products would have higher and more predictable life. Aerospace, Industrial Machine, and other applications that require more predictable run time to avoid downtime and component changes would benefit from the technology.

REFERENCES:

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2. Sub-committee E04-09 on Inclusions. "ASTM E45 - 18a Standard Test Methods for Determining the Inclusion Content of Steel." ASTM International. http://www.astm.org/cgi-bin/resolver.cgi?E45.
3. "ISO 4967:2013 Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams." International Organization for Standardization, July 2013, https://www.iso.org/standard/63156.html.

KEYWORDS: Inclusion; refractory; steel; Exogenous inclusion; indigenous inclusion; X-53 (AMS 6308); double melt

VERSION 5

N212-109 TITLE: Naval Aircrew Life Preserver Unit Automatic Inflation Device

RT&L FOCUS AREA(S): Autonomy

TECHNOLOGY AREA(S): Human Systems

OBJECTIVE: Optimally design and develop life preserver units (LPU) that automatically inflate for downed rotary-wing and non-ejection seat aircraft in which naval air crew have egressed their aircraft.

DESCRIPTION: The current LPU require either manual activation or oral inflation which require aircrew that are conscious and physically able to activate or orally inflate the LPU. Aircrew in non-ejection aircraft must manually activate their LPUs. In the event of partial or total non-inflation, aircrew must tread water while orally inflating their LPUs. A recent fatality occurred when an aircrew member was unable to manually or orally inflate the LPU and, subsequently, drowned. In other occurrences, injured or unconscious aircrew have been unable to manually or orally inflate their LPUs leading to loss of life.

This SBIR topic seeks a capability that would auto-activate LPU inflation. Innovative solutions must include consideration of whether aircrew are within the aircraft trying to egress or outside the aircraft and incapacitated. Critical escape and survival equipment should work on time, every time, with minimal/no user input (similar to ejection seat technology).

Major concerns related to early auto-inflation are creating a larger presented volume relative to egress paths, additional bulk to snag on the structure, vulnerability of the LPU to puncture or tear, or the occupant floating up and having to move downward against buoyancy to egress. Keeping the device stowed until needed is required for operational, evasion, and reserving LPU function for when actually required. Most of these concerns are serious to the point of being showstoppers, if they are realized. However, this topic presents the opportunity to preserve human life in situations where life could be lost, and that may result in an incremental improvement in survival for aircrew and other aircraft occupants. An automated system may be able to replace horse collar flotation devices for passengers who have not had egress training while wearing devices. While passengers are not the norm, this could also be important in increasing the odds of survival among passengers.

Under certain conditions, aircrew may desire not to have LPU automatic inflation or to disable it after water entry. For example, the aircraft might be in shallow water or partially submerged and the aircrew might want to remain inside. Or aircrew could be in a mission or survival situation where water entry is desired but LPU is not needed, e.g., shallow water crossing. Also in some situations—e.g., fixed wing ditch—aircrew can enter a raft without inflating the devices and save inflation for a more critical situation such as leaving the raft, for rescue, or capsize. As such, designs should include an optional disable capability.

The logic, data acquisition and flow, algorithm development, and the means to implement/package it with the LPU system will be key portions of the effort and will determine success. It is not required, but highly recommended that performers interact with the qualified naval LPU manufacturers as needed.

Additional considerations:

(a) "escape buoyancy" should be addressed in the topic. Escape buoyancy is the total buoyancy from trapped air and insulation that is present in a survival suit "system" and still allow the wearer to escape a submerged helicopter. This includes net positive buoyant items that are part of the systems such as any foam mittens, hood, thermal liners and suit insulation, and trapped air.
(b) does not appreciably increase the weight and bulk burden of the LPU;
(c) operates in windy or calm air and in turbulent or calm water conditions;
(d) operates at a submerged depth of less than or equal to 30 ft (9 m);

(e) operates in cold water (32 °F (0 °C)) through the range of freshwater and seawater salinities;
(f) operates in chlorinated swimming pool water;
(g) operates reliably in cold and hot ambient air (-65 °F [-54 °C] to 160°F [71.1 °C]);
(h) resists inadvertent actuation while traversing ship ladders/hatches, operating within 120 knot rotor outwash, conducting pre-flight inspections and boarding aircraft, flying routine missions, flying combat missions, and egressing aircraft in routine or emergency situations;
(i) does not create hazards (e.g., injury, foreign object debris, snag/trip, static discharge) in any mission or survival operations to include survivable vertical crash loads (those less than or equal to 5Gs);
(j) does not interfere with vest or vest gear, armor/armor release, seat harnesses, fall arrest tethers, helmets or head-mounted gear, communication cords and devices, clothing or other body-mounted gear;
(k) does not impede water survival or land survival procedures to include raft boarding and hoisting;
(l) does not contribute to wearer's burn injury hazard;
(m) does not give away wearer's position in covert day or night operations;
(n) is tolerant of naval aviation environments (e.g., salt spray, humidity, drop impact, exposure to petroleum/oil/lubricant contaminants; exposure to sun);
(o) has an obvious visual indicator for correct rigging;
(p) possibly a design consideration is when/how to fully inflate. The key word here is "fully". Crews are wearing net negative buoyant gear loads, and it is possible that a flotation system could be designed that inflates in stages (immediate inflation, then to neutral state to enable egress or reduce effort to tread water/drown proof, then 15 s later to full state to serve as a surfacing aid and for flotation).
(q) inflation at depth considerations. Crews surfacing quickly and holding their breaths can cause air trapped in their lungs to expand. This may rupture lung tissue (i.e., pulmonary barotrauma), which can lead to gas bubbles being released into the arterial circulation (i.e., arterial gas embolism).

Note: NAVAIR will provide Phase I performers with the appropriate guidance required 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: Develop, design, and demonstrate feasibility of new and innovative solutions that have the potential for auto-activation for downed aircrew that are egressing an aircraft or who are on the outside of the aircraft and incapacitated. An analysis of the auto-activation for the range of the downed aircrew scenarios, in which it is or is not appropriate, must be performed, and the risks associated with auto-activation for the range of those scenarios must be addressed. Those trades must be realized in the proposed solution. The risks to the wearer of fully inflating an LPU in a submerged aircraft must be addressed, mitigated, and reported on as a part of Phase I. 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.

PHASE II: Develop and produce a prototype naval aircrew LPU inflation device. Perform laboratory and human validation testing to evaluate performance in mission-representative scenarios. Develop life-cycle costs and supportability estimates.
Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype, validate, integrate and transition to naval platforms. Coordinate with naval platforms to test and qualify production representative units as needed.

Commercial air and sea safety, general aviation over water safety, and recreational boating industries could all benefit from this technology.

REFERENCES:

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KEYWORDS: Aircrew; LPU; life preserver units; flotation; auto-inflation; water survival; egress

VERSION 5

N212-110 TITLE: Machine Learning, Tactical Cross-Domain Solution, Cryptography Module

RT&L FOCUS AREA(S): Artificial Intelligence (AI)/Machine Learning (ML);Cybersecurity;Networked C3

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 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 Tactical Cross Domain Solution (CDS) Cryptography Module for a Manned-Unmanned Teaming (MUM-T) that will achieve certification per the National Security Agency (NSA) Cross Domain Enterprise Service (CDES)/National Cross Domain Strategy Management Office (NCDSMO) and achieve Authority to Operate (ATO).

DESCRIPTION: Currently, MUM-Ts employ encryption/decryption on their communications links, usually through dedicated box-level components referred to as Encryption Control Units (ECUs). The use of ECUs in unmanned aerial vehicles (UAVs) must be certified by the NSA as “Type 1”. The 10 OCT 2018 Department of Defense CIO memo, “Suspension of New Point-to-Point Cross Domain Solutions and Changes to Existing Point-to-Point Cross Domain Solutions Implementations,” directed that development of new point-to-point CDS solutions be halted in favor of “enterprise” CDS solutions managed and monitored by the National Cross Domain Strategy and Management Office (NCDSMO). In addition, NSA released the Cross Domain Solution Design and Implementation Requirements: 2019 Raise the Bar Baseline Release (RTB). The RTB policy identifies four foundational concepts for a CDS, which are Redundant, Always Invoked, Independent Implementations, and Non-Bypassable (RAIN).

Using the nomenclature of the NCDSMO, this SBIR topic-requested system would classify as a Tactical-Class Transfer CDS (TCDS) with environmental constraints such as heat, humidity, and vibration, as well as a need to operate in an environment where communications capabilities may be interrupted. Usually these TCDS systems support a limited number of message formats. For this SBIR topic, the TCDS system should be designed to use a modular design capable of supporting a potentially large number of message formats, although any single instantiation would likely support a smaller set of message formats based on MUM-T mission requirements.

The proposed MUM-T CDS cryptography module may be either a multifunctional ECU, or a chassis ECU with multiple crypto functions on computer Printed Circuit Board (PCB) slices, or multiple smaller ECU modules with crypto functions in individual modules electronically connected together or being stand-alone ECUs. The CDS cryptography module must be capable of supporting multiple CDS channels at 100 Mb/s in less than or qual to 0.5 watts and within a threshold 1.5 cubic inches with an objective 0.5 cubic inches and a weight of threshold 0.7 ounces with an objective of less than 0.5 ounces, certified for Top Secret and Below (TSAB) Interoperability environments. The “Raise the Bar” compliant CDS cryptography module key factors in an envisioned NCDSMO certified solution would have minimally:

(a) an intelligent domain security hierarchy control point as an intellectual property (IP) core that is capable of reading, parsing, and intelligently routing to associate security domains, messages, data, images, and/or video. The proposed intelligent domain security hierarchy control point would be able to automate Object Identifier/Globally Unique Identifier (OID/GUID) data tagging that can be used for data analytics and distribution in the DCGS-N Inc. 2 Multi-Domain Federated Query (MDFQ) Architecture; manage and disseminate diverse types and formats of multi-domain messages, data, images, and/or video with different volumes, velocities, variability, and veracity characteristics; and handle changes in formats/fields of existing messages, data, images, and/or video types and feeds from multiple data sources.

(b) a scalable, guard-agnostic, cross-domain discovery service to communicate between different security domains allowing individual messages, images, or data fields within them to be selectively passed, blocked or changed.
(c) reprogrammable or configurable rulesets that allow adaptability in configuring each security domain to automate the "man in the middle" screening of message exchanges, thereby accelerating communications and reducing human error.
(d) pluggable filters, which include functions to filter data based on user programmable rulesets.
(e) machine learning (ML) algorithms to create data-driven content checkers for data leakage prevention (DLP), autonomous screening of message exchanges with no operator required, and also for an adaptive power management solution.
(f) a protocol adapter that uses an agile performance-enhancing proxy (PEP) protocol to be enabled during a disadvantaged network condition.
(g) an operator interface that allows role-based access and administration for configuration of each security domain through a separate management port.
(h) Raise the Bar Compliant filters supporting multiple message formats including images, video, audio, Link 16/JREAP-C, USMTF, FDMP, FTP, and SMTP formats.
(i) modular connectors for a cross-platform solution to enforce domain separation using separate high- and low-data ports.
(j) zero packet loss in disadvantaged networks where communication performance suffers, or is disrupted, or is not feasible due to characteristics of the datalink or subnetwork on the path to transfer information.
(k) a scalable guard-agnostic cross-domain discovery service using a service-oriented architecture (SOA) to autonomously screen message exchanges with no operator required.
(l) machine-to-machine (M2M) algorithm to authenticate all outbound traffic using the high assurance Transport Layer Security (TLS) cryptologic and NSA Key Management Infrastructure (KMI) trusted certificates with no operator required.
(m) anti-tamper protection with device zeroization built-in.
(n) full audit logging of all system, security, and message events.
(o) encrypted storage of rule sets and audit logs.
(p) secure boot and trusted platform verification upon power up.
(q) authenticated, role-based, device administration through management port.

The CDS cryptography module must be able to operate in the following environments:

- Operational Temperature: -40 °C to 70 °C
- Storage Temperature: -51 °C to 85 °C
- Operational Altitude: 0–65,000 ft above sea level
- Mechanical Shock: 40g, 11 ms, each axis
- Vibration: Tracked and Wheeled Vehicle, Fixed-and Rotary-Wing Aircraft, Gunfire
- Fluid Contaminations: Diesel, Hydraulic, Oil, Bleach
- Relative Humidity: 10-95%
- EMI/EMC: MIL-STD-461F, RE102, CE102, CS101, CS114, CS115, CS116, RS103
- Power: MIL-STD-1275E, MIL-STD-704F

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 Counterintelligence and Security Agency (DCSA). The selected contractor 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 DCSA 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 feasibility of a flyable routing solution scalable to various platform configurations with a CDS addressing multiple security levels. Develop a draft architecture and plan for attaining NSA approval for cryptologic systems. The Phase I effort will include prototype plans to be developed under Phase II.

The Phase I final report must include in the appendices: (a) a plan for NCDSMO certification of the final design which would achieve Common Criteria Evaluation Assurance Level (EAL) greater than four; (b) a Hardware/Software/Firmware Requirements/Design Specifications including use case diagrams (i.e., file drop, API/socket data transfers, database data transfers, video transfers, multiple CDS/file decomposition); and (c) a Design Description containing a full and detailed description of the proposed MUM-T CDS cryptography module design, including detailed system design, a traceability matrix to the software requirements and interfaces which abstracts isolation and security low-level communication details and exchanges.

PHASE II: Further design and develop the solution identified in Phase I into a prototype. In conjunction with the Government, develop simulated data and then use that data to demonstrate the prototype. Develop an unclassified set of controls to handle organic and off-board classified data types provided by the Government. Demonstrate features and function that would be best suited for transition into an operational environment.

Initiate process of attaining NSA approval for designed hardware and software.

Finalize the design, fabricate the design, and test the design developed in Phase I for proof of operation and ability to be certified. Finalize the steps necessary for NCDSMO certification and ATO.

Deliver prototype hardware and software documentation, which should include reports on: NSA Certification; Decryption; Encryption; Authentication; Transmission Security; Algorithms; Cryptographic Status; Cryptographic Alerts; Key Management Infrastructure -Enabled; Re-programmability; Protocols; Interfaces; Over-the-Network-Keying; Over-the-Air-Re-key; Key Storage; Multiple User Access; Key Manager; Crypto Manager, and System Manager.

Work in Phase II may become classified. Please see note in the Description section.

PHASE III DUAL USE APPLICATIONS: Complete development of the cross-domain control measures and perform final testing in a Government-designated simulation environment. After identifying specific data types and classifications of airborne system data, demonstrate a fully capable multilevel security CDS in a live fly event. Continue work with the Government sponsor to gain NSA approval for provided approach and transition to applications across naval airborne platforms.

The control measures and techniques employed may benefit companies seeking to protect proprietary data while working with other organizations. This technology will apply beyond the contractors supporting the DoD. Medical, financial, and civilian electronics industries will benefit from a technology that allows networking with competitors for collaboration while preventing proprietary or personal data from spillage onto an improper domain.

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KEYWORDS: Multilevel Security; Cross Domain Solution; CDS; Data Sorting; Adaptive; Small Form-factor; Machine Learning

N212-111 TITLE: Technology for Transmitting and Receiving Airborne, High-Speed, Wideband, Covert Communications

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Networked C3

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 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 low-cost, covert, high-speed, high-density means of transmitting and receiving broadband data for use on Navy Land/Sea/Air platforms.

DESCRIPTION: The U.S. Navy requires a high-capacity, covert communication link providing two-way communication through free space. This communication link must be covert, or undetectable, which has a low probability of intercept (LPI) or a low probability of detection (LPD) and cannot be susceptible to jamming. The communication path must allow for fast, large-data transfer(s) from one aircraft to another aircraft and/or sea- or land-based hub. The types of data include, but are not limited to, the following types of data: maritime tactical information, imagery (Still and Full Motion Video), Synthetic Aperture Radar, Multi-and hyper-spectral imagers, Precise Navigation and Timing (PNT) data, Electronic Warfare, and Acoustic data.

The goal of this SBIR topic is to develop a covert, wideband communication device that supports a 100 Mbps data transfer rate at line of sight ranges (150 nm). The first challenge for many engineers in wireless communication design is how to overcome white Gaussian noise. The proliferation of wireless technologies has also added hostile noises as a major cause of interference. A covert, high-bandwidth communication device could overcome a harsh Gaussian environment even with the addition of hostile noises while maintaining a high-bandwidth data transfer. If Radio Frequency (RF) is used as the transmission source, desired bands are L band to X band, Ku band, and Ka band ability with the ability to transmit and receive (TR/RX) in multiple bands. The volume of the device should be less than 4.5 ft3 (0.127 m^3). The weight should be less than 50 pounds (22.7 kg). The estimated cost per unit should be less than \$50K per kit. Conformal antennas are desired to limit the drag impacts on the host aircraft. The system is required to be undetectable outside of the main beam (i.e., highly directional, meaning you have to be in the path to intercept). For RF, the system should be able to null noise sources, in addition to being a non-detectible signal below the RF noise floor and agile enough to mitigate against jamming sources. The desire is to limit the number of moving parts to reduce the sustainment footprint of this device.

PHASE I: Develop, design, and demonstrate a strategy, taking into consideration the feasibility and suitability for a covert high-speed, high-capacity airborne communication link. Identify potential roadblocks likely to be encountered and possible roadblock solutions. Recommend an architecture and implementation plan. Illustrate the benefits of being able to pass high-speed, high-capacity data covertly. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Based on the architecture and algorithms, develop a working prototype to include high-level requirements, software development, testing, and demonstration.

PHASE III DUAL USE APPLICATIONS: Perform final testing, and finalize the prototype. Develop platform integration execution plans, and engineering documentation, suitable for the transition of a functional prototype.

Covert netted high-bandwidth communications, wireless sensors and multimedia communications are increasingly becoming a required asset for success in modern society. As a result, issues surrounding their effective use, safety, and security are becoming more important. Even for commercial applications, covert commercial communication platforms will help protect private and sensitive information by reducing the possibility of interception and compromise.

Additionally, wireless communications often suffer from hostile noises or hostile noise environments. This would have commercial use for anyone who uses wireless technologies.

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3. “DoD 5220.22-M National Industrial Security Program Operating Manual (Incorporating Change 2, May 18, 2016).” Department of Defense, February 28, 2006. https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodm/522022m.pdf.

KEYWORDS: Covert; network; high-capacity; RF; optical; survivable; communications

VERSION 5

N212-112 TITLE: Extending the Surveillance Horizon for Improved Ship Self-Defense Against Hypersonic Cruise Missiles

RT&L FOCUS AREA(S): Hypersonics

TECHNOLOGY AREA(S): Air 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 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 critical elements of advanced airborne radar system designs for the detection and tracking of supersonic and hypersonic cruise missiles to provide early cueing of ship self-defense systems.

DESCRIPTION: Navy ships face a variety of missile threats. Highly advanced and very capable ship self-defense systems are in place to defeat these threats. However, hypersonic cruise missile threats operating at lower altitudes pose a unique challenge. As opposed to ballistic missile trajectories where Navy guided missile destroyers and cruisers have on the order of several minutes to detect, track, lock onto, and then launch interceptors against a hypersonic reentry vehicle, low flying missiles [Refs 1–3] provide as little as 10 seconds (s) of flight time above the ship's radar horizon before missile impact. Some supersonic missile threats present similar challenges. An airborne platform, either manned or unmanned, with a suitable radar system operating in the vicinity of the ship could—in principle—dramatically extend the engagement timeline by providing early detection, tracking, and cueing to the ship. The most obvious candidate aircraft to host the radar system would be on high altitude long-endurance (HALE) and medium-altitude long-endurance (MALE) unmanned aircraft (UA). Hosting this desired capability on existing Navy airborne radar systems is very desirable and worthy of consideration. Even when a threat vector is identified so as to constrain the radar surveillance volume, the detection and tracking timeline for single or multiple inbound missiles whose radar return may be buried within a plasma envelope is extremely challenging. The desired solution is a radar mode and signal processing approach capable of being hosted in modern Navy airborne radar systems.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor 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 DCSA 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: Develop, design, and demonstrate feasibility of a high-fidelity target-and-clutter model to establish radar system mode and signal processing requirements when operating from a HALE or MALE UA platform utilizing open-source literature on potential-threat, anti-ship, hypersonic cruise missile systems, their flight profiles, and expected radar cross sections, including the potential plasma surrounding a hypersonic missile. With those requirements, develop conceptual radar system mode implementation concepts and evaluate those using the missile and radar models. Identify the most promising approaches from a detection and tracking performance perspective. Prepare a Phase II plan that demonstrates operational and technical feasibility of the proposed approach. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Refine the radar architecture using threat-and-host platform information provided by the Navy. Increase model fidelity, as required, to more confidently characterize the radar's performance in an operational environment. Refine the radar system performance requirements as necessary based on modeling results. Demonstrate and document results of tests of critical technologies identified in Phase I. At the end of Phase II, a prototype radar system design should be completed and delivered to the Navy. The design should be sufficiently detailed to inform the scope of a Phase III development program.

Work produced in Phase II may become classified. See Description for details.

PHASE III DUAL USE APPLICATIONS: Complete development, perform final testing, and integrate and transition the final solution to naval airborne radar systems either through the radar system OEM or through third party radar mode developers.

The algorithmic approaches could be utilized by a very wide variety of airborne, surface, and space-based radar systems for the detection and tracking of very high-speed objects including those that are moving in a high-clutter environment.

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1. Howard, A. "Fast and furiously accurate: Conventional hypersonic weapons need precision to match their speed.." U.S. Naval Institute Proceedings, 145(7), July 2019, p. 1397. https://www.usni.org/magazines/proceedings/2019/july/fast-and-furiously-accurate.
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KEYWORDS: Radar; Hypersonic; Cruise Missile; Ship Self Defense; Detection in Clutter; Anti-Ship Missiles

VERSION 5

N212-113 TITLE: Modeling of Solid-State Materials Consolidation Repair Process for Static Strength and Fatigue Life Predictions

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Air Platforms;Materials / Processes

OBJECTIVE: Develop a thermal/mechanical/metallurgical-analytical tool to predict static strength and fatigue life of solid-state materials consolidation process for structural repairs via process modeling.

DESCRIPTION: This effort will further the Navy’s push to take advantage of solid-state additive methods for repair/sustainment and reduce reliance on experiments alone by improving our understanding of the physics involved, assisting in selecting appropriate materials, and improving process parameter optimization. Various solid-state materials consolidation processes have proven to be attractive and promising procedures to perform repair of metallic structural aircraft components. An attractive aspect is the ability to add material with a reduced heat input, thermal gradients, and residual stresses compared to melting-based technologies. The plastic flow-induced diffusion process can introduce a stronger bonding at material interfaces, allowing for bonding of dissimilar materials that other methods cannot accomplish [Refs 1, 4]. The various solid-state repair methods involve a large range of interdependent relationships between the microstructure, thermal, and mechanical aspects. Examples of important phenomena include plastic deformation, dynamic recrystallization, and heating-and-cooling rates [Ref 3]. While no melting is involved, the various solid-state processes induce heating, which affects the repair material and substrate and needs to be considered. Minimizing the impact to the substrate material is critical to doing no harm during the repair process.

Given the coupled physical mechanisms, the large number of geometry and process dependent variables to control, and the material evolution associated with solid-state materials consolidation repair, it is imperative to develop a physics-based modeling tool. Such a tool will reduce both testing costs and time to identify important process parameters. The process parameters need to meet the performance requirements in terms of restoring or enhancing the strength and fatigue life of the damaged components. That is, any repair should meet a part's static strength requirements and provide increased fatigue life compared to no repair.

The developed tools should provide conservative estimates of the static strength and fatigue life. In addition, prediction of damage initiation and propagation in repaired components is important, but still in its formative stage due to the complexity associated with material heterogeneity, defects, and residual stress field. To achieve these goals, the tool will need to consider thermal, mechanical, and metallurgical phenomena. The tool should also predict bond strength, damage initiation, and its progression in a repaired component. In order to predict strength and durability, the impact of the thermal history and the plastic strain of the process on the repair and substrate material's microstructure will require consideration [Refs 1, 3]. The focus material should be aerospace-grade aluminum alloy (e.g., 2024 or a 7000 series aluminum alloy). This modeling tool will advance the Navy’s ability to analyze solid-state repairs, setting the stage for improved repair options.

PHASE I: Develop an integrated computational modeling framework for a solid-state materials consolidation repair method. Such a framework should simultaneously consider thermal, mechanical, and metallurgical phenomena. The simulation should consider process simulation and structural analysis. Ensure that the concept methodology in Phase I demonstrates its ability to model the process’s thermal history and residual stresses. At a minimum, provide the methodology for the consideration of bond strength, damage initiation, and its progression of solid-state repaired components under static and fatigue loading in Phase II. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Fully develop, verify, and validate a prototype modeling simulation tool for solid-state materials consolidation repair subject to static and fatigue loading. Demonstrate its ability to optimize repair on aircraft components for improved static strength and fatigue life.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype. Perform final testing to demonstrate the analysis model's ability to provide conservative, but structurally useful, static strength and fatigue life for a variety of repairs (e.g., hole damage and corrosion) and materials. Transition the tool.

Commercial aviation has similar incentive to repair damaged aircraft and get them airworthy quickly. This analysis capability will be just as useful for the commercial aviation industry.

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4. Cavaliere, P. and Silvello, A. "Crack repair in aerospace aluminum alloy panels by cold spray." Journal of Thermal Spray Technology, 26(4), 2017, pp. 661-670. https://doi.org/10.1007/s11666-017-0534-9.

KEYWORDS: Solid-state material consolidation; additive repair; Static strength; Fatigue life prediction; additive friction stir deposition; cold spray

VERSION 5

N212-114 TITLE: Advanced Low Probability of Intercept/Low Probability of Detection Radar (LPI/LPD) Techniques Using Artificial Intelligence Driven Methods

RT&L FOCUS AREA(S): Artificial Intelligence (AI)/Machine Learning (ML);General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Air Platforms;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 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 advanced low probability of intercept/low probability of detection (LPI/LPD) radar techniques using artificial intelligence (AI) driven methods.

DESCRIPTION: The use of low probability of intercept/low probability of detection (LPI/LPD) radar techniques in radar and communication systems operating in adversarial environments has been common for many years. A wide range of techniques have been utilized in various combinations, including wide operational bandwidth, frequency agility, proper power management, antenna side lobe reduction, and advanced scan patterns, as well as host LPI waveform designs including binary phase codes, polyphase codes, Barker codes, Frank codes, and Polytime codes. Countermeasures to these techniques have been widely documented in open source literature. Many of the more recent approaches rely on machine- and deep learning-based detection and localization algorithms to dramatically reduce the effectiveness of conventional LPI/LPD radar techniques. The Navy requires the development of highly adaptive, advanced AI-based LPI/LPD radar techniques to regain and maintain an enduring advantage in the presence of capable adversaries. Computational resources to host this capability vary significantly across the candidate transition platforms. As a result, the computational efficiency of the approach along with its robustness and training requirements should be considered important criteria in the selection of an AI technique.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor 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 DCSA 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: Develop concepts for multiple synergistic LPI/LPD radar techniques that are able to quickly adapt in response to the tactical environment. One or more AI-based decisions engines to achieve this adaptability. The concepts should directly address how the approach will counter those advanced machine and deep learning LPI/LPD radar techniques widely discussed in open source literature. Consideration should be given to how invasive each conceptual approach is in terms of hardware requirements and performance impacts. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Based on Phase I results, candidate concept(s) will be matured through more detailed high-fidelity analyses with a focus on a particular legacy radar system. Examine sensor integration concepts. Working with the Navy sponsor, assess hardware, software, and firmware impacts to accommodate the candidate techniques. Identify critical technical challenges and perform necessary analysis and as required experimentation to understand the associated risk. The Phase II deliverable should provide a detailed conceptual approach with supporting analyses of sufficient detail to support follow-on design and integration in the candidate radar system.

Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Complete development, perform final testing, integrate, and transition the final solution to naval airborne radar systems.

The techniques could be utilized by commercial applications in commercial communication and data systems.

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3. Alrubeaan, T., Albagami, K., Ragheb, A., Aldosari, S., Altamimi, M. and Alshebeili, S. “An Investigation of LPI Radar Waveforms Classification in RoF Channels.” IEEE Access, 7, 2019, pp. 124844-124853. https://doi.org/10.1109/ACCESS.2019.2938317.

KEYWORDS: Radar; Low Probability of Intercept; LPI; Low Probability of Detection; LPD; Counter Electronic Attack; Maritime Surveillance; Waveform Design

N212-115 TITLE: Additive Fiber Reinforced Composite Repair for Aircraft

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials / Processes

OBJECTIVE: Develop a novel additive material deposition system that produces high-quality composite laminate repairs that return parts to original strength.

DESCRIPTION: High-performance composite materials used on current, and future, aircraft construction will exhibit damage and wear throughout their lifetimes. Repair methods usually consist of damaged material removal, surface preparation, and applying a repair patch in order to bring the structure back up to original strength. Although repair systems exist, these can be very labor intensive. Much effort is spent on cutting and handling the repair materials. This handling often produces excess waste as the maintainer must cut circular material to make the patches from stock material that comes in square sheets. These repairs must be carefully cut to fit the damaged area they are replacing, often made from successive circular layers in a step scarf geometry. There is also the struggle with time as the liquid resin systems either pre-impregnated in the fiber or applied from a two-part mixture have a finite shelf life. Finally, there is a great amount of training associated with individuals doing repair to produce consistent and quality products every time.

Recent advances in Additive Manufacturing (AM) have the potential to make automated repairs a reality. Stemming from earlier work on Automated Fiber Placement (AFP), commonly used in industry, AM has moved from printing thermoplastics to fiber-reinforced thermoplastics and thermosets [Ref 1]. It has been shown that the resulting parts are not only stronger, but contain nearly as much fiber content as the high-performance composites used in making aircraft. There have also been advances in resin materials. Recent products featuring higher temperature thermoplastics are becoming commercially available. Thermosetting resins such as epoxies are being developed [Ref 2]. These resins can meet the structural and environmental properties demanded by naval aircraft. Coupling the superior strength of fiber reinforcement with durable, high temperature-resistant resins are the next technological step for performance AM [Ref 3].

An automated repair system will leverage the miniaturization of composite processing through AM to enable fleet maintainers to make faster more consistent repairs to composite aircraft. The user would mount the system over the damaged area and load in the repair materials. Repair patch outer dimensions may reach a maximum size of up to 18 inches and a minimum size of 5 inches. Applying repair material at the point of deposition will eliminate the waste generated by hand cutting pre-impregnated or wet layup composites. It will also speed up repair as the maintainer would not have to handle and mix resin before wetting out the dry fibers before cutting to size. Consistency will also improve as the resin is pre-mixed and uniformly impregnated into the fiber feedstock for the system. Using the aircraft as a tool surface, the proposed system can apply local pressure and heat to improve consolidation of the fibers, as well as, cure. Machine vision can be used to confirm ply orientation, scan for Foreign Objects and Debris (FOD), and provide documentation of the process which is useful for Digital Twin applications. Once complete, the user can remove the system and the leftover repair materials to be stored for future repairs.

The objective is to be able to install, operate, and cure the repair in one shift (8 hr) although longer duration is acceptable depending on technology maturity. Develop and add the capabilities of machine vision to confirm repair ply size, orientation, and if FOD/defects exist. Further refine the intended repair material to be deposited by this system. Utilize a resin system with a cure temperature no greater than 350 °F (177 °C) although lower is desired. Show that the resin is fully cured when the intended system and repair process is complete. Perform additional mechanical testing per ASTM Standard of the repair material to confirm that physical and mechanical properties are suitable for a repair system.

Desired threshold mechanical performance are listed below.

Threshold Composite (0°/90°) Symmetric Laminate Mechanical Properties

- Short Beam Shear Average Strength: 9 ksi Room Temp Ambient, 6 ksi 180 °F (82 °C) wet
- Tension Average Strength: 115 ksi Room Temperature Ambient, 109 ksi 180 °F (82 °C) wet
- Tension Average Modulus: 10.36 msi Room Temperature Ambient, 9.74 msi 180 °F (82 °C) wet
- Compression Average Strength: 69 ksi Room Temperature Ambient, 48 ksi 180 °F (82 °C) wet
- Compression Average Modulus: 7.91 msi Room Temperature Ambient, 7.62 msi 180 °F (82 °C) wet.

The final repair material will have to undergo sufficient mechanical testing and characterization such that strength allowables can be generated and used to perform repair analysis. The proposer should conduct demonstrations of the material being deposited and utilize cross-sectional imaging and Non-Destructive Inspection (NDI) to confirm porosity does not exceed 4% by volume. The proposer should perform acid digestion of repair material to confirm a fiber content.

The goal is to meet or exceed 50% fiber content by volume. The final system should be such that it can be handled, carried, and placed by no more than two personnel.

PHASE I: Develop, design, and demonstrate the feasibility of a portable system that can additively repair a composite material through the automated deposition of thermoset polymer and carbon fiber reinforcement. Identify and prototype a fiber and resin system that will be used by this machine. Fiber may be continuous or discontinuous. The final intended resin system should have a wet Glass Transition temperature (Tg) of no less than 230 °F (110 °C). Demonstrate the system by depositing and consolidating material with a quasi-isotropic fiber orientation on a flat surface. Also, demonstrate that the system is capable of applying subsequent layers in such a manner that the net shape is the stepped scarf normally used in composite scarf repairs. Provide cross-sectional imaging, and additional analysis of these materials to inspect for porosity and fiber content. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop and demonstrate the technology to show that it can deposit material on curved surfaces. Demonstrate that it can deposit material in the scarfed recess left over from removing damaged material from a parent laminate. Integrate and refine the developed system such that it can be handled, carried, and placed by no more than two personnel. Refine the prototype system such that it can be securely mounted in reference to an aircraft's outer surface. Provide refined demo system as a deliverable to be used by NAVAIR.

PHASE III DUAL USE APPLICATIONS: Perform additional work to produce allowables data sufficient for traditional repair analysis per aircraft platform. Determine an adhesive system to be used for this repair. Ideally this would be one currently used in the fleet although the repair's own resin matrix may be sufficient. Prove this with mechanical testing. Complete full integration of the technology from a prototype to a commercially viable system. Provide this system as well as a comprehensive manual for its operation. Integrate the machine vision system into current aircraft maintenance tracking procedures.

Aircraft repair is common in the aerospace industry including transportation as well as military use. Composites are becoming more and more commonplace for commercial aircraft with the skin and stringers taking up much of the loads as seen with the Boeing 787. Being able to restore material properties to their original strength in an automated and consistent manner will keep aircraft flying longer, reducing costs for air carriers. Additional use can be found within the Army and Air Force for their composite aircraft.

VERSION 5

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KEYWORDS: Repair; Composites; Additive Manufacturing; Automated Fiber Placement; Machine Vision; Portable

N212-116 TITLE: Acoustic Tomography Using Tactical Sensors

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Battlespace Environments

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: Inform Air Anti-Submarine Warfare (ASW) operations by applying acoustic tomography through leveraging the tactical sonobuoy sensors used for wide-area search to estimate the three-dimensional sound-speed field.

DESCRIPTION: Air ASW systems rely on environmental information to plan sensor fields and assess the performance of the mission afterwards. In future Air ASW systems designs, environmental predictions will be used to better separate targets from clutter. Sound speed is a fundamental component of this suite of environmental information and is critical for determining transmission loss. Transmission loss is an important parameter in reconciling the sonar equation and is needed to understand achieved search performance and to derive performance estimates. Maximum acceptable Transmission Loss is highly dependent on environmental factors such as ambient noise and reverberation.

Currently, Maritime Patrol Reconnaissance Aircraft rely on a combination of pre-flight estimates of the sound-speed field, augmented with sparse direct measurements of the sound speed using air expendable bathythermograph (AXBT) sonobuoys. An AXBT provides the sound-speed profile only for the point at which it enters the water, however; distributed fields of sonobuoys can extend over large areas and more complete estimates of the sound-speed across the sonobuoy field are needed in order to provide improved mission planning and execution. Dropping more AXBT sensors is not desired because of payload constraints on the aircraft, lost search time deploying more sensors for environmental assessment, and increased cost for each mission from dropping more buoys.

Acoustic tomography has been previously applied to improve ASW situational awareness [Ref 1-3]. This SBIR topic will take advantage of the information already used by Air ASW systems to infer the sound-speed field by using acoustic tomography drawn from bistatic active sonar measurements used in wide-area search. Acoustic tomography [Ref 4] measures acoustic travel times between two points, along a multitude of paths, crossing at many different angles, to reconstruct the sound speed in a manner similar to medical computer aided tomography (CAT) scans. One constraint associated with using data from air deployed sensors is the limited bandwidth of both the source and receiver (on the order of 100 Hz). It may also be the case that not all receivers in the field reliably receive the source transmission. Any derived sound speed should be less than 1% different from a measured value at the same depth when a measured value is available for comparison.

Modern multistatic sonobuoy fields offer a similar multitude of paths, and aircraft avionics can readily measure travel times as part of the sonar processing chain. In recent years, the size of the sonobuoy fields have grown, and the accuracy of buoy location estimates during a mission has increased. These two trends appear to make acoustic tomography using tactical sensors more feasible than in the past.

Air ASW systems that benefit from this technology include: mission planning, tactical decision aides, post-mission assessment systems at tactical support centers, and onboard target detection processing systems.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor 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 DCSA 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: Conduct a study to account for the impact of various factors (e.g., buoy location uncertainty (0 – 1 NMI uncertainty), time of arrival uncertainty (+/- 1 sec or less), and sonobuoy spacing (5 km – 15 km), demonstrating the feasibility of the proposed approach through the use of simulations. Demonstrate using simulations that transmission loss estimates for tactical sensors, based on climatology and now-casts (Generalized Digital Environmental Model (GDEM) or Hybrid Coordinate Ocean Model (HYCOM)), can be improved by using acoustic tomography methods via tactical sensors. Demonstrate through simulations that Transmission Loss prediction accuracy using acoustic tomography for the entire multistatic sonobuoy field is within +/-6 dB of TL estimates generated by using GDEM or HYCOM at the point where that data is available. The Phase I effort will include prototype plans and software architecture to be developed under Phase II.

PHASE II: Develop a prototype processing algorithm suitable for integration into mission planning tools and onboard target discrimination algorithms. Analyze real-world data to show improved reconciliation of measured target detections and measured echo levels with environmental predictions of echo levels and signal excess that incorporate tomography results.

Work in Phase II may become classified. Please see note in Description paragraph.

PHASE III DUAL USE APPLICATIONS: Finalize and implement the capability as part of an operational sonar system. Transition of this capability should utilize the Advanced Product Builds (APB) process.

The tomography techniques developed under this effort have application across the Navy for sonar, radar, electro-optic, and other sensor devices. Other commercial applications for this technology are oil exploration and predicting storm tracks based on sea temperature.

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KEYWORDS: Acoustic Tomography; Sound Speed Profile; Multistatics Mission Planning; Target Detection; Target Search; Intelligent Search; sonobuoy

VERSION 5

N212-117 TITLE: Infrared (IR) Optical Windows for Hypersonic Aerial Vehicles

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Hypersonics;Microelectronics

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 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 infrared (IR) optical windows that are capable of protecting IR optical sensors and ensuring high-performance sensing during a hypersonic flight.

DESCRIPTION: Hypersonic aerial vehicles require the use of IR windows to protect sensitive opto-electronics from the aggressive aerothermal environment of high-speed flight while providing transparency to the IR optical signal used for intelligence, surveillance, reconnaissance, guidance, and communication applications [Ref 1]. The high temperatures of 3000 °F (1649 °C), or higher, associated with aerothermal impact of a high-speed/hypersonic vehicle during hypersonic flight, pose very challenging operating environments for the window material [Ref 2]. The interface surface or window material must be able to withstand extreme thermal, mechanical, and chemical environments during hypersonic flight that can limit the performance of the IR window and the IR sensor platform [Ref 3]. Furthermore, shock waves and extremely high heat loads produced during flight adversely impart wavefront distortions, and for this reason, affect the fidelity and accuracy of the signal/image detected by the optical sensors. Aerothermal-mechanical loads also create additional thermal requirements for the window to protect and insulate the sensor from the vehicle’s extreme exterior condition [Ref 4].

The Navy requires development and demonstration of a new class of IR windows that can operate at extreme conditions of high-heat fluxes and high-air pressures, and enable high-performance optical sensing during hypersonic flights. The key performance parameters for the windows include:

(a) wavelengths of interest: short-wave infrared (SWIR) – 1.4 to 3 µm mid-wave infrared (MWIR) – 3 to 5 µm, and long-wave infrared (LWIR) – 8 to 14 µm;
(b) meet aerothermal and pressure loading conditions for hypersonic aerial vehicles;
(c) accommodate both flat and non-flat (conformal, ogive, faceted) surface shapes to match vehicle aerodynamic design;
(d) maintain electromagnetic and thermo-mechanical properties associated with the intended optical sensor during hypersonic flight;
(e) window must endure the high temperatures (3000 °F [1649°C] or higher) and high-dynamic pressures (up to 12,000 lb/ ft^2) (5,443.2 kg/0.0929 m^2) during hypersonic flight;
(f) the optical materials and designs of the windows should have minimum transmission loss in the desired wavelength bandwidths for each of the IR bands during hypersonic flight conditions.

PHASE I: Develop, design, and demonstrate the feasibility of candidate materials for window application through material properties testing. Research and select the IR window candidate materials for each of the IR wavelength band. The testing should include optical transmissivity, structural strength, and thermal properties of the window materials. Use modeling and simulation to estimate the thermal-optical and elastic-optical effects of the window materials and the impacts on transmission amplitude and bandwidth during hypersonic flight. Provide a Phase II plan to develop and test the optical windows in accordance with their performance goals and key technical milestones while addressing technical risks and challenges discovered from the modeling and simulation in Phase I. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Fabricate the optical windows according to the fabrication plan laid out in Phase I. Perform comprehensive tests and evaluations of the fabricated candidate windows regarding their performance and reliability in a relevant hypersonic environment. Iterate the design/fabrication steps to modify the designs and fabrications of the optical windows due to technical challenges discovered in the test and evaluation phase to close the gaps in the performance and survivability endurance gaps.

PHASE III DUAL USE APPLICATIONS: Finalize development based on Phase II results, for transition and integration of the product into a hypersonic vehicle candidate airframe. Conduct flight test units for fielding on Navy experimental flight tests.

Potential commercial applications could include the applications of this research for infrared optical windows for commercial hypersonic re-entry vehicles.

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KEYWORDS: Hypersonic; Optical Window; Infrared; IR; mid-wave infrared; MWIR; short-wave infrared; SWIR; long-wave infrared; LWIR; Wavefront Distortion; Aerothermal; Thermal-optical

VERSION 5

N212-118 TITLE: Integrated Low-Jitter Mode-Locked Source for Optical Signal Processing Applications

RT&L FOCUS AREA(S): Microelectronics

TECHNOLOGY AREA(S): Air Platforms;Electronics

OBJECTIVE: Develop a compact, low-timing jitter, semiconductor mode-locked for optical signal processing applications.

DESCRIPTION: Emerging optical signal processing methods utilize the broadband nature of the optical spectrum to perform radio frequency (RF) signal processing in the optical domain. Examples of this include time-stretch analog analog-to to-digital converters [Ref 1], photonic sampling [Ref 2] and the use of optical speckle to perform compressive RF sensing [Ref 3]. Both applications require pulsed optical sources with a wide wide-optical envelope and low low-timing jitter. To date, fiber-based mode-locked lasers [Ref 4] have been used for this application and have met the performance requirements for these applications such as ultra wideband electronic warfare receivers. To allow a reduction of size and power of these emerging optical signal processing techniques, there is a need to develop compact (on the order of 100 cubic centimeters (cc), efficient semiconductor sources that can be chip-scale integrated in compact implementations, and can meet the requirements for implementation on size-and-power constrained Navy platforms. The developed source must be compatible with further integration of additional functionality such as analog optical modulators and low-loss optical waveguides. The mode-locked optical source should operate in the 1.5-micron band with average output power exceeding 10 milliwatts (mW). The pulse repetition rate should be in the 10-100 megahertz (MHz) range, with pulse timing jitter less than 100 femtoseconds (fs), and an optical envelope exceeding 10 nanometers (nm).

PHASE I: Develop, design, and demonstrate the feasibility of an approach for a mode-locked or pulsed optical source that operates in the 1.5 micron µ band with average output power exceeding 10 milliwatts (mW), 10-100 MHz pulse repetition rate, pulse timing jitter less than 100 fs, and an optical envelope exceeding 10 nanometers (nm). Develop a model for an optical signal processing system of interest for the Navy. Develop further application--specific requirements specifications for the mode-locked source. Through simulations or practical supporting measurement show that the proposed optical source will meet these requirements. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Fabricate and demonstrate a laser source that meets requirements defined in Phase I. Develop a prototype packaged laser demonstrator. Ensure, that at the end of Phase II, this packaged laser should be at Technology Readiness Level (TRL) 4 [Ref 5], with performance measured in a laboratory environment.

PHASE III DUAL USE APPLICATIONS: Complete development, perform final testing, and integrate and transition the final solution to future naval airborne electronic warfare and wideband radar systems.

As pointed out in the Description, this technology can be applied to time-stretch analog-to-digital converters, photonic sampling and the use of optical speckle to perform compressive RF sensing.

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KEYWORDS: Low jitter Lasers; Mode Locked Lasers; Photonic Sampling; Optical Speckle; Direct RF Conversion; Optical Compressive Sensing

N212-119 TITLE: Mobile User Objective System Dynamic Scanning Improvement

RT&L FOCUS AREA(S): Space

TECHNOLOGY AREA(S): Electronics;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 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 second-generation spectrally adaptive dynamic scanning algorithm to improve Mobile User Objective System (MUOS) Wideband Code Division Multiple Access (WCDMA) capable terminal UHF transmission efficiency and co-sharing spectrum supportability.

DESCRIPTION: As with any Department of Defense (DoD) radio system, radio frequency spectrum is shared and there is always the increased possibility of mutual or co-site interference. For MUOS capable radios, there are three types of interference mitigated by Spectrum Adaptation (SA): first, the MUOS radio transmission interference with the reception of non-MUOS radios (commonly called victims); second, interference to the satellite caused by other ground-based radios operating in the MUOS radio uplink frequency bands; and third, interference with the MUOS radio reception caused by non-MUOS radios operating locally within the MUOS radio's receive carrier.

The principal approach to defining interference limits within the Ultra High Frequency (UHF) bands is defined in the National Telecommunications and Information Administration (NTIA) Redbook. Typical narrow band radios have an equivalent isotropically radiated power (EIRP) in the 10 to 100 watt range. Applying the National Telecommunications and Information Administration (NTIA) Redbook criterion, the required out-of-band emission must be in a range no greater than -25dBW to -15dBW, with spurious emissions no larger than -43dBW. Narrow band radios must comply with this Spectral Emission Mask to avoid having additional coordination requirements imposed upon it.

Currently, the MUOS spectrally adaptive waveform transmits in the UHF (300 MHz – 320 MHz) band (20 MHz with 5 MHz distinct and separate channel) – equivalent to multi-carrier WCDMA. To avoid and protect other users within the transmitted band, the MUOS waveform is designed with the capability to scan the transmitted band, determine the presence of a victim signal (based on the pre-determined threshold), and then create RF masks in the amplifier and mask out the transmitted band. The algorithm employed in this case is a modified Discrete Fourier Transform (mDFT) using a polyphaser filterbank technique [Ref 1] and amplified further [Ref 2].

The envisioned second-generation spectrally adaptive algorithm would improve the frequency resolution, achievable notch depth, minimum notch bandwidth, computation cost, and design flexibility. From there, the algorithm would be implemented into a design suitable for incorporation with the MUOS waveform software. The goal for notching bandwidth is to reduce it to 25 kiloHertz or smaller per bin. The goal for notch depth is at least 27 decibels with an objective of 30 or more. The improved notching capability must require the same or less computational complexity in order to allow for software-only updates to existing radios.

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 Counterintelligence Security Agency (DCSA). The selected contractor 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 DCSA and NAVWAR 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: Create an initial conceptual design for a second-generation spectrally adaptive dynamic scanning algorithm. Predict performance using modeling and simulation or other tools. Consider radio integration issues. Estimate the power requirements and improved notch depth effectiveness. Determine the feasibility of the proposed approach to develop the algorithm to improve notch depth and scanning efficiency for MUOS radios. Develop a Phase II plan.

PHASE II: Build a prototype algorithm and simulate/test it in the spectrum-congested environment. Evaluate measured performance characteristics versus predictions from Phase I and make design adjustments as necessary. Develop a Phase III commercialization 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 integration of the design into the existing MUOS waveform. Support interoperability testing with existing systems in a lab and through end-to-end system test.

The technology developed under this SBIR topic may be applied to a variety of SATCOM and other spectrum dependent communication systems that are currently in development.

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KEYWORDS: Mobile User Objective System; MUOS; Wideband Code Division Multiple Access; WCDMA; satellite; communications; cellular; 3G; adaptive algorithm; Spectrum Adaptation; SA; Ultra High Frequency; UHF; modified Discrete Fourier Transform; mDFT; polyphaser filte

VERSION 5

N212-120 TITLE: Development of Non-Toxic but BioFouling Deterrent Marine Coatings

RT&L FOCUS AREA(S): Autonomy;General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Ground / Sea Vehicles;Materials / Processes

OBJECTIVE: Develop marine coatings that deter the settlement of biofouling without relying on the release of toxic chemicals. The coatings must not rely on an external source for activation (i.e., mechanical, optical, chemical) and must be practical for application on the large surface areas of the wetted ship hull.

DESCRIPTION: Marine antifouling coatings use biocides to minimize biofouling on ship hulls and are thus a compromise in terms of being environmentally beneficial (e.g., maximizing fuel efficiency, minimizing introduction of non-indigenous species) and environmentally harmful (i.e., releasing toxins). Current coatings either have an ablative matrix that the biocides diffuse through or are self-polishing and slowly hydrolize to release the biocides. When the biocide release rate drops below a threshold, hard foulers such as barnacles can strongly adhere to the ship hull. Alternative "fouling release" coatings have been developed, which do not release biocides and operate as easy to clean coatings which may self-clean by the shear of water against the hull when moving or be easily cleaned with soft brushes or wiping with a sponge. These coatings are generally based on silicone resins sometimes enhanced to present hydrophilic or amphiphilic domains on the immersed coatings surface. However, when ships are idle in port, biofouling can quickly accumulate to the extent that it will not self-clean. This is problematic for the Navy so most ships use antifouling coatings.

Commercial marine coatings manufacturers have started to develop hybrid coatings in which biocides are added to fouling release matrices. In some ways, these represent the best of both worlds, but it is doubtful that these coatings will retain these biocides to provide a long coating lifetime. Also, in the long run, non-toxic approaches are desired.

The goal of this SBIR topic is to develop environmentally benign coatings that deter settlement without the release of biocides, are effective for five years or more, and are easy to clean should some biofouling occur. To compete with antifouling coatings from a cost/performance perspective, such approaches should not resort to expensive active mechanisms involving electrical, thermal, mechanical, or optical stimulation. There are several approaches to achieve this in the literature, though currently none are fully successful so more development is necessary. The challenge is that the breadth and diversity of the marine biofouling community is high and extends from microscopic to macroscopic (i.e., bacterial to algae and barnacles), though stopping the initial foulers is a good approach. One strategy is to tether the biocides to the coating surface. Efficacy in this approach may depend on the inhibition mechanism of the biocide, and also whether cell debris is easily dislodged enabling the biocide to remain effective [Ref 1]. Another approach involves creating hydrophilic or amphiphilic surfaces using zwitterions. In general, this approach results in easy release surfaces but some methods of presenting the zwitterions seem to make the surfaces deterrent [Ref 2]. Though it is less desirable to release chemicals, registered irritant compounds such as Selektope which could provide a non-toxic coating. Researchers have also investigated release of various biofoulant signaling compounds [Ref 3]. Other novel approaches are welcome.

PHASE I: Develop approaches to producing coatings that are easy release and deter biofouling settlement relative to control surfaces (e.g., glass, polydimethylsiloxane (PDMS), commercial fouling release coating (Navy can identify relevant coatings) without releasing toxic compounds. Demonstrate this capability in lab assays against marine fouling on various fouling levels including marine bacteria, algae, and possibly invertebrates such as barnacles or tubeworms. Performers can use their own lab assays and/or submit samples to the ONR basic research program in this area [Ref 4]. Performers that use their own assays will need to calibrate them against the ONR assays. (ONR assays are generally carried out on coated microscope slides and coverslips.)

PHASE II: Scale coating for testing of coated 4 inch by 8 inch substrates in static field assays at ONR funded facilities. Optimize coating based on iterations of lab assay characterization and field testing. Optimize coating for longer term performance. Provide a business plan to commercialize coating.

PHASE III DUAL USE APPLICATIONS: Scale coating for patch testing on a Navy ship. Execute commercialization strategy for commercial and defense applications. The Navy currently utilizes coatings developed for commercial shipping which pass additional Navy qualification tests.

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KEYWORDS: antifouling coatings; fouling release coatings; biocides; non-toxic

VERSION 5

N212-121 TITLE: Improved Marx Pulse Generator for High Power Microwave (HPM) Systems

RT&L FOCUS AREA(S): Directed Energy (DE)

TECHNOLOGY AREA(S): Electronics;Ground / Sea Vehicles;Weapons

OBJECTIVE: Develop a sub-10 nanosecond rise time, GW-class Marx generator with long-lifetime insulated spark gap switches with preferred air (or other gas) as the primary insulation medium to support the deployment of next-generation HPM weapons.

DESCRIPTION: High power microwave (HPM) systems frequently require high voltage, high current, nanosecond duration pulses in order to generate radio frequency (RF) signals [Ref 1]. Such pulses are frequently generated by Marx generators [Refs 2, 4], which consist of multiple stages of capacitors charged in parallel and rapidly connected in series, usually by gas spark gap switches [Ref 5], to boost the voltage and provide an output pulse [Ref 6]. The spark gap switches consist of at least two electrodes, often contained within a high-pressure body filled with gas, and often utilize a trigger electrode situated between the two primary electrodes. A high voltage pulse is sent to the trigger, which breaks down to one of the primary electrodes, causing breakdown between both primary electrodes, thereby electrically connecting stages in series. Several failure mechanisms exist for these switches, making lifetime and maintenance a frequent issue. This is particularly true when compact designs are required. Problems include surface tracking between electrodes along the body of the switch and electrode erosion. High repetition rates can also be problematic, as gas flow is required to clear ionization and heat from previous shots. If sufficient gas purging is not accomplished between shots, thermal damage may be incurred or hold-off decreases, allowing breakdown to occur before full voltage is achieved [Ref 7].

Meanwhile, the Marx stages must be insulated from each other, which is usually accomplished with gas or transformer oil. In compact Marx generators, oil is often the insulator of choice due to its superior voltage hold-off qualities at Standard Temperature and Pressure (STP). However, oil insulation creates several issues. First, the use of insulating oil complicates Marx maintenance in deployed environments because of onerous drain and fill processes and OCONUS supply chain challenges. Second, high pressure switches leak into the oil at finite rates. Gas leakage occurs through switch body or gas fitting failures or by gas diffusion through the switch body and routing lines over long-term depot storage periods. Gas leaking into the oil results in dissolved gas or bubbles that significantly reduce the voltage insulating capability of the oil, and can cause ill-formed pulses or catastrophic failure of the Marx. Finally, oil insulation may result in Marx designs heavier than those insulated by gas.

A compact, fast rise time Marx design that utilizes air as its insulation and long life gas switches is therefore desired.

KEY MARX GENERATOR PARAMETERS:

- 300 kV peak pulse voltage or more into a matched load
- 13-20 O (ohm) output impedance
- 10 ns 10 – 90% voltage rise time or less
- 15 – 50 ns FWHM
- Threshold 10,000 / Objective 50,000 shot lifetime without maintenance or better
- 0.50 m diameter or smaller
- 1.25 m length or smaller
- Threshold 50 Hz / Objective 300 Hz repetition rate for 10 shots every 2 seconds for 5 bursts, or better
- 200 kg weight or less
- Air insulated (or other gases such as SF6 replacement mixture)

- Tolerant of up to 40% reversal of the output

PHASE I: Develop a concept for a compact Marx generator meeting the above Key Parameters that utilizes air as its insulation medium for both the switch and primary Marx insulation. Simulate switch electrostatics, and establish switch-purging methodology. Simulate Marx pressure vessel hydrostatics and electrostatics. Prepare a report to ONR and AFRL on designs and simulations and a Phase II testing plan.

PHASE II: Fabricate switch design(s) developed during Phase I for high voltage and pressure testing and gas flow analysis. These tests are to be performed under the temperatures outlined in MIL-STD-810H Test Methods 501.7 (Hot Dry) and 502.7 (Basic Cold). Measure switch lifetime under representative conditions and refine design as necessary to meet Key Parameters. Fabricate Marx pressure vessel and test at pressure. Provide switch prototype, Marx pressure vessel prototype, and report containing designs and testing results, and a Phase III plan to ONR/AFRL/NSWCDD for prototype evaluation.

PHASE III DUAL USE APPLICATIONS: Assemble full gas-insulated Marx generator and demonstrate output meeting Key Parameters. Demonstrate full Marx lifetime operating into a matched load. Deliver Marx prototype and a report containing designs and testing data to ONR/AFRL/NSWCDD. The development of a compact, high reliably pulsed power system would expand the present state of the art for Directed Energy and enable component level exploitation for commercial applications in the pulsed power industry.

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KEYWORDS: High Power Microwaves; Marx Generator; Spark Gap Switches; HPM; Marx; Pulsed power

VERSION 5

N212-122 TITLE: Characterizing 5G vulnerabilities in an expeditionary environment

RT&L FOCUS AREA(S): 5G;Cybersecurity

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 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 lightweight and reliable vulnerability detection and verification system for 5G end user devices and its supported infrastructure at the Physical (PHY) and Media Access Control (MAC) layers.

DESCRIPTION: The Navy seeks development of a lightweight and reliable vulnerability detection and verification system for 5G end user devices and its supported infrastructure at the Physical (PHY) and Media Access Control (MAC) layers.

The general architecture for 5G networks demonstrates the ability to connect to many differing types of devices such as high speed mobile networks, vehicular networks, and industry machine-to-machine communications. The throughput, latency, and bandwidths not only appeal to every day users but to military operations that seek to become more connected. However, little is understood how the vendors will implement the security features provided in the 3GPP R16 specification [Ref 4]. Due to the diversification of the emerging commercial lines, it is likely that each 5G network will exhibit very different security stances.

The objective is to develop a prototype device that can perform integrity checks and vulnerability discovery actions upon entry into prototypical 5G networks (e.g., vehicular networks, smart communities, healthcare networks). The device will focus on assessing security issues with the media access control (MAC) layer and physical (PHY) layer and providing users that feedback. Major attacks that threaten wireless networks include eavesdropping, jamming, denial-of-service, and man-in-the-middle. Emerging work in protocol fuzzing and protocol reverse engineering provides higher order effects even on proprietary systems. Many of these approaches are difficult under ideal situations.

The prototype device must be able to demonstrate the ability to be deployed in an expeditionary setting. The system should be able to be operated using a power draw from a medium sized tactical vehicle (i.e., JLTV). It should not exceed 100 lbs for easy transport and its dimensions should not warrant larger than a 2-man carry.

Security and privacy studies have focused on earlier generation wireless networks. Only in the last couple of years has a systematic approach to looking at vulnerability discovery for 4G Long Term Evolution (LTE) been published. 5G presents a heavier reliance on virtualization and software-defined networking. The impact of this on security has not yet been fully grasped. These impacts must be understood at the sub-6GHz and the mmWave bands.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor 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 DCSA 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: Define and develop a concept to meet Naval needs for an innovative and mobile 5G vulnerability detection reporting capability. Evaluate the technical feasibility of this concept for the Naval Forces. Perform modeling and simulation to provide initial assessment of concept. This will include network architectures likely to be encountered in expeditionary environments (see MCTP 3-40G), the attack vectors, and security features expected. Initial system design parameters to perform assessments will also be derived.

PHASE II: Develop a Phase II prototype for evaluation based on the results of Phase I. The prototype will be evaluated to determine its capability in meeting the performance goals defined in Phase II Statement of Work (SOW) and the Naval need for improved security via integrity assessment of nearby local 5G networks that could be leveraged for military operations. Knowledge of which networks are reliable could be disseminated to service members using personal devices in forward deployed zones to increase operational security. Demonstrate the ability to discover vulnerabilities across the PHY and MAC layers (threshold) as well as higher in the stack (objective) and present this data to users. Showcase this ability over various differing network use case configurations. The prototype design should be at least of a vehicle mount configuration. Deliver a minimum of three prototypes to the Navy for evaluation. Perform detailed analysis to ensure the materials are rugged and appropriate for Naval application, including environment, shock, and vibration analysis.

Phase II may become classified (see Description) with the discovery of vulnerabilities within the PHY and MAC layers of signals of interest to the Naval Forces. In those cases, surrogates as well as the specific signals of interest will be evaluated.

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II to build an advanced module, suitably packaged with arbitrary waveform generation, ability to either self-power or connect with a vehicle plant, and to characterize the local 5G network to include its vulnerabilities as defined by Naval requirements. Working with the Navy and applicable industry partners, demonstrate application with the potential to be implemented on a light tactical vehicle and/or at a land-based test site to support vulnerability discovery and reporting. Support the Navy with test and validation to certify and qualify the system for Naval use. Explore the potential to transfer the vulnerability discovery tool to other military and commercial systems (e.g., telecommunications). Identify the most promising areas via market research and analysis and develop manufacturing plans to facilitate a smooth transition to the Navy.

5G is an emerging network that is gaining traction across the entire global market. As users share more and more content online, security and privacy will become a larger concern. Providing a means to understand network integrity will aid users in data transfer decisions and potentially reduce catastrophic vulnerability and economic impacts.

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VERSION 5

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KEYWORDS: Wireless networks; security and privacy; network architecture; attack models; 5G; vulnerability discovery

VERSION 5

N212-123 TITLE: External Payload Deployment System for Cylindrical UUVs

RT&L FOCUS AREA(S): Autonomy;Microelectronics;Networked C3

TECHNOLOGY AREA(S): Ground / Sea Vehicles;Sensors;Weapons

OBJECTIVE: Develop an external payload deployment system for cylindrical unmanned underwater vehicles (UUVs. Example payloads may be sensors, markers, or communications relays. The system will not interfere with the operation of the UUV and will respond to UUV commands to detach and activate.

DESCRIPTION: There are many UUV missions that would benefit from leave-behind technology. However, the UUV market is dominated by cylindrical UUVs, making development of an external payload deployment system technically challenging. Despite the technical difficulties involved, the potential for UUV navigation, communication, environmental monitoring, and surveillance payloads make this SBIR topic a worthwhile endeavor. The main technical challenge is that such a system will modify the hydrodynamic behavior of the host UUV and will therefore affect its controllability and maneuverability. Another important technical challenge is minimally invasive command and control communications between the UUV and the external payload.

Most current UUVs cannot leave behind useful technology when they encounter something of interest. In many retrieval scenarios, precisely placing an acoustic beacon would aid the following retrieval mission normally undertaken with work class Remotely Operated Vehicles (ROVs). In another scenario, placing a communications relay, where underwater communications starts to degrade, would avoid the loss of communications with a vehicle. In yet another scenario, leaving a trail of small markers may aid feature-based navigation in featureless environments. For these scenarios, the most versatile and fastest integration approach would be to mount an external payload onto the vehicle and have this payload receive instructions without having to make physical connections to the vehicle's systems.

Technology proposed under this effort should develop an external payload for cylindrical UUVs up to 21" in diameter that minimizes interference with UUV hydrodynamics and vehicle control while limiting reduction to mission endurance. Additionally, the payload should communicate with the UUV payload computer using connections that do not pierce the UUV hull. Proposers should also understand and demonstrate the flight stability of the payload when dropped, and determine the accuracy of the deployment relative to the intended location. The design must have a robust buoyancy compensation system for the payload such that the changes to the UUV's Center of Gravity and Center of Buoyancy are not detrimental. Deployment should be effective over a limited range of UUV altitudes and speeds (less than 5 m altitude and speed of less than 5 m/s).

DESIGN CRITERIA:

- UUVs Under Consideration: Cylindrical main body with a diameter of between 5 and 21 inches and length less than 20 ft.
- Buoyancy: Neutral when attached to UUV / Negative when detached from UUV
- Hydrodynamic Forces: Should not appreciably change UUV Center of Gravity or Center of Buoyancy and not require UUV controller modification
- Communications: no through-hull modifications
- Detachment: on-command from UUV
- Payload drop accuracy: determined by program @ UUV min speed: 1 m/sec and UUV min depth 3 m
- Parasitic drag after release: minimal less than 10% over unmodified vehicle drag

- Payload drag (before or after detachment): should not decrease UUV mission time by more than 25%
- Adaptable buoyancy in variety of seawater densities – including freshwater
- Anticipate standard mil spec environment, shock, vibration, transportability testing in Phase II/III
- Carry load: module that weighs up to 5 kg in air

Testing for standard mil spec compliance (environment, shock, vibration, and transportability) will occur in Phase II and III.

PHASE I: Demonstrate the feasibility of a concept for an external UUV payload that satisfies the previously listed design criteria for a cylindrical vehicle. Smaller diameters that the 5 inches in the design criteria can be proposed, as long as there is evidence that the payloads would provide a useful function. Analysis on initial hardware and software concepts will be completed to determine the optimal design and feasibility in the projected use case. Either modeling using semi-empirical methods [Refs 1, 4, 5] and simulations [Refs 2, 3] or in-water tests will be performed to justify the approach. An analysis will also be made of the most effective command and control communication approach that will not require perforation of the UUV hull. Develop a Phase II plan.

PHASE II: Develop and fabricate two to three prototype systems for evaluation. Precise evaluation metrics will be developed in consultation with the appropriate acquisition program office. The prototype demonstration should show applicability to current UUV form factors and mission requirements. Perform detailed analysis on ruggedness and compatibility with Navy UUV handling, storage, and environmental operating conditions. Testing will be conducted by both the performer and by Navy personnel on Navy assets. Cost effectiveness and manufacturability feasibility should be addressed as part of the prototype test and evaluation.

PHASE III DUAL USE APPLICATIONS: Applying the knowledge gained in Phase II, build an advanced UUV payload system that meets appropriate technology readiness level (TRL) metrics set by the acquisition program office. Support the Navy for test and validation of the system for certified Navy use. Explore the potential to transfer the payload delivery system to commercial use (e.g., oil and gas industry). Develop manufacturing plans to facilitate transition to a UUV program of record.

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KEYWORDS: Unmanned underwater vehicle; UUV; payload, navigation, communication, surveillance, hydrodynamic forces

VERSION 5

N212-124 TITLE: Low-cost Mid-wave Infrared Focal-Plane Arrays through Direct-on-Read Out Integrated Circuit Detector Fabrication

RT&L FOCUS AREA(S): Autonomy;Microelectronics

TECHNOLOGY AREA(S): Materials / Processes;Sensors

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 new detectors, bonding methods, or fabrication techniques for mid-wave infrared (MWIR) focal plane arrays that enable lower cost infrared imaging for navigation, object detection, collision avoidance, and force protection.

DESCRIPTION: Electro-Optic and Infrared (EO/IR) sensors are used in a wide variety of applications and missions such as long-range detection and identification of objects, seeing at night, and wide area surveillance. Although infrared offers superior imaging in most scenarios, visible sensors are more proliferated than IR due to the dramatically lower cost and higher pixel resolution available. IR sensors have higher costs compared to visible because of many system factors; this SBIR topic proposes to solve one of those factors: the focal plane array (FPA). The MWIR imaging band of 2.8 um to 5 um is used across the Naval forces for imaging targets in a wide range of atmospheric conditions. The goal is to develop novel MWIR FPA materials or processes to achieve > 20x cost reduction over existing MWIR FPAs.

In order to get an image out of the IR FPA, die-to-die bonding of the FPA to a read out integrated circuit (ROIC) is performed creating a sensor chip assembly (SCA). Multiple infrared imaging technologies are used today for the FPA [Ref 1] and most are now available at higher operating temperatures (HOT) (e.g., above 110 K). All of the highest performing FPAs are made from either group III-V or II-VI semiconductors [Ref 1, 2]. The IR-absorbing material chosen sets the limit on overall FPA size, pixel size, and cost. Some of these factors are directly related to the substrate (e.g., size and cost), while others are material and processing specific (e.g., pixel size). No matter what FPA material is chosen, the ROIC is always made in (Silicon (Si) due to the low-cost manufacturing and superior electronics properties.

To accomplish the goal of a low-cost MWIR FPA, various strategies might be explored. One such method might be the use of IR-absorbing semiconductors that are compatible with Si-complementary metal oxide semiconductor (CMOS) processes. In this approach the absorber would be directly deposited (i.e., grown) on the Si wafer containing the ROIC-enabling large-scale batch processing directly on 200 mm or 300 mm Si CMOS wafers. Multiple material systems within this direct growth area have been explored previously that could be applied to this topic. Possible research directions include, but are not limited to, Group IV materials [Ref 3], III-V direct growth [Ref 4], and quantum dots [Ref 5]. Another such method outside of direct growth on Si is novel direct bonding methods of an FPA wafer to the Si ROIC. In this approach, the FPA active absorber material is grown on III-V or II-VI substrates, then subsequently bonded to the Si ROIC. All solutions should address yield and the ability to scale down to smaller pixels to meet future large format sensing requirements.

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The solution should be a drop-in replacement to existing MWIR SCAs and thus should not require significant deviation in design to existing MWIR optics. If the solution requires cooling, then industry standard integrated dewar cooler assemblies (IDCA) or thermoelectric coolers should be used to maximize backwards compatibility.

End of program deliverable design characteristics:

- Specific detectivity (D*) of individual detectors/pixels within the 3 um to 5 um band: above 10^11 Jones [normalized to 2*pi field of view (FOV) and 300 K background]
- Noise equivalent temperature difference (NETD) for imaging array: below 25 mK
- Quantum efficiency (QE) within the 3 um to 5 um band: shall be no less than 20% of the peak QE
- Peak QE: shall be between 3 um and 5 um
- Detector cooling: >= 110 K
- Pixel size: <= 10 um
- Frame rate: >= 30 fps
- Dynamic range: >=14 bits

PHASE I: Develop a concept for new detectors, bonding methods, or fabrication techniques for MWIR FPAs that demonstrates the approach, while providing for design scalability for MWIR operation. This demonstration can be for a single-element detector or detector array, along with performance metrics, or demonstration of a direct bonding method.

- Identify major hurdles and physical limits of the approach that might include: dark current, 1/f noise, threading dislocations, thermal stress of dissimilar materials, etc.
- Reports and findings on the fabrication, growth, and tunability of the recipes to create a hardware prototype.
- Investigate, document, and select best-of-breed approaches to a low cost MWIR FPA.
- Test the prototype in a laboratory environment with a minimum of electrical read-out of the dark current and could include quantum efficiency.

PHASE II: Build, develop, demonstrate, validate, and mature the hardware.

- Improve detector level performance metrics such quantum efficiency, detectivity, dark current I-V, and spectral noise.
- Build a test chip carrier suitable for proof-of-concept demonstrations.
- Fabricate a small format FPA suitable for an imaging demonstration. Test chip can either be directly with a ROIC or read out element wise to show detector functionality.
- Test the prototype in a laboratory simulated operational environment and identify metrics to validate the system's advantages over state-of-the-art in MWIR imagers.
- Work with the Government to identify and develop a representative set of transition opportunities for early deployment of the developed concepts.
- Develop a transition plan for the Program of Record (PoR) and for commercial industries via a Phase III commercialization plan.

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II toward the manufacture of a full frame imaging SCA at 640 x 480 or larger format.

- Build an imaging sensor and characterize its performance using imaging array level performance metrics such as modulation transfer function (MTF), QE, and noise equivalent temperature difference (NETD).
- Identify packaging and yield for transition to a PoR.
- Work with the Navy and applicable industry partners to demonstrate that the SCA can be readily, non-disruptively adapted to an existing EO/IR platforms and optics. Test the sensor in a representative environment (e.g., on a Navy-owned range) with conventional MWIR optics to measure performance comparable to existing state-of-the-art in MWIR cameras.

- Market research and analysis shall identify the most promising users across the Navy and/or commercial markets. Develop and document a methodology for smoothly integrating the capability onto identified platforms.

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KEYWORDS: Focal plane array; FPA; infrared imaging; IR; semiconductor processing; read out integrated circuit; ROIC; sensor chip assembly; SCA; mid-wave infrared; MWIR; semiconductor materials

VERSION 5

N212-125 TITLE: Mobile Electrocardiogram Monitor for Bottlenose Dolphins in the Marine Environment

RT&L FOCUS AREA(S): Biotechnology

TECHNOLOGY AREA(S): Biomedical;Electronics

OBJECTIVE: Develop a wearable, wireless electrocardiogram (ECG) unit to analyze and communicate heart rate and rhythm in bottlenose dolphins in the marine environment (i.e., salt water).

DESCRIPTION: The U.S. Navy uses bottlenose dolphins (Tursiops truncatus) in the Fleet's operational Marine Mammal Systems to protect harbors and Navy assets, detect and/or mark underwater mines, and locate and attach recovery hardware to underwater objects. To contribute to maintaining the fitness of these marine mammals for duty and the readiness of the U.S. Navy Marine Mammal Systems, the U.S. Navy is interested in developing a wearable, wireless ECG unit to monitor dolphin cardiac rate and rhythm while the animal is at rest and actively swimming in the marine environment. Synchronized information regarding the swimming depth of the animal is required.

With aging populations of marine mammals under professional care, cardiac disease is of increasing clinical concern. Over the years, the U.S. Navy Marine Mammal Program has diagnosed several dolphins with cardiac disease, particularly in geriatric animals. Developing improved cardiac monitoring techniques are vital to identifying and monitoring cardiac disease cases, supporting healthy aging, and enhancing dolphin cardiac medicine.

Due to their marine environment home, no clinically viable options for in-water ECG monitoring exist in bottlenose dolphins. Limitations include electrode signal interference from seawater, animal motion artifacts, and lack of wireless systems. Several studies have described ECG evaluation in cetaceans over the last two decades [Ref 1-6]. However, there are no commercially available units that allow for ECG recording while the dolphin is swimming or diving untethered. Electrodes are also very sensitive to interference from motion and seawater. Analyzing not only heart rate, but heart rhythm as well, while dolphins are free swimming will provide valuable data to drive clinical decision making and will be especially valuable in monitoring animals with known dysrhythmias. Examples of cardiac health issues in Navy dolphins leading to dysrhythmias have included dilated cardiomyopathy, valvular disease, and arrhythmias due to a variety of etiologies. This need for "in ocean" monitoring is significant because, while we are able to obtain ECG data with the animal out of the water, we do not fully understand the physiologic consequences that may be occurring with the animal out of its aquatic habitat, potentially confounding the ECG interpretation. The techniques that would be most reflective of true cardiac health will be best assessed while the animal is in the natural marine environment. This technique would also allow for cardiac event monitoring over longer periods of time, which may identify important dysrhythmias not evident in brief ECGs. As such, proposed concepts should generate a reliable, wireless, mobile ECG device for in-water recording in dolphins that can be used and evaluated by veterinarians to help maintain Navy dolphin health.

PHASE I: BASE period: Conceptualize, design, and build a prototype mobile ECG monitor for bottlenose dolphins. The mobile ECG monitor should be cordless and wearable, allowing dolphins to swim safely and freely in enclosures or the open ocean, up to 50m depth and at temperatures between 32-98 degrees F. The device should have 4-leads with 6 vector recordings (i.e., leads I, II, III, AVR, AVL, AVF). The device should be able to transmit ECG data in real time via Bluetooth to a laptop or tablet when worn at the surface or out of water; it should also be able to record and store ECG data when the dolphin is swimming or diving underwater for a minimum of 24 hours, which can then be transmitted or downloaded onto a laptop/tablet once the animal has returned from swimming or diving. Synchronized information on the depth the animal swimming is also required. Battery life should allow for several hours of recording at a time. The wearable design, materials, and lead locations should be refined to create an optimal working prototype and allow for animal safety and comfort. To allow for future testing and refinement of the ECG unit, documentation required by the U.S. Navy to conduct research involving vertebrate animals should be completed and approval obtained. Collaboration with dolphin ECG experts and board-certified veterinary cardiologists is recommended.

OPTION period: Test and refine the prototype mobile ECG monitor for bottlenose dolphins.

PHASE II: Build an operable mobile ECG monitor with the technology developed in Phase I. Demonstrate/validate the operability and reliability of the system on bottlenose dolphins in the marine environment. Document and report the ECG findings of dolphins wearing the unit, and refine the technology for optimal use in terms of wearability (i.e., lack of physical harm or change in animal’s behavioral or condition) and ECG quality (i.e., interpretable ECG trace with lack of artifacts, repeatability, and comparison to out of water measurements).

PHASE III DUAL USE APPLICATIONS: Efforts should lead to development of a product that meets appropriate standardization requirements and focuses on technology transition, preferably commercialization (i.e., marine mammal health management industry for zoos, aquariums, marine mammal parks, marine mammal conservation organizations, etc.; professional or recreational diving industry).

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KEYWORDS: Marine Mammal Health; Dolphin; Mobile Electrocardiogram Monitor; Wearable Heart Rate Monitor; ECG; Heart Rate; Heart Rhythm; Cardiac Disease

N212-126 TITLE: GHz Optical Underwater Detection Receiver

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Sensors;Weapons

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OBJECTIVE: Develop a wide bandwidth (GHz), multi-element optical receiver to enable the extraction of both reflectivity and range features of objects in water. The optical receiver should have high sensitivity at visible wavelengths and sufficient dynamic range to detect signals in high clutter environments.

DESCRIPTION: Time resolved detection is needed in underwater imaging to distinguish between desired object returns and unwanted environmental clutter. Sufficient resolution (< 5cm) in both space and time is required to identify underwater threats. While techniques have been developed on the transmitter side to create high bandwidth optical interrogation signals, the receiver side has been limited to single element receivers that must be mechanically scanned to image a scene. Such a configuration is not compatible with moving platforms. While time of flight cameras have been developed for the automotive industry, these cameras do not have the time resolution necessary to operate in high clutter environments. A multi-element, wide bandwidth optical receiver is needed to achieve the benefits of high time resolution with a spatially resolved optical detector.

PHASE I: Develop a concept for a multi-element (>10,000), wide bandwidth (1GHz) optical receiver with optical sensitivity in the blue-green wavelengths. The concept should include methods to simultaneously sample the optical receiver elements with sufficient speed to enable the processing of GHz-bandwidth signals. Areas of technical risk and mitigation methods should be identified. 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, build and test the multi-element, wide bandwidth optical receiver developed in Phase I. Test the developed optical receiver with wide bandwidth, chirp-modulated optical signals to verify its capability to recover high bandwidth signals with multiple receiver elements.

PHASE III DUAL USE APPLICATIONS: Support the Government in transitioning the optical receiver to fielded laser imaging systems. Dual use opportunities include unmanned underwater vehicle (UUV) surveying and automotive light detection and ranging (LIDAR).

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KEYWORDS: LIDAR; laser imaging; underwater vision; time of flight camera; 3D camera; modulated laser; undersea weapon; underwater sensor

VERSION 5

N212-127 TITLE: High-Temperature Fuel Coking Mitigation Frangible Coatings for Fuel Nozzles and Screens

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Hypersonics

TECHNOLOGY AREA(S): Air Platforms;Materials / Processes

OBJECTIVE: Develop a frangible coating that can slough off carbonaceous deposit precursors adhering and growing onto fuel-wetted surfaces, such as “last-chance screens”, to prevent dysfunction of critical aircraft fuel system components.

DESCRIPTION: Increasing heat loads, projected today for advanced aircraft of the near future, will lead to higher average fuel system temperatures for both commercial and military aircraft [Ref 1]. However, fuel deposit issues currently prevent long-term fuel system operation at temperatures over ~300F [Refs 2, 3]. Fuel deposit issues are also projected to increase in current generation aircraft: for example, a recent analysis of F-24 fuel obtained from a military garrison showed extreme thermal stability problems – high coke deposition in fuel lines and hysteresis on critical valves – indicating a potential increase in thermal stability issues following the transition from JP-8 to F-24 [Ref 4]. Special consideration for Navy fuels, JP-5 with copper contamination should be made.

While the formation of carbonaceous deposits can be problematic for several components of an aircraft fuel system, it is expected to have the highest negative impact in the vicinity of the fuel injectors, which are wetted by fuel with the highest time-at-temperature exposure. Of some concern are the “last-chance screens”, positioned immediately upstream of the fuel injectors, because the screen openings comprise some of the smallest fuel passages in the entire system and are exposed to fuel of temperature sufficient for coke formation. Blockage of these passages can have serious consequences in terms of aircraft propulsion control.

A thin, conformal coating applied directly onto the screen would be a direct and cost-effective mitigation approach for deposit prevention; moreover, it would incur no weight penalty. However, the highly reactive radicals implicated in jet fuel deposition phenomena [Ref 5] are known to attach indiscriminately to essentially any organic or inorganic surface. For that reason, typical off-the-shelf “release coatings” are not a very effective mitigation approach even though some are better than others. The objective of the proposed SBIR topic is to create a frangible coating that can slough off carbonaceous deposit precursors adhering and growing onto fuel-wetted surfaces, thus preventing blockage on the most critical, most susceptible aircraft fuel system components. The thickness of the coating and its erosion rate should be adjusted such that it can remain operational for a time frame comparable to a typical fighter aircraft engine service interval, targeting a 5X increase in Mean-time Between Overhaul (MTBO) compared to the baseline at 400F fuel operation.

KEY FRANGIBLE COATING ATTRIBUTES

- “Frangibility”: Low cohesive strength of nano-layers prevents build-up by shedding adhered varnish precursors.
- Nano-scale, conformal coating for complex geometries applied via vapor deposition.
- Lubricity equal to or higher than underlying material, coefficient of friction equal to or lower than underlying metal, chemical inertness.
- Temperature stability up to 600F.
- Nano- to micro-meter coating thickness.
- No off-gassing or other contamination.

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PHASE I: Focus on vapor deposition parameter optimization onto bill-of-materials last-chance screen samples. Confirm spectroscopically that a uniform, defect-free coating of thickness not-to-exceed 1 µm can be applied on a 200 to 120 µm mesh wire stainless steel screen such that it covers the entire surface (front and back) leaving no areas of exposed metal.

PHASE II: During this phase, candidate samples resulting from the optimization efforts in Phase I will be tested with 400F flowing fuel under nominal cruise conditions and/or other conditions characterized by low fuel flow at high temperature. Evaluate within a long-duration test rig constructed with design parameters such that it simulates, as faithfully as possible, fuel system flow conditions and geometries expected in a real aircraft fuel system, with emphasis on time-at-temperature of the fuel entering the screen. The samples will be tested vis-à-vis a control (uncoated) wire mesh screen. Update vapor deposition application conditions and coating thickness based on evaluation of the flowing fuel test results in an iterative fashion until the coating application conditions which lead to the most successful coating validated under real aircraft fuel system flow conditions are identified. Demonstrate a coated screen exposed to flowing 400°F JP-5 fuel that exhibits a 5X increase in the run time to reach 80% blockage compared to a control (uncoated) screen.

PHASE III DUAL USE APPLICATIONS: Focus on the development of manufacturing methods to improve component yield, production time, and component cost. Determine whether fuel system and components with the new screens require requalification or whether the screens can be qualified independently. Identify opportunities to use the technology in manufacturing areas, such as semiconductor fabrication and additive manufacturing, to prevent fouling of small and intricate tooling.

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KEYWORDS: coating, frangible, jet fuel, fuel nozzle, last chance screen, vapor deposition, carbonaceous deposit precursors

VERSION 5

N212-128 TITLE: Publicly Available Information Analysis Curation Tool

RT&L FOCUS AREA(S): Autonomy;Networked C3

TECHNOLOGY AREA(S): Battlespace Environments;Human Systems;Information Systems

OBJECTIVE: Develop a cloud-based tool set to facilitate the creation of an analyst's notebook or journal to catalog and document the analysis of publicly available information.

DESCRIPTION: Information environment analysts use multiple tools to track information environment threats, narratives, propaganda, and their own communication efforts and impacts. Analysts have no means of recording their investigations through the steps they take to come to a logical conclusion or record their suppositions about activities, intentions, and proclivities of information actors or the streams of information from topic communities using common hashtags, suspected botnets and coordinated actors, and the information maneuvers in play that relate to commander's intent. The use of multiple tools is necessary. Current methods are labor intensive and lack the capabilities for tagging, searching and supporting analysis or for providing an archive of analyses useful for tracking change over time. The envisioned capability will enable analysts to create journals of their analyses, enabling them to investigate phenomena in Publically Available Information (PAI) over time; develop better information products and reports; and track performance and effectiveness of operations in the information environment. The capability will facilitate screen shots from web-based sources and analytic tools, with additional capabilities for annotation, search, and tracking of activities and events in the digital information environment so that analysts and decision makers can develop tailored, mission playbooks to enable planning and evaluation of performance and effectiveness over time.

The result would be the development of an electronic, searchable "analyst's journal." Currently, record keeping by analysts is piecemeal, documented only as final work products such as reports in Word or PowerPoint for presentation. This capability will streamline work flow for faster analyses, better "look back" ability to see how an information threat behaves over time, and the capability to visualize and understand correlation and causality regarding activities on social and digital media platforms. The "analyst's journal" will provide a substantial improvement over existing Tactics, Techniques, and Procedures (TTPs) in social media analysis. The various services have strong demand for the development of social media playbooks that are tailored to the demands and concerns of particular missions. This effort will provide the means for developing a playbook, allowing analysts and decision makers to track metrics of effectiveness and metrics of performance, emerging information environment threats, and blue as well as red activities on social media.

PHASE I: Design and develop a cloud-based tool set for capturing and cataloging screen shots with some semi-automated tagging capabilities and a task-oriented editor for tracking information maneuvers, threat actors and influencers, and analyst's research across multiple platforms and tools to enable the creation of an electronic, searchable and archivable "analyst's notebook" with a user-friendly interface.

PHASE II: Develop the working prototype of the data curation toolset that can work across multiple tools and incorporate screen shots of relevant websites and other Internet assets. Enable the development of smart-tagging and the curation of multiple analyst notebooks into a "watchstander's notebook" to aggregate the work of more than one analyst, with templates for different types of analysts such as public affairs, information operations, and Military Information Support Operations. Expand the capabilities of the analyst's and watchstander's notebooks to a full, tailored playbook for operations in digital and social media, to support decision maker's needs at the middle and upper tiers of operational authority. Create capabilities for planning and assessment of operations on the digital and social media platforms.

PHASE III DUAL USE APPLICATIONS: Many marketing and brand name companies employ analysts to investigate the effectiveness of their advertising. With the high growth of existing platforms and the expansion of the number of important, relevant platforms, one tool for analysis is no longer sufficient for understanding activities and events relevant to their companies and their customers. Brands and marketing firms also must deal with new problems: trolling, meme conflicts and smear campaigns need to be discovered, tracked and countered. Currently, their analysts lack an integrated system for managing multiple tools and their investigations into what's happening on multiple platforms. As the market for these new tools grows at a steady, high pace, the need for a system to easily and simply track an analyst's research is expected to grow.

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KEYWORDS: Social Media Analytics, Public Affairs, Information Environment Assessment, Information Warfare, Analysis, Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance, C4ISR

N212-129 TITLE: Components for a Deep Operating Unmanned Underwater Vehicle

RT&L FOCUS AREA(S): Microelectronics;Networked C3

TECHNOLOGY AREA(S): Battlespace Environments;Electronics;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 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 pressure tolerant deep Unmanned Underwater Vehicle (UUV) components such as flooded motors, pressure tolerant electronics, and communication systems that work at ocean depth with the goal of improved performance, stealth, and reduced Size Weight and Power (SWaP).

DESCRIPTION: The U.S. Navy wishes to extend applications of UUVs to missions that require operation at greater depths, speeds, endurance, and stealth. Some future missions will be conducted using larger UUVs (Large Displacement Underwater Unmanned Vehicles [LDUUVs] aka Snakehead and Extra Large Unmanned Underwater Vehicles [XLUUVs]) than are currently common but must remain affordable. The motor drive the majority of the cost for these systems and currently cost $1M Future missions will require operation to the abysmal depths of 5 km. or more. Future missions will require average speeds of 6-7 knots (kts.) and endurance on the order of days to weeks. Some future missions will require stealth at speed. Means of communicating while remaining at depth will be required. Current missions often use smaller (Small Diameter UUV (SDUUVs) and Medium Diameter UUVs (MDUUVs)) relatively affordable UUVs operating at lower speeds (3-4 knots) for shorter duration (one a day) on the continental shelf. Stealth has been a requirement but it is easier to achieve low speed. Hence new propulsion systems and signature quieting systems are sought for deep operating UUVs. The plan is to feed successful SBIR efforts into a Tech Candidate executing over FY22 to FY23 leading to and Future Naval Capability (FNC) executing over FY24 to FY25.

Typical communication solutions for submerged, deep operating, UUVs are limited. The Navy is seeking novel solutions for both unidirectional and bidirectional communications for Command and Control of the deep diving UUVs.

Electronics in Deep Diving UUVs have the option to either be pressure tolerant or protected within a pressure vessel to protect against the immense forces of the deep ocean. Commercial Off-the-Shelf (COTS) electronics can be kept at atmospheric pressure with minimal modifications as long as a pressure vessel (PV) is utilized. However, the PV adds cost, size and weight to the electronic housing as well as requiring expensive, long-lead connectors to and from the PV. An alternative is to have pressure tolerant electronics (PTE) designed to operate in nonconductive-fluid-filled enclosures at the ambient ocean pressure. While there are several existing PTE solutions, these are often one-off designs. Deep UUV may have need for a variety of sensors such as side scan sonar, magnetic, LiDAR, and optical to perform their mission. Any deep operating UUV would greatly benefit from not requiring a PV around these sensors.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor 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 DCSA 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: Perform a feasibility study for novel deep UUV components for potential inclusion on next generation deep operating UUVs. These components can include conceptual design and CONOPS of new propulsion system, new communication system and links for deep UUVs, and/or modification of sensors to allow them to not require PVs by implementing PTEs for performance up to full ocean depth.

PHASE II: Develop and test a prototype for the proposed approach. This shall include hydrostatic testing of the components. Complete preliminary performance testing in a surrogate 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: 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 deep water resource mining and oil/gas extraction.

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KEYWORDS: Axial Flux Motor; Pressure Tolerant Electronics; Underwater-to-Air bistatic/monostatic communication; UUV; LDUUV

N212-130 TITLE: Integrated Sensor Technologies for Composites

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials / Processes;Sensors

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 integrated sensor technologies that can be incorporated into composite primary structures to allow for the monitoring and characterization of the structures' behavior to support their development, production, and sustainment.

DESCRIPTION: Composites materials are used extensively throughout the aerospace industry due to their great specific strength and stiffness. Unlike traditional metallic components, the ultimate performance of composites can be much harder to characterize and monitor because they are a product of the manufacturing process, can be susceptible to aging issues, and damage may be difficult to identify. Traditionally strain gages are used to characterize a structure and can only sense a very limited portion of that structure, are labor intensive to install, and can be susceptible to handling damage. Traditional strain gages and the associated wiring are generally only used for limited test activities and were not intended for prolonged monitoring and for durability over the deployment of the system. Embedded sensors would allow the structural integrity and behavior of composite structures to be effectively monitored to address the previously described challenges throughout the entire product lifecycle. This will help improve the depth of understanding of these products and assist in driving down lifecycle costs, particularly in the area of sustainment. This sensing system should be designed to operate within the environmental constraints that would be expected of aerospace composites and should be mindful of size and weight to minimize their impact to the flight vehicle while balancing the performance of the sensor.

The sensor system should consider the following parameters:

- Capable of taking distributed measurements over a length or area
    - Max Span: ~10 ft
    - Measurement distribution: ~inches
- Measuring one or more of the following, ranges shown are indicative of a representative order of magnitude:
    - Strain (microstrain, inches, 0-5%)
    - Displacement (0"-0.1")
    - Impact detection/impact damage detection
    - Delamination
    - Force (0-10000's lbs)
    - Temperature (32F-500F)
- Modular interface with different data logging equipment
    - Enable interfacing with lab console, remote data storage, or to a communication system for real time transmission

  - Note that remote data storage would be removed before flight and would not need to survive flight loads
- Service life of greater than 25 years.
  - Can be powered by either an internal or external power source.
  - System size and weight should consider that some elements may be integrated with a flight system and will need to be minimized as much as practical.

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 Counterintelligence Security Agency (DCSA). The selected contractor 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 DCSA and 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: Define and develop inspection and sensor concepts and assess their feasibility. Examine concept formulation, development, and possible validation that could include subscale demonstration, including data logging operations. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II. Prepare a Phase II plan.

PHASE II: Develop and validate a prototype (not necessarily hardware). Solidify the process for designing and incorporating the sensors into a variety of structures, such as primary aerospace vehicle structures of complex geometry, specific detail will be provided after award. The cost to procure and implement the system should be assessed. Quantify the performance of the embedded sensor, corresponding data logging equipment, and the sensor's impact on the system.

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: Work with the Navy to formalize the process for the final design, integration, calibration and/or correlation of the integrated sensors for use to help with the detection of the early failure of parts, which will aid in the reliability of systems and mutually benefits the Navy and aerospace industry. This will include the qualification of the sensing system for use on Navy and aerospace primary and secondary structures.

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KEYWORDS: Strategic Missiles; Composite Materials; Health Monitoring; Embedded Sensors; Optical Strain Gauge; Damage Detection

VERSION 5

N212-131 TITLE: Innovative Manufacturing/Materials for Structural Insulators in Hypersonic Flight Body Thermal Protection Systems

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Hypersonics;Space

TECHNOLOGY AREA(S): Battlespace Environments;Materials / Processes;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 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 low conductivity thermal insulation materials comparable to current generation commercial products that provide higher levels of strength at temperature and are manufactured by Aerospace-grade methods/processes as befits the Navy application. Current methods are basically Industrial grade.

DESCRIPTION: The best performing commercial insulation products are oxide-based felts and blankets produced in bulk for furnace linings and furnace furniture. They are well known and have been available for many decades. While low in cost and providing excellent thermal resistance, they are not typically intended for structural load bearing applications. The bulk manufacturing process tends to add local property variations, which are not always averaged out in the finished component form factor. Furthermore, the bulk format of these materials adds additional steps to the flight vehicle assembly as vehicle piece parts are fabricated from the bulk materials. Availability in near-net shape format would remove this secondary fabrication step and simplify vehicle assembly.

Thus, the opportunity presented by this SBIR topic is to apply some of the advanced aerospace composite materials and manufacturing technology developed over recent years; including but not limited to: fiber reinforcement, fiber coatings, tape placement, tape wrapping, 3D weaving, additive manufacture to develop reliable, uniform, low thermal conductivity/high strength materials and near-net shape components in form-factors applicable to Navy hypersonic flight vehicles.

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 Counterintelligence Security Agency (DCSA). The selected contractor 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 DCSA and 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: Demonstrate low thermal conductivity and structural capability of materials/manufacturing solutions at the desk top/lab scale level. Figures of merit for comparison against current commercial products are physical density less than 0.7 g/cm^3, compressive strength greater than 750 psi, melting point greater than 3400°F, and in-plane/through thickness thermal conductivity less than 0.4 W/mK up to 3000°F against a commercial benchmark are the figures of merit [Ref 1]. Both active (decomposing) and passive insulation approaches are acceptable. Active approaches must still show equivalent weight performance improvement over benchmark materials as well as a discussion of strength retention and decomposition product management in a flight vehicle environment. Active approaches should also be able to function over a mission time of one hour. Current commercial products are available in blanket and plate format [Ref 2]. Companies should also discuss manufacturing approach and scale-up potential for production of aerospace grade hardware.

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 prototype hardware to the requirements, materials, form factors and manufacturing approach from Phase I. Material thermal and mechanical characterization data will also be provided in order to assess replacement risk against current incumbent materials. At the end of Phase II, prototype hardware will be provided for government evaluation in a simulated flight test environment.

It is probable that the work under this effort will be classified under Phase II. See details in the Description.

PHASE III DUAL USE APPLICATIONS: In Phase III the firm will be expected to work with the government to integrate the final phase II product into Navy systems. Additional testing, such as flight tests, will occur then. High temperature capable, low thermal conductivity materials and components would have much interest in the commercial access-to-space environment, commercial aerospace, and gas turbine engine applications.

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KEYWORDS: Conventional Prompt Strike; Thermal Protection System; Structural Insulators; High Thermal Diffusivity Materials; Thermal Resistance; Reentry Vehicles; Hypersonic Vehicle Heat Loads

N212-132 TITLE: Large Footprint Silicon Leadless Chip Carrier (LCC)

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Electronics;Materials / Processes;Sensors

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 large footprint (~2 cm x 2 cm) silicon Leadless Chip Carrier (LCC) that is strategically radiation-hardened for use with Micro-Electromechanical-System (MEMS) sensors.

DESCRIPTION: The performance requirements for sensors used in strategic navigation applications continue to be stringent, necessitating continued innovation for sensor packaging technologies. For commercial applications, conventional LCC materials are typically acceptable for most silicon MEMS sensors, but for strategic applications, the stress induced from coefficient of thermal expansion (CTE) creates mismatches between the package and the sensor, which can result in significant performance errors. Additionally, the radiation-hardness required for strategic applications disqualifies many conventional silicon chip packages from being considered. Examples of existing research for LCC for use with MEMS sensors can be found in the referenced articles [Refs 1-5].

A silicon LCC that can meet the stringent performance requirements of strategic instrumentation is likely to bring value to many existing commercial applications, to support packaging of high performance MEMS which can be used across the commercial class use, for example in automotive class accelerometers among many others.

PHASE I: Design a manufacturing process using existing capabilities in the market to produce a package with the desired goals of: 1) having 40 or more pins that are isolated from an electrically conductive substrate; 2) accommodating chips that have the approximate dimensions: 17mm x 17mm x 3mm; and 3) incorporating a hermetic seal ring to be used with a silicon cap. Material space is not constrained and unique designs are encouraged. Analyze all aspects of fabrication to assess and justify the feasibility and practicality of the designed approach. If the Phase I Option is exercised, include the initial design specifications and capabilities description to build prototype solutions in Phase II.

PHASE II: Based on the Phase I design and execution plan, fabricate and characterize a small lot (up to Qty: 3) of prototype packages. Characterization shall comprise various parameters, including continuity/isolation of the pins, hermeticity of the package, and mechanical surface features (e.g., flatness, parallelism, heights). Deliver the prototypes by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Based on the prototypes developed in Phase II, continuing development must lead to productization of silicon LCCs. While this technology is aimed at military/strategic applications, LCCs are heavily used in numerous other applications. A silicon LCC that can meet the stringent performance requirements of strategic instrumentation is likely to bring value to many existing commercial applications to support packaging of high performance MEMS, which can be used across the commercial class use for example in automotive class accelerometers.

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KEYWORDS: Micro-Electromechanical-System; MEMS; Packaging; Leadless Chip Carrier; Navigation; Sensors; radiation-hardened

VERSION 5

N212-133 TITLE: Microfabricated Noble Gas Vacuum Pump

RT&L FOCUS AREA(S): Quantum Science

TECHNOLOGY AREA(S): Electronics;Materials / Processes;Sensors

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 method for pumping noble gases at ultra-high vacuum (1e-7 to 1e-10 Torr) that is compatible with microfabricated atomic vapor cells and can either be able to be fabricated simultaneously with a silicon-based vacuum cavity or be bonded to, inserted in, or otherwise attached to a silicon-based vacuum cavity.

DESCRIPTION: Atomic inertial sensors and clocks often require high or ultra-high vacuum to operate. While non-evaporable getters can provide high pumping rates for many gases, they cannot capture noble gases. As a consequence, helium and to a lesser extent argon can leak through glass windows, ultimately raising the pressure inside the vacuum cavity to unworkable levels. In laboratory scale systems, those noble gases are typically pumped out by ion pumps. While progress has been made to reduce the size of the atomic vacuum cavity [Refs 1-3], even the smallest commercial ion pumps are relatively bulky in comparison (~500 cm3 compared to < 1 cm3). Thus far, microfabricated atomic systems have either operated at higher pressures with a buffer gas, or have relied on slowing the leakage of helium from a careful selection of window material. An active noble gas pump would be a distinct advantage in creating compact, long-lifetime, ultra-high vacuum cavities.

A number of commercial sensors (e.g., accelerometers, pressure sensors, microbolometers) require an evacuated chamber to meet their performance goals. Improved vacuum conditions may be able to extend the useful lifetime of these devices, but would be critical for the performance of ultra-precise inertial sensors and clocks that are particularly useful to military programs. There exist multiple avenues for innovative solutions to this problem (e.g., development of novel microstructured materials to aid in the miniaturization of ion pumps), hence the desire for an SBIR effort.

Significant advances have been made to create ever-small vacuum pumps [Refs 3,4], but there does not yet exist a solution that satisfies the combination of fabrication method and pumping performance required for atomic systems. The applications for such a pump extend beyond atomic systems; any system that needs to operate at even modest vacuum (e.g., mTorr) with a glass component will ultimately be lifetime-limited by the leak rate of helium so could benefit from an improved vacuum pump.

PHASE I: Perform a design and materials study to assess the feasibility of fabricating an ultra-compact vacuum pump capable of pumping noble gases at ultra-high vacuum (1e-7 to 1e-10 Torr). The study shall analyze potential approaches, exploring the risks and risk mitigation strategies associated with each, and identify the most promising option. Similarly, the study shall detail the planned fabrication process, again identifying risks and risk mitigation strategies. The study shall include an evaluation of the anticipated (goal) size (< 20 cm3), electrical power draw (< 1 W), robustness, and lifetime (> 2 yr at 10-9 Torr) of the final device. Finally, the study should discuss how the pump can be combined with a silicon-based vacuum cavity. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build prototype solutions in Phase II.

PHASE II: Fabricate and test a small lot (up to Qty of 3) of the device designed in Phase I. Ensure that the prototypes are prepared in such a way that they can be bonded to a cavity and prepared for third party testing. Characterization of the components shall be performed, demonstrating their basic performance (e.g., noble gas pump speed, lowest achievable pressure) and evaluating their heat production, magnetic character, and robustness to vibration. Deliver the prototypes by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Advancement of microfabricated noble gas pump technology has applications in any field that requires a long-lasting vacuum, e.g., MEMS vibration or acceleration sensors, pressure sensors, gas sensing microsystems, etc. For use in laboratory applications in chemical and biological testing.

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KEYWORDS: atomic sensor; atomic clock; inertial sensor; vacuum; microfabrication; Micro-Electromechanical-System; MEMS, pump

N212-134 TITLE: Moderate Spectral Resolution Spectrometer

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Electronics;Materials / Processes;Sensors

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 Moderate Spectral Resolution Spectrometer that can be deployed on telescopes currently in use or being considered for future use by the United States Naval Observatory (USNO) to collect data. The spectrometer will have a moderate resolution (R ~ 500), be capable of observing wavelengths in the range of 0.5-1.6 micrometer, and be able to be deployed on moderate-aperture (D = 20-40 cm) telescopes.

DESCRIPTION: Currently, USNO collects photometric data, including bright star spectra, which is converted into artificial stellar spectra. This photometric data must be measured and monitored periodically to ensure weapon system utility and performance. The data measured by USNO at present contains gaps that inhibit a comprehensive formulation of stellar spectra. A Moderate Spectral Resolution Spectrometer would enable the tailoring of data collection through direct monitoring of spectral ranges of interest to the Navy, thereby reducing both costs and scheduling impacts, and increasing reliability and accuracy of current and future star catalogs within the FC subsystem. Such an instrument would be useful to the larger DoD community, the United States Geological Survey (USGS), astronomical situational awareness communities, and commercial providers of such data; thus, the commercialization potential for this spectrometer is assessed to be high. All work executed under this topic will be unclassified.

PHASE I: Develop and define a concept design for a Moderate Resolution Spectrometer that can be deployed to moderate aperture-class (D = 20-40 cm) Navy telescopes. The deployed spectrometer will be used to collect the stellar data needed by the Navy. Work with the Navy in understanding size, function, and interface requirements for the spectrometer. Construct measures that ensure data and network connection integrity and USNO software application.

Specific threshold requirements/goals are as follows:

- Fiber-fed: Threshold, spectral range - lambda: 800-1000 nm
- Goal, spectral range - lambda: 500-1600 nm
- Spectral resolution, R: Threshold - 200-500 (R =lambda/delta lambda)
- Goal, functionality: switchable between “modes”:
- Goal, mode 1: 1000-2000
- Goal, mode 2: 5000-20000

Identify risks to the proposed concept and develop Phase II plans that include ways to mitigate those risks for Phase II. 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 and deliver a prototype Moderate Resolution Spectrometer. Work with the Navy to fully understand the data and interface requirements and to understand hardware and integration standards to be deployed with moderate aperture-class (D = 20-40 cm) telescopes currently used by the USNO. Provide testing scenarios that ensure Navy operational use with the telescope designed to show data collection efficiencies compared to current practice. Establish a feedback loop with the Navy for implementing changes due to prototype testing. All the work under this Phase II effort will be unclassified.

PHASE III DUAL USE APPLICATIONS: Deliver a Moderate Resolution Spectrometer for telescopes deployed by USNO in a manner that fulfills bright star photometric data requirements and are usable by NSWCDD FC capabilities. Provide design and test cases that demonstrate integration of the spectrometer in photometric data collections. Support remote field qualification testing with a spectrometer deployed on off-site telescopes. Work with the Navy to set up a Moderate Resolution Spectrometer with deployed telescopes to include troubleshooting and resolving implementation/execution issues at various Navy, DoD, and civilian telescope observatories.

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KEYWORDS: Moderate Resolution Spectrometer; Telescope; Data Collection; Photometric; Stellar Spectra; Moderate Aperture

VERSION 5

N212-135 TITLE: Development of a Widely Applicable Supporting Optical Circuit in Micro Optics

RT&L FOCUS AREA(S): Hypersonics;Microelectronics

TECHNOLOGY AREA(S): Battlespace Environments;Electronics;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 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 widely applicable supporting optical circuit in micro optics to address the supporting optical circuit building block.

DESCRIPTION: The optical circuit should provide single, polarization-maintaining input fiber and output fiber, for integration into a gyro assembly. The input fiber would bring broadband light, typical for Interferometric Fiber-Optic Gyro (IFOG) operation, into the package. The optical circuit should provide dual photo detectors, one for sampling and monitoring the input light source and the other serving as the detector for the returned, interfered light from the IFOG optical coil and phase modulator. The output fiber will be bi-directional. Internal to the package there must be a means of directing the input light out onto the output fiber and directing the light returning through the output fiber onto the photo detector. The final circuit should be capable of surviving shock, vibration, and thermal excursions typical of aircraft or missile flight. While some performance specifications may need to be altered, depending on desired gyro performance, a re-usable architecture, assembly methodology, and supply chain would be of great value. As an initial prototype, the target is a 14-butterfly package, making the integration of readout electronics with the internal photo diodes as simple as soldering down the component. Future packaging options will be investigated in later phases.

The outcomes of the proposed work are:

1) Closed, hardened optical circuits with sources and detectors on chip to operate an IFOG optical coil.
2) Defined, documented interfaces between micro-optical and electrical components to facilitate rapid, simplified designs of optical/electronic devices and circuits.

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. The Phase II effort may require secure access, if so SSP will process the DD254 to support the contractor for personnel and facility certification for secure access.

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 Counterintelligence Security Agency (DCSA). The selected contractor 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 DCSA and 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: The Phase I effort will consist of proof-of-concept assembly of micro-optical circuits utilizing photodetectors and light sources for the operation of an IFOG system. A laboratory-scale prototype will be constructed incorporating two photodetectors; a broadband light source, all requisite electrical and optical circuitry, and fiber optic patch cables for exterior connections. The function of the circuit will be demonstrated with a surrogate IFOG. The Phase I Option, if exercised, will include single-board packaging of the optical/electronic circuit, as well as requisite tests to confirm function of the device.

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: The Phase II effort will consist of the construction of a ruggedized single-board optical/electronic circuit. The device will incorporate sufficient insulation, vibration isolation, shock and crush protection, and thermal management to operate in conditions characteristic of aircraft or missile flight. Platform surrogate testing will be utilized to verify performance under these conditions. The device will function as a standalone item, excepting input and output to the IFOG or surrogate system. In addition, its exterior interfaces will be sufficiently universal to allow incorporation of a variety of mounting hardware, computer interfaces, and IFOG devices. The architecture of the system will be well documented to facilitate modification and future development. Prepare a Phase III development plan to transition the technology for Navy use 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: Phase III will focus on transitioning the product into the final system (for Navy purposes the hypersonic glide-body). Refinement will be focused on integration of the product. Single-board optical/electronic circuits, particularly those with rugged interfaces, will find use in data processing systems, RF photonic systems, and security and safety control systems in both military and civilian use. Other notable uses include “plug and play” fiber analysis systems.

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KEYWORDS: Conventional Prompt Strike; Micro-Optics; Optical Circuits; Extreme Shock/Vibration Environments; Thermal Extremes; Re-usable Architecture; Interferometric Fiber-Optic Gyro; IFOG; IFOG Performance; Phase Modulators; IMU Optimization; 14-Butterfly Package

VERSION 5

N212-136 TITLE: Development of Predictive Aero-Optical Models of the Hypersonic Environment

RT&L FOCUS AREA(S): Hypersonics;Space

TECHNOLOGY AREA(S): Battlespace Environments;Information Systems;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 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 predictive aero-optical models for the hypersonic environment.

DESCRIPTION: Optical sensors operating in hypersonic vehicles are subject to environments which distort the images and light such sensors seek to capture. Three main categories of distortions exist:

1) Unsteady distortions, such as turbulence, that lead to random image blur
2) Steady distortions, such as shock waves, that lead to systematic image tilts
3) Background radiation/optical emission that can degrade the signal to noise ratio

Each of these image distortions represents a risk for developing a hypersonic imaging system that must be reduced with validated predictive models and experiments. This work will develop such validated predicted models.

The outcomes of the proposed work are:

1) Databases that contain aero-optical environmental characteristics predicted for an entire flight trajectory.
2) Predictive models which can be applied to specific hypersonic vehicles

The Phase I effort will not require access to classified information. The Phase II effort will require secure access. SSP will process the DD254 to support the contractor for personnel and facility certification for secure access.

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 Counterintelligence Security Agency (DCSA). The selected contractor 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 DCSA and 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: Develop a model for a range of unclassified hypersonic environmental conditions, including Mach number, altitude, and vehicle angle of attack. Characterize the aerodynamics of the vehicle wake and conduct aero-optical analysis of light passing through the wake. Aero-optical experiments, such as wind-tunnel tests, will also be conducted to validate models against experimental data. Models will be further validated against existing literature. Focus on the environment surrounding the wake of a hypersonic vehicle. Characterize unsteady effects, such as turbulence, steady effects, such as systematic optical deflection through fluid boundary layers, and identify the spectral wavelengths and absolute power of background photon emission. Validate models with wind-tunnel testing experiments.

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: Leverage the models developed during Phase I for application to classified trajectory points of interest. Aerodynamic analysis of the wake in the classified environment will be conducted, as will optical analysis of light passing through this wake. The radiative effects of the classified hypersonic environment will be considered. The vehicle sensor window will also be analyzed using parametric studies to provide further data on potential optical aberrations. The product of this work will consist of databases that contain aero-optical environmental characteristics predicted for the entire flight trajectory.

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: Utilize the developed models for application in classified points of interest and trajectories. The verified models will be provided to the national community for use in optic sensor development. Work with the Government to transition this database that contains aero-optical environmental characteristics predicted for the entire flight trajectory. The defense industry with focuses on SLBM, ICBMs, etc. will benefit from this technology as they consider unconventional navigation approaches. Also, future commercial hypersonic vehicle developers will has interest in utilizing these models for development of their products.

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KEYWORDS: Conventional Prompt Strike; Aero-Optics; hypersonic environments; optical distortion; background radiation; predictive models; optical sensors

VERSION 5

N212-137 TITLE: High Efficiency, Low Size Weight and Power (SWaP) Solid State Power Amplifiers (SSPAs) for Sensor Applications

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Hypersonics

TECHNOLOGY AREA(S): Battlespace Environments;Sensors;Weapons

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OBJECTIVE: Develop size-constrained solid-state power amplifier for future Navy radar applications that can operate in extreme environments.

DESCRIPTION: Radar (radio detection and ranging) imaging provides several advantages compared to optical imaging, including all-weather/day-or-night sensing capability. It often has lower resolution than optical techniques; however, the ability to coherently combine multiple samples across synthetic apertures can mitigate some resolution limitations. Additionally, the ranging aspect of radar allows information regarding the distance to objects in a scene as opposed to the simple detection of the objects. For the ranging to occur, a radar system must transmit energy toward a scene of interest and receive reflected energy from that scene. Radar sensitivity is subject to a number of factors including the size of the transmit and receive antennas, the range to the objects of interest, the amount of transmit power broadcast, the sensitivity of the receive electronics, the frequency of operation, (among other things) and is quantified in the radar range equation to first order.

The power amplifier for the transmitter can be improved to increase radar performance. Solid-state power amplifiers are increasing in their use in a variety of applications.Gallium Nitride (GaN) monolithic microwave integrated circuit (MMIC) technology has been instrumental in the adoption of solid-state power amplifiers for power ranges that previously were only addressable using vacuum electronics such as traveling wave tube amplifiers (TWTAs) [Ref 1-2].

The desired outcome of this work is to develop microwave electronics, specifically a prototype solid-state power amplifier radar transmitter that is capable of operation across a variety of possible radar applications of interest to the U.S. Navy. These include intelligence, surveillance, reconnaissance, weather sensing, search and tracking of objects, and fire control.

Broad performance objectives include:

- Frequency of Operation: approximately 15 GHz to 18 GHz
- RF Saturated Output Power: > 200 W
- Saturated Gain: > 50dB
- Duty Factor: Up to ~35% (but variable)
- Pulse Widths: 1 µs to 300 µs
- Power Added Efficiency: > 30% (at Psat)
- Mechanical Shock: > 1,000 G (relatively few events)
- Size: < 75 in3
- Mass: < 8 lbs

- Cooling Method: Conduction

Better performance than requested in any or all of the areas listed above may simplify system trades, enable additional capability or open new opportunities for the developed amplifier. As such, improved functionality is welcome and desired. The winning proposed effort may require a MMIC development effort to achieve the desired efficiency over the frequency range of operation, and strong microelectronics packaging expertise to achieve the objective integration density and maintain the efficiency provided by highly-efficient MMIC amplifiers when multiple amplifiers are combined.

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. The Phase II effort may require secure access, if so SSP will process the DD254 to support the contractor for personnel and facility certification for secure access.

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 Counterintelligence Security Agency (DCSA). The selected contractor 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 DCSA and 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 feasibility study and initial design effort to provide anticipated performance for the subject power amplifier parameters detailed in the Description. Develop and communicate plans for producing an amplifier prototype in Phase II, including engaging any potential vendors, partners or suppliers the small business contractor may require to complete the anticipated work. The Phase I Option effort, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Produce and demonstrate through testing a prototype power amplifier capable of meeting the performance goals of the effort. The results should be correlated to current state-of-the-art capabilities. Provide a plan for application-specific qualification testing. Prepare a Phase III development plan to transition the technology for Navy use 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: Work with the Navy to transition the amplifier technology to the target program. High-efficiency power amplifiers with wide frequency bandwidth may enable multiple simultaneous missions from a single antenna aperture, when paired with flexible exciters, including software-defined radios. Such multi-mission power amplifiers may have more widespread Government use and address defense industries with specific interest in radar applications in extreme environments, such as SLBMs, ICBMs and future commercial hypersonic vehicle developers.

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KEYWORDS: Conventional Prompt Strike; Radar; Solid State Power Amplifier; GaN MMIC; Microwave Electronics; Microelectronics; Transmitters; Microwave Power Modules; monolithic microwave integrated circuit

N212-138 TITLE: Advanced Persistent-Surveillance Sky Camera

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Electronics;Materials / Processes;Sensors

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OBJECTIVE: Develop and demonstrate an Advanced Persistent-Surveillance Sky Camera by enhancing the Wide Area Staring Photometer (WASP), currently in use by United States Naval Observatory (USNO), to be accurate within milli-arcseconds and include simultaneous, multi-filter photometry that has associated star brightness variability estimates valid for at least one year.

DESCRIPTION: Wide-field, non-tracking Commercial Off-the-Shelf (COTS) Digital Single Lens Reflex (DSLR) camera arrays that observe many square degrees of the sky are now in use by USNO and other Government agencies. These camera systems are critical for the long-term photometric monitoring of bright stars. They can also be used to observe geostationary satellites and transient celestial events and objects. Because these systems utilize COTS cameras, which are not designed for astronomical use, they are limited in terms of their accuracies and photometric capabilities. USNO desires to develop the next generation of camera systems (“WASP 2.0”) that are more astrometrically accurate, more compact, sensitive to a wider range of stellar magnitudes, and include simultaneous, multi-filter photometry. This will benefit Navy by providing relatively inexpensive yet highly capable systems for the long-term monitoring of stars. Since these systems observe large swaths of the sky, they will allow USNO to obtain better measurements of the long-term brightness variability of stars. USNO anticipates that they will be readily deployable around the world, on land sites, as well as ocean surface vessels. This is critical to support observations of stars in both northern and southern hemispheres. Moreover, these systems support other defense applications (e.g., space situational awareness) as well as general astronomical purposes; thus, their commercialization potential is expected to be high. All work executed under this topic will be unclassified.

PHASE I: Develop and define a concept design for an Advanced Persistent-Surveillance Sky Camera by enhancing the current WASP to be more astrometrically accurate (at least a degree of magnitude better) with simultaneous, multi-filter photometry. The new WASP 2.0 system will be designed to have the capability to measure astrometric parameters at the milli-arcsecond level and have derivative estimates of brightness variability that are viable for at least one year. Work with the Navy in understanding size, function, and interface requirements for WASP 2.0. Interface requirements will be furnished after Phase I has been awarded. Construct hardware and software that ensure data and network connection integrity as well as USNO data application. Identify risks to the proposed concept, and develop Phase II plans that include ways to mitigate those risks. 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 and deliver a prototype WASP 2.0 camera system. Work with the Navy to fully understand the data and interface requirements. Work with the Navy to understand hardware and integration standards for WASP 2.0 being deployed and used in a manner useful for USNO data constructions as well as NSWCDD data utility. Provide testing scenarios that ensure operational use of data collection efficiencies compared to current practice. Establish a feedback loop with the Navy for implementing changes during prototype testing. All the work under this Phase II effort will be unclassified.

PHASE III DUAL USE APPLICATIONS: Deliver a WASP 2.0 camera system to be integrated for operational use by USNO in a manner that supplies data collections needed for SP23 developed capabilities. Provide design and test cases that demonstrate integration of the WASP 2.0 camera in USNO-designed operational environments. Support on-site testing and work with the Navy in the operational set up of the camera system including troubleshooting plus resolving implementation and execution issues at various Navy, DoD, and civilian telescope observatories that can provide information for star tracker navigation. Coordinate with Navy guidance technical teams to leverage stellar data streams that will enhance the design trade space for other guidance and navigation capabilities for these other DoD programs.

In addition to including simultaneous, multi-filter photometry, the next generation of camera systems (“WASP 2.0”) are expected to be more astrometrically accurate, more compact, and more sensitive to a range of stellar magnitudes as compared with current COTS cameras. These systems observe large swaths of the sky, and it is anticipated that they will be readily deployable around the world, on land sites, as well as ocean surface vessels. The increased capability and portability make these cameras an attractive option to users outside of the military.

REFERENCES:

1. Dao, Phan et al. “Machine Classification and Sub-Classification Pipeline For GEO Light Curves.” Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS) 2019. https://amostech.com/TechnicalPapers/2019/Machine-Learning-for-SSA-Applications/Dao.pdf.
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5. Abraham, Roberto G. and van Dokkum, Pieter G. "Ultra-low surface brightness imaging with the dragonfly telephoto array.” Publications of the Astronomical Society of the Pacific, 2014, 126(935):55. https://arxiv.org/pdf/1401.5473.pdf.

KEYWORDS: Sky Camera; Bright Star Variability; Data Collection; Photometric Monitoring; Multi-filter Photometry; Astrometry; Astrometric; Wide Area Staring Photometer; WASP

VERSION 5

N212-139 TITLE: Radiation Hard Mid-Wave Infrared Imagers

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Electronics;Materials / Processes;Sensors

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 radiation hardened mid-wave infrared (MWIR) sensors for strategic applications.

DESCRIPTION: The performance requirements for MWIR image sensors used in strategic navigation applications continue to become more stringent, necessitating continued innovation for image sensor technologies. Examples of existing research for MWIR imaging sensor technology can be found in the referenced articles [Ref. 1-3]. The applications are also expanding, leading to a need for larger pixel counts and smaller pixels in MWIR imagers. Conventional MWIR sensors have large pixels making large arrays prohibitively expensive.

Commercial applications for MWIR are far reaching, with some examples being stress identification in materials, human tracking/security and automotive and machine industries. This technology would enable devices to be used at higher temperatures in a wider range of environments.

In terms of idealities, these MWIR sensors should have low-noise readout preferably with minimal cooling (e.g., High Operational Temperature (HOT) sensor), have high-density (< = 8 µm) pixel pitch, be radiation-hard at strategic levels, have low power consumption, and be able to be fabricated using foundry processes.

PHASE I: Perform a design and performance modeling study aimed at MWIR sensors with improved performance for strategic sensors as compared to the current state-of-the-art. Assess performance and environmental sensitivity of parameters including responsivity, speed, noise, and defective pixels. Consider all aspects of fabrication and justify the feasibility/practicality of the approach. A goal of quantum efficiency greater than 40% and operability greater than 95% of pixels is desired. Propose, in a Phase II plan, a specific device design for fabrication based upon this analysis.

PHASE II: Fabricate and characterize a small number of prototype MWIR sensors (Up to Qty: 3). Characterization using EMVA1288 standard, shall comprise various parameters including responsivity, speed, noise, and defective pixels in relevant radiation environments. The prototypes should be delivered by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Continue development to lead to production of MWIR sensors. Production level applications would be highly sought for military seeker applications, strategic needs as well as commercial applications. An image sensor that can meet the stringent performance requirements of strategic instrumentation is likely to bring value to many existing commercial applications. MWIR can be used in the commercial sector for a variety of reasons including stress identification in materials, human tracking/security, and automotive and machine industries. This technology would enable devices to be used at higher temperatures in a wider range of environments.

VERSION 5

REFERENCES:
1. Morath, C.; Cowan, M.; Treider, L.; Jenkins, G.; and Hubbs, J. “Proton Irradiation Effects on the Performance of III-V Based, Unipolar Barrier Infrared Detectors.” IEEE Transactions on Nuclear Science, Vol. 62, No. 2, 2015. https://ieeexplore.ieee.org/document/7047245.
2. Hoglund, L.; Ting, D.; Soibel, A.; Fisher, A.; Khoshakhlagh, A.; Hill, C.; Keo, S.; and Gunapala, S. “Minority carrier lifetime in mid-wavelength infrared InAs/InAsSb superlattices: Photon recycling and the role of radiative and Shockley-Read-Hall recombination mechanisms.” Applied Physics Letters 105, 193510, 2014. https://aip.scitation.org/doi/10.1063/1.4902022.
3. Soibel, A.; Rafol, B.; Khoshakhlagh, A.; Nguyen, J.; Hoglund, L.; Fisher, A.; Keo, S.; Ting, D.; and Gunapala, S. “Proton radiation effect on performance of InAs/GaSb complementary barrier infrared detector.” Applied Physics Letters 107, 261102, 2015. https://aip.scitation.org/doi/10.1063/1.4938756.

KEYWORDS: mid-wave infrared sensor; seeker; navigation; image sensor; radiation-hard; imagers; MWIR

DEPARTMENT OF THE NAVY (DON)
21.2 Small Business Innovation Research (SBIR)
Direct to Phase II (DP2) Announcement and Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to Direct to Phase II (DP2) SBIR topics only:**
  - **N212-D03 to N212-D05**
- **The information provided in the DON Proposal Submission Instruction document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**
- **Proposers that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF) or any combination of these are eligible to submit proposals in response to DON topics advertised in this BAA. Information on Majority Ownership in Part and certification requirements at time of submission for these proposers are detailed in the section titled ADDITIONAL NOTES.**
- A DP2 Phase I Feasibility proposal template, unique to DP2 topics, is available at https://www.navysbir.com/links_forms.htm; use this template to meet Volume 2 requirements.
- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- The Supporting Documents Volume (Volume 5) is available for the SBIR 21.2 BAA cycle. The 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.

INTRODUCTION

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	When	Contact Information
Program and administrative	Always	Program Managers list in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to section 4.13 of the DoD BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to section 4.13 of the DoD BAA for details.

Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DoD Help Desk via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	Navy-sbir-sttr.fct@navy.mil

TABLE 2: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N212-D03 to N212-D05	Ms. Donna Attick	Naval Air Systems Command (NAVAIR)	navair.sbir@navy.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. 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 SBIR award to a small business firm under Phase II , without regard to whether the firm received a Phase I award for 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: 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 make no awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposers must read the topic requirements carefully. The Government is not responsible for expenditures by the proposer prior to award of a contract. For 21.2 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

Proposers are required to submit proposals via the Defense SBIR/STTR Innovation Portal (DSIP) https://www.dodsbirsttr.mil/submissions; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. It is recommended that firms register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process. Proposals that are not successfully certified in DSIP prior to BAA Close will NOT be considered submitted. Please refer to section 5.1 of the DoD SBIR/STTR Program BAA for further information.

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the proposal will be deemed noncompliant and shall 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
    - Comply with primary employment requirements of the principal investigator (PI) during the Phase II award including, employment 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 4.14 of the DoD SBIR/STTR Program BAA. To register, visit https://beta.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:
    - Content is responsive to evaluation criteria as specified in DoD SBIR/STTR Program BAA section 6.0
    - Not to exceed **30** 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, and imbedded tables, figures, images, or graphics that include text, a font size smaller than 10-point is allowable; however, proposers are cautioned that if the text is too small to be legible it will not be evaluated.

  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 20 pages)
  1. Introductory Statement
  2. Phase I Proof of Feasibility
  3. Commercialization Potential/Transition Plan Summary

- Snapshot of Proposed Phase II Effort (NTE 10 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. Facilities/Equipment - Describe available instrumentation and physical facilities necessary to carry out the effort.
  6. Order of Magnitude Cost Estimate Table (example provided below in the Cost Volume (Volume 3) section).

It is recommended that proposers use the DP2 Phase I Feasibility proposal template at 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 3 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 3: COST & PERIOD OF PERFORMANCE

Topic Number	Base		Option One		Total (NTE)
	Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
N212-D03 to N212-D05	$800,000	24 mos.	$300,000	12 mos.	$1,100,000

- **Company Commercialization Report (Volume 4)**. DoD requires Volume 4 for submission to the 21.2 DP2 BAA. Please refer to instructions provided in section 5.4.e of the DoD SBIR/STTR Program BAA.

- **Supporting Documents (Volume 5)**. Volume 5 is available for use when submitting Phase I and Phase II proposals.

  The DoD must comply with Section 889(a)(1)(B) of the FY2019 National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. **As such, all proposals must include as a part of their submission a written certification in response to the NDAA clauses (Federal Acquisition Regulation clauses 52.204-24, 52-204-25 and 52-204-26).** The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume 5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to instructions provided in section 5.4.g of the DoD SBIR/STTR Program BAA.

  In accordance with DFARS provision 252.209-7002, a proposer is required to disclose any interest a foreign government has in the proposer when that interest constitutes control by foreign government. Proposers must review the Foreign Ownership or Control Disclosure information to determine applicability. If applicable, an authorized firm representative must complete the

Disclosure of Offeror's Ownership or Control by a Foreign Government (found in Attachment 2 of the DoD SBIR/STTR Program BAA) and upload as a separate PDF file in Volume 5. Please refer to instructions provided in section 5.4.h of the DoD SBIR/STTR Program BAA.

Volume 5 is available for small businesses to submit additional documentation to support the Technical Proposal (Volume 2) and the Cost Volume (Volume 3). A template is available on https://navysbir.com/links_forms.htm. DON will not be using any of the information in Volume 5 during the evaluation.

- Additional Cost Information
- SBIR/STTR Funding Agreement Certification
- Data Rights
- Allocation of Rights between Prime and Subcontractor
- Disclosure of Information (DFARS 252.204-7000)
- Prior, Current, or Pending Support of Similar Proposals or Awards
- Foreign Citizens
- Majority-Owned VCOC, HF, and PEF Certification, if applicable

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 requires Volume 6 for submission to the 21.2 DP2 BAA. Please refer to instructions provided in section 5.4.i of the DoD SBIR/STTR Program BAA.

DON SBIR PHASE I FEASIBILITY 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. 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. The "Additional Cost Information" of Volume 5 may be used if additional space is needed to detail these costs. 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 included in Volume 5 as "Additional Cost Information". Failure to include the required information in Volume 5 will result in the denial of TABA. TABA may be proposed for a DP2 effort which will be included as part of the award amount and limited by the established award values for Phase II by the SYSCOM. The total value of TABA must not exceed $25,000 under this DP2 contract.

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 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 $1,700,000 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. A TABA Report, detailing the results and benefits of the service received, will be required annually by October 30.

Approval of direct funding for TABA will be evaluated by the DON SBIR/STTR Program Office. If the TABA request does not include the following items the TABA request will be denied.

- 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 <u>NOT</u>:

- 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 requests must be included as follows:

- DP2:
    - Order of Magnitude Cost Estimate Table (within the Technical Proposal, Volume 2) – the value of the TABA request.
    - Online DoD Cost Volume (Volume 3) – the value of the TABA request.
    - Supporting Document Volume (Volume 5) – a detailed request for TABA (as specified above) specifically identified as "Discretionary Technical and Business Assistance".

Proposed values for TABA must <u>NOT</u> exceed:

- A total of $25,000 per award, not to exceed $50,000 per Phase II project

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 proposals and DP2 proposals using the evaluation criteria in Sections 6.0 and 7.0 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. 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 2. 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.

Protests to this BAA and proposal submission must be directed to the DoD SBIR/STTR Program BAA Contracting Officer, or filed with the GAO. Contact information for the DoD SBIR/STTR Program BAA Contracting Officer can be found 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. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase II awards. 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).

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

Majority Ownership in Part. Proposers which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DON topics advertised within this BAA.

For proposers that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:

a. Prior to submitting a proposal concerns must register with the SBA Company Registry Database.
b. The proposer within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm. Include the SBIR VC Certification in the Supporting Documents Volume (Volume 5).
c. Should a proposer become a member of this ownership class after submitting its application and prior to any receipt of a funding agreement, the proposer must immediately notify the Contracting Officer, register in the appropriate SBA database, and submit the required certification which can be found on https://navysbir.com/links_forms.htm.

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.

System for Award Management (SAM). It is strongly encouraged that proposers register in SAM, https://beta.sam.gov, by the Close date of this BAA, or verify their registrations are 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.

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).

Support Contract Personnel for Administrative Functions. Proposers are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.

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 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 21.2 SBIR DIRECT TO PHASE II TOPIC INDEX

N212-D03 TITLE: DIRECT TO PHASE II - Electrical Capacitors for High-Temperature Power Conversion

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Identify and demonstrate that advances in polymeric (or other film materials) dielectrics can be exploited in high temperature (150 °C–200 °C), compact, long life, highly reliable, electrical power capacitors in aircraft.

DESCRIPTION: Electrification of naval aerospace platforms continues. Aircraft designers are being challenged to supply more power to new classes of nonlinear and constant power loads. In response to these new loads, the electrical power generation/distribution system, as well as the electrical loads themselves, are being required to minimize losses, while rejecting heat at high temperatures and maintaining conversion equipment reliability. A well-established design practice indicates component reliability of their insulation systems can be increased by 2 times for every 100 °C the operating temperature is lowered below the design maximum temperature.

While new classes of power semiconductor switching devices based on wide-bandgap materials (i.e., SiC and GaN) are maturing with advertised operating junction temperatures up to 200 °C, the development of high-temperature, reliable capacitors have not followed suit. To achieve reliability, today’s power conversion capacitors are operated at temperatures of ~150 °C – thus limiting converter/inverter fluid-in temperatures at/or below 75 °C.

Capacitors with operating temperatures in the range of -40 °C to 150 °C, with a maximum temperature of 200 °C is the program’s primary goal. There are additional characteristics which are important for aircraft including: operation at altitude (up to 70,000 ft (21,336 m)), weight and volume comparable to state-of-the-art aerospace capacitors, equivalent series resistance (< 2 MO goal), and low inductance (< 50 nH goal). In addition, the capacitors are needed for both DC link applications as well as for AC filters. Capacitors with operating capabilities in the temperatures stated above will enable converter/inverter fluid-in cooling temperatures of 100°C or higher.

The Navy requires representative high-temperature capacitors for aircraft electrical DC link and filter applications with the following characteristics that are important for aircraft including, but not limited to:

- DC Voltage Rating (Nominal): 600 Vdc (Target), 500 Vdc
- Capacitance: 300 uF ± 5.0% (1 kHz – 40 kHz & @ 150°C)
- Operation Temperature: -55°C (Start-up) -40°C – +150°C
- Maximum Storage Temperature: 175°C
- ESR: < 1 MO (1 kHz – 40 kHz at 150°C)
- ESL: < 1 nH per mm of lead spacing
- Dissipation Factor (DF): <= 1.8% @10 kHz; <= 7.5% @40 kHz, 150°C
- Ripple Current: 30 Arms average; 10 Arms @ 80 kHz
- Peak Current: 180 A
- Voltage Ripple: 15 V
- Dielectric Withstanding Voltage: 900 V DC voltage for 30 seconds, no reliability impact with the maximum leakage current < 0.5 mA
- dv/dt > 20 V/μS @ 600 V and 150°C
- Vibration/Shock: Random Vibe = 40 Grms, 10-2000 Hz; Shock = 15 gs@11 ms
- Altitude (Partial Discharge): > 65,000 ft (19,812 m)
- Insulation Resistance: 10 MO between positive terminal or negative terminal and case

- Dimension (Target): <= 8 in3 (20.32 cm^3)
- Weight (Target): <= 2.5 lb (1.134 kg)

This SBIR topic seeks development of typical aircraft capacitors and demonstration of reliability and life for these capacitors in representative aircraft electrical power conversion applications. The primary target is 600-800 Vdc capacitors to be used in conversion equipment that operates in 400 Hz power system architectures and with Variable Speed Constant Frequency (VSCF) generator control units. Specifically, this includes the F/A-18 where a need for 35% more electrical power is expected. Better capacitors will help ensure a 100 KVA system can operate without major changes to the F/A-18 cooling system. A secondary target will be for application in 270 Vdc power system architectures (e.g., F-35). A strong collaboration with an electrical generation system or components supplier is highly recommended for Phase II.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. Have developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

The proposal must state a capacitor physical design, the high-temperature material characteristics that will be used, and calculation showing the capacitance can be met in the size and weight constrains.

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 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 offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 21.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop prototype representative high-temperature capacitors for aircraft electrical DC link and filter applications with the characteristics that are important for aircraft as outlined in the Description.

Develop a test apparatus to demonstrate life and reliability for representative electrical and temperature conditions. Accomplish testing to indicate life and reliability. Deliver test apparatus and test reports. Deliver 25 functional capacitors of each type developed beyond those used in life/reliability testing.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype and perform final testing. Transition in a 100 KVA DC Link Generator Converter Units for use on applicable platforms.

All High-Power Electronic Converters use high-power, high-temperature capacitors to keep size, weight, and cooling requirements low. These characteristics are useful in all commercial converter applications including commercial aircraft, commercial computer centers, and commercial trains.

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1. Von Kampen, T. “Ensure AC film capacitor reliability with thermal analysis.” Power Electronics, March 1, 2001. https://www.powerelectronics.com/content/ensure-ac-film-capacitor-reliability-thermal-analysis#close-olyticsmodal.

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3. Demcko, R. S. "Evolution of high-temperature capacitors." Proceedings 38th Electronics Components Conference May 1988, pp. 390-395. https://doi.org/10.1109/ECC.1988.12622.
4. Haywood, R. "Downhole tools in the oilfield services industry: Transformation to improve reliability." 2017 IEEE Applied Power Electronics Conference and Exposition, Tampa, FL, United States, March 26-30, 2017. https://www.psma.com/sites/default/files/uploads/tech-forums-capacitor/presentations/is186-downhole-tools-oilfield-services-industry-transformation-improve-reliability.pdf.

KEYWORDS: High Temperature; Aircraft Capacitor; DC-Link; Converter; 100 KVA DC Link Generator Converter Unit

N212-D04 TITLE: DIRECT TO PHASE II - High-Speed Digital Fiber Optic Receiver

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Networked C3

TECHNOLOGY AREA(S): Air 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 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 package an uncooled digital fiber optic receiver that operates up to 100 Gbps, binary, non-return-to-zero for air platform fiber optic link applications.

DESCRIPTION: Current airborne military (mil-aero) core avionics, electro-optic (EO), communications and electronic warfare systems require ever-increasing bandwidths while simultaneously demanding reductions in space, weight, and power (SWaP). The replacement of shielded twisted pair wire and coaxial cable with earlier generation, bandwidth-length product, multimode optical fiber has given increased immunity to electromagnetic interference, bandwidth, throughput, and a reduction in size and weight on aircraft. The effectiveness of these systems hinges on optical communication components that realize high per-lane throughput, low latency, large link budget, and are compatible with the harsh avionic environment [Refs 6, 7, 8, 9].

In the future, data transmission rates of 100 Gbps and higher will be required. Substantial work has been done to realize data rates approaching this goal based on the use of multilevel signal coding; but multilevel signal encoding techniques trade off link budget and latency to achieve high digital bandwidth [Refs 1-3]. To be successful in the avionic application, existing non-return-to-zero (NRZ) signal coding with large link budget and low latency must be maintained [Refs 4-5, 10]. Advances in optical receiver designs are required that leverage novel photo-detector technology, semiconductor process technology, circuit designs, architectures, and packaging and integration techniques.

The proposed avionic receiver must operate across a -40 °C to +95 °C temperature range, and maintain performance upon exposure to typical naval air platform vibration, humidity, temperature, altitude, thermal shock, mechanical shock, and temperature cycling environments [Refs 6-9]. The receiver must support a 10 dB link loss power budget when paired with a transmitter meeting similar environmental requirements, as well as applicable electro-optic performance restrictions. The receiver must be compatible with transmitters operating in the O band (1260-1360 nm range) and capable of receiving multi-wavelength signals transmitted over both single-mode fiber and 50 µm multimode fiber (Threshold performance). The receiver optical subassembly must be configurable to function at other wavelengths using high-speed photodetectors that operate at 850 nm, 980 nm, and 1,550 nm (Objective performance). The saturation level of the receiver must allow for operation while maintaining a bit error rate no greater than 1 X 10-12 over a link having 0 dB link loss and a transmitter having an extinction ratio of 4 dB operating at its highest allowed average power (Threshold average power of 10 dBm, and Objective average power of 15 dBm). The sensitivity of the receiver must allow for operation while maintaining a bit error rate no greater than 1 X 10-12 in a link with 10 dB link loss and a transmitter operating at its lowest allowed power of -5 dBm and an extinction ratio of 4 dB. The received signal must be retimed. Additionally, the full-rate signal may be converted (de-serialized) and output as multiple lower-rate signals. The electrical output of the receiver must be differential current mode logic with a suitable pre-distortion mechanism to allow transmission of the electrical output across at least 4 in. (10 cm) of board-level interconnect. The electrical output of the receiver must provide receiver signal strength indication to the extent that SFF-8472 is appropriate for military avionics application [Ref 11].

The proposed receiver design must be capable of being demonstrated to perform reliably over the stated environmental, functional, and performance requirements with an Objective aggregate data rate of 200 Gbps. A Threshold performance level of 100 Gbps would represent an attractive option for near-term system deployment in concert with available digital fiber optic transmitter technology, while demonstrating a pathway to the 200 Gbps objective.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. Have developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

Designed and analyzed an uncooled high-speed digital fiber optic receiver circuit and provided an approach for determining receiver parameters and testing. Designed a high-speed digital fiber optic receiver package prototype that is compatible with the receiver circuit design and coupling to optical fiber.

Determined and demonstrated the feasibility of the receiver design, the package prototype design, and a path to meeting Phase II goals based on analysis and modelling. The analysis and modeling should reference results obtained in previous efforts.

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 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 offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 21.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this SBIR topic.

PHASE II: Optimize the receiver circuit and package designs. Build and test the receiver circuit and packaged receiver prototype to meet performance requirements. Characterize the receiver over temperature and perform highly accelerated life testing. If necessary, perform root cause analysis and remediate circuit and/or packaged receiver failures. Deliver packaged receiver prototypes for 50 Gbps and 100 Gbps digital fiber optic communication link application.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype. Verify and validate the receiver performance in an uncooled 100 Gbps fiber optic receiver that operates from -40 °C to +95 °C. Transition to applicable naval platforms.

Commercial sector telecommunication systems, fiber optic networks, and data centers could benefit from the development of high-speed receivers.

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1. Binh, L. N. "Advanced digital optical communications (2nd ed.)." CRC Press, July 26, 2017. ISBN 1482226537. https://doi.org/10.1201/b18128.
2. Verbist, J., Verplaetse, M., Srivinasan, S. A., De Heyn, P., De Keulenaer, T., Pierco, R., Vaernewyck, R., Vyncke, A., Absil, P., Torfs, G., Yin, X., Roelkens, G., Van Campenhout, J. and Bauwelinck, J. "First real-time 100-Gb/s NRZ-OOK transmission over 2 km with a silicon electro-absorption modulator." 2017 Optical Fiber Communications Conference, Los Angeles, CA, United States, March 19-23, 2017. https://ieeexplore.ieee.org/document/7937157.
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7. "MIL-STD-810G: Environmental engineering considerations and laboratory tests." Department of Defense, October 31, 2008). http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G_12306/.
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9. "MIL-PRF-38534J: General Specification for Hybrid Microcircuits." Department of Defense, March 13, 2015 http://everyspec.com/MIL-PRF/MIL-PRF-030000-79999/MIL-PRF-38534J_52190/.
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11. "Specification for Management Interface for SFP+." https://www.snia.org/technology-communities/sff/specifications.

KEYWORDS: Digital Fiber Optic Receiver; Binary Non-return to zero signaling; 100 Gigabits per Second; 200 Gigabits per Second Packaging; Highly Accelerated Life Testing; data rate

N212-D05 TITLE: DIRECT TO PHASE II – Yield Increase for High-Performance Optical Interference Filters

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials / Processes

OBJECTIVE: Develop processing and manufacturing techniques to significantly improve the yield of high-performance optical interference filter systems, thus reducing unit cost.

DESCRIPTION: Currently optical receiver systems use low to moderate performance interference filters to pass the desired wavelength light and block all unwanted wavelength light. As the receiver aperture size increases or the optical performance requirements (i.e., higher transmission, larger acceptance angle, lower bandpass width) increase, the cost of the optical filter increases dramatically. The cost increase is directly related to yield decrease due to limitations in coating uniformity when considering increased piece size or increased performance. For ultra-narrow high performance filters, reducing the non-uniformity to 0.1% and below is required to minimize wavelength shift and bandwidth broadening [Refs 2, 3].

In order to meet the emerging demands of large-aperture high performance optical filters while reducing costs, a system-level approach must be taken. Reducing non-uniformity to 0.01% over a large area is not feasible, but it is feasible to combine multiple high performance pieces into a single system while maintaining high fill factor. A high yield process will be required to reduce overall system cost.

This SBIR topic focuses on the development of a high yield, lower unit cost process for large area state-of-the-art (SOA) optical interference filter systems in the visible light spectrum. Filter performance goals for a filter line in the 460 to 490 nanometer range: 0.1 nm bandwidth, +/- 30 milli-iadianl acceptance angle, > 80% in-band system transmission, and > 4 orders of out of band blocking. Use MIL-STD-810 [Ref 1] for guidance on environmental storage and operating conditions.

PHASE I: For a Direct to Phase II topic, NAVAIR 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. The below actions would be required in order to successfully satisfy the requirements of Phase I:

- Developed a process to manufacture high-performance optical interference filter systems [Ref 4].
- Manufactured high-performance optical filter systems [Ref 4].
- Understood limitations of current processes, and identified methods and techniques to improve performance and yield of optical filter systems.

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 212 Direct to Phase II BAA Instructions. Phase I Proposals will NOT be accepted for this BAA.

PHASE II: Based upon the work described in the Feasibility Documentation, develop and implement a process to consistently provide high-yield, high-performance filter systems. Demonstrate process success by providing a high-performance 100 mm diameter filter system prototype with a center wavelength in the 460 to 490 nm range, 0.1 nm bandpass, +/-30 mil acceptance angle, average in-band transmission of greater than 80%, and greater than 4 orders of out-of-band blocking. During the option period, if exercised, produce a large diameter (300 mm) prototype filter system with the same or better performance as the base demonstration unit, and demonstrate the feasibility of low-volume (10) unit costs of less than $50,000.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype, providing optical filter systems tailored to existing, or new, active and passive optical systems, as well as, provide integration assistance. Perform environmental testing consistent with various platform requirements and provide test results.

High-performance, low-cost optical filter systems can directly improve the performance of existing commercial LIDAR systems. Subcomponents of the filter system can be applied to short range lidar systems being considered for the autonomous automobile market, where unit cost at minimum performance is key.

REFERENCES:

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KEYWORDS: Optical filter; high yield; narrowband; interference filter; thin-film; lidar

AIR FORCE
21.2 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 specific requirements. **Firms must ensure their proposal meets all requirements of the Broad Agency Announcement currently posted on the DoD website at the time the solicitation closes.**

All SBIR Phase I proposals under this solicitation must be submitted through the DoD SBIR/STTR Innovation Portal (DSIP), https://www.dodsbirsttr.mil/submissions/login, no later than the date and time published in the DoD 21.2 SBIR BAA.

Questions pertaining to the AF SBIR/STTR program and these proposal preparation instructions should be directed to the AF SBIR/STTR Program Office at usaf.team@afsbirsttr.us. For questions regarding DSIP, contact the DoD SBIR/STTR Help Desk via email at DoDSBIRSupport@reisystems.com. For technical questions about the topics during the pre-release period, contact the Topic Authors listed for each topic. To obtain answers to technical questions during the formal announcement open period, visit the Topic Q&A on DSIP at https://www.dodsbirsttr.mil/submissions/login.

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 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.

Information at a Glance for Air Force 21.2 SBIR Phase I Topics:

Topic Number	Performance Period	Max SBIR Funding	Technical Volume Contents
AF212-0001	6 months	$100,000	White paper NTE 25 pages
AF212-0002	6 months	$100,000	White paper NTE 25 pages
AF212-0003	6 months	$100,000	White paper NTE 25 pages
AF212-0004	9 months	$150,000	White paper NTE 30 pages
AF212-0005	12 months	$150,000	White paper NTE 25 pages
AF212-0006	9 months	$150,000	White paper NTE 30 pages
AF212-0007	9 months	$100,000	White paper NTE 20 pages
AF212-0008	3 months	$75,000	White paper NTE 25 pages
AF212-0009	6 months	$100,000	White paper NTE 25 pages
AF212-0010	12 months	$150,000	White paper NTE 15 pages
AF212-0011	12 months	$150,000	White paper NTE 15 pages
AF212-0012	9 months	$150,000	White paper NTE 15 pages
AF212-0013	12 months	$150,000	White paper NTE 25 pages
AF212-0014	12 months	$150,000	White paper NTE 25 pages
AF212-0015	12 months	$150,000	White paper NTE 25 pages

PHASE I PROPOSAL SUBMISSION

DoD 21.2 SBIR Broad Agency Announcement, https://www.dodsbirsttr.mil/submissions/login, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic's requirements. For the AF, the Phase I contract periods of performance and dollar values are found in the table above.

Limitations on Length of Proposal

The Phase I Technical Volume page/slide limits as identified in Chart 1 (above) do not include the Cover Sheet, Cost Volume, Cost Volume Itemized Listing (a-j). The Technical Volume must be no smaller than 10-point on standard 8-1/2" x 11" paper with one inch margins. Only the Technical Volume and any enclosures or attachments count toward the page limit. In the interest of equity, pages/slides in excess of the stated limits will not be considered for review. The documents required for upload into Volume 5, "Other", do not count toward the specified limits.

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 selected for funding, the proposal's technical abstract and discussion ofanticipated benefits will be publicly released. 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, which is completed separately. Phase I technical volume (uploaded in Volume 2) shall contain the required elements found in Chart 1. Make sure all graphics are distinguishable in black and white. Once uploaded to DSIP, the completed, uploaded file will be virus checked and converted to a .pdf document within an hour. If it does not appear after an hour, please contact the DoD SBIR/STTR Help Desk via email at dodsbirsupport@reisystems.com

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. Identify all U.S. permanent residents to be involved in the project as direct employees, subcontractors,or consultants. 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.

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
Progress reports
Final report with SF 298

Cost Volume: Cost information should be provided by completing the Cost Volume in DSIP 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) regarding funds use if an award is received. The DSIP Cost Volume and Itemized Cost Volume Information will not count against the specified page limit. The itemized listing may be submitted in Volume 5 under the "Other" dropdown option.

a. Special Tooling/Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness to the work proposed. Special tooling and test equipment purchases must, in the Contracting Officer's opinion, be advantageous tothe Government and relate directly to the effort. It 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 containingtypes, quantities, prices and where appropriate, purpose.

c. Other Direct Costs: This category includes, but it not limited to, specialized services such as machining, milling, special testing or analysis, and costs incurred in temporarily using specialized equipment. Proposals including leased hardware must include an adequate lease vs. purchase justification.

d. Direct Labor: Identify key personnel by name, if possible, or by labor category if not. Direct labor hours, labor overhead and/or fringe benefits, and actual hourly rates for each individual are also necessary.

e. Travel: Travel costs must relate to project needs. Break out travel costs by trip, number of travelers, airfare, per diem, lodging, etc. The number of trips required, as well as the destination and purpose of each, should be reflected. Recommend budgeting at least one trip to the Air Force location managing the contract.

f. Subcontracts: Involvement of university or other consultants in the project's planning and/or research stages may be appropriate. If so, describe in detail and include information in the Cost Volume. The proposed total of consultant fees, facility lease/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. The SBIR funded work percentage calculation considers both direct and indirect costs after removal of the SBC's proposed profit. Support subcontract costs with copies of executed agreements. The documents must adequately describe the work to be performed. At a minimum, include a Statement of Work (SOW) with a corresponding detailed Cost Volume for each planned subcontract.

g. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly statewhat service or assistance will be provided, the number of hours required, and the hourly rate.

NOTE: If no exceptions are taken to an offeror's proposal, the Government may award a contract without negotiations. Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. If there are questions regarding the award document, contact the Phase I Contracting Officer identified on the cover page. The Government reserves the right to reopen negotiations at a later time if the Contracting Officer determines it to be necessary.

j. DD Form 2345: For proposals submitted under export-controlled topics, either International Traffic in Arms Regulations (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. DD Form 2345 approval will be required if proposal if selected for award.

NOTE: Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors TEC Solutions, Inc., APEX, Oasis Systems, Riverside Research, Peerless Technologies, HPC-COM, Mile Two, Wright Brothers Institute, and MacB (an Alion Company). 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 at kristina.croake@us.af.mil.**

k. The Air Force does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals in response to Air Force topics should not include TABA.

PHASE I PROPOSAL SUBMISSION CHECKLIST

NOTE: If you are not registered in the System for Award Management, https://www.sam.gov/, at the time of proposal submission, you will not be eligible for award. Additionally, verify you are registeredto receive contracts (not just grants) and the addresses in the proposal and SAM are consistent.

1) Air Force Phase I proposals should meet the specific topic's period of performance and cost limitations located on page 1 of these Air Force Instructions.

2) The Air Force will accept only those proposals, including all required volumes, submitted electronically via DSIP, https://www.dodsbirsttr.mil/submissions/. Hard copies or email copies sent outside the system will not be accepted.

Please note the Fraud, Waste and Abuse Training must be completed prior to proposal submission. When training is complete and certified, the DoD Submission Website will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

The AF recommends completing submission early, as computer traffic is heavy prior to solicitation close, causing system lag. **<u>Do not wait until the last minute</u>.** The AF will not be responsible for proposals not completely submitted prior to the deadline due to system inaccessibility unless advised by DoD. Please ensure the e-mail addresses listed in the 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. If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF at usaf.team@afsbirsttr.us. The message shall include the subject line, "21.2 Address Change".

AIR FORCE PROPOSAL EVALUATIONS

The AF will utilize the Phase I proposal evaluation criteria in section 6.0 of the 21.2 SBIR DoD announcement in descending order of importance with technical merit being most important, followed by principal investigator's (and team's) qualification, followed by the potential for commercializationas detailed in the Commercialization Plan.

The AF will utilize the Phase II proposal evaluation criteria in section 8.0 of the 21.2 SBIR 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 addresses or company points of contact after proposal submission, the information shall be provided to the AF at usaf.team@afsbirsttr.us. The message shall include the subject line, "21.2 Address Change".

Feedback will not be provided for Phase I proposals determined Not Selectable. Feedback will be provided only for Phase II proposals determined Not Selectable.

IMPORTANT: IMPORTANT: Proposals submitted to the AF are received and evaluated by different organizations, handled topic by topic. Each organization operates within its own schedule for proposal evaluation and selection. Updates and notification timeframes will vary. If contacted regarding a proposal submission, it is not necessary to request information regarding additional submissions. Separate notifications are provided for each proposal.

It is anticipated all the proposals will be evaluated and selections finalized within approximately 90 calendar days of solicitation close. Please refrain from contacting the BAA Contracting Officer for proposal status before that time.

PHASE II PROPOSAL SUBMISSIONS

AF organizations may request Phase II proposals while technical performance is on-going. This decision will be based on the contractor's technical progress, as determined by an AF TPOC's review using the DoD 21.2 SBIR BAA Section 8.0 Phase I review criteria. All Phase I awardees will be provided an opportunity to submit a Phase II proposal unless the Phase I purchase order has been terminated for default or due to non-performance by the Phase I company.

NOTE: Air Force primarily awards Phase I and II contracts as Firm Fixed Price. However, Phase II awardees are strongly urged to work toward a Defense Contract Audit Agency (DCAA) approved accounting system. If the company intends to continue work with the DoD, an approved accounting system will allow for competition in a broader array of acquisition opportunities. Please address questions to the Phase II Contracting Officer, if selected for award.

All proposals must be submitted electronically at https://www.dodsbirsttr.mil/submissions/login by the date indicated in the Phase II request for proposal. Note: Only ONE Phase II proposal may be submitted for each Phase I award.

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 21.2 SBIR Phase I Topic Index

AF212-0001	Man-Packable NAV-AID
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AF212-0012	Rocket Landing on Irregular Surfaces
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AF212-0014	Simultaneous Harvesting of Incoming Solar and Outgoing Thermal Radiation in a Space Environment
AF212-0015	Meta-lens Filtering and Beam Forming for Mid-Wave and Long-Wave Infrared LEDs and Photodiodes

AF212-0001 Man-Packable NAV-AID

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics; Battlespace

OBJECTIVE: Develop a two man-packable, man-portable, air-deliverable (parachute), covert tactical aircraft navigational aid system. RF emissions should be very low, designed to be Low Probability of Intercept/ Low Probability of Detection (LPI/LPD). The solution should be lighter and smaller than an airfield mobile Tactical Air Navigation (TACAN) AN/TRN-47v2. The proposed solution should provide the user with bearing and distance (slant-range) to a ground or ship-borne station at a range of at least 20 nm. The Navigation Aid should be capable of meeting Instrument Flight Rules (IFR) certification standards similar to existing portable TACANs.

DESCRIPTION: The desired near-covert Navigational System should provide the user with bearing and distance (slant-range) to a ground or ship-borne beacon at a range of at least 20 nm from altitudes up to 30,000', performing similar to VHF Omni-Directional Range/Distance Measuring Equipment (VOR/DME). Units should be lighter and smaller than the current MM-7000 MP TACAN (Moog Industries) for harsh environments. The system should be capable of tracking up to 50 airborne targets concurrently. The ability to track ground personnel and vehicular traffic at close range would also be beneficial. The proposed solution should be capable of being Instrument Flight Rules (IFR) certifiable per Federal Aviation Administration (FAA) guidelines and standards (ref. AC 00-31A). The system must provide an all-weather non-precision navigational aid for use at remote landing sites, assault landing zones, and unprepared or dissuaded runways. The system should enable rapid setup and tear-down by a two-man team to keep pace with the maneuver elements, yet provide the same accuracy as a TACAN AN/TRN-47v2 or MM-7000MP TACAN. The system should include an on-demand mode where it will only transmit when interrogated by an aircraft on-channel.

The proposed solution must be interoperable with all models of current TACAN/VOR/DME receivers already installed on US Military aircraft and interface with those receiver controls. The covert Navigational Aide should be able to be powered in the man-packable configuration by 5590 B/U 12V/24V 15Ah Primary Lithium Sulfur Dioxide (LiSO2) Dual-Voltage Military radio batteries (multiple batteries is permissible). It should also have the option of being powered by a small generator when in-place for longer durations.

The system must be hardened and packaged to withstand parachute operations when loaded in an individual soldier's rucksack on a lowering line below him and hitting the ground first. Utilizing a para-container for the system is not preferred; however, if Size Weight and Power (SWAP) requirements would require a large para-container, that would be considered. The design should be able to be assembled and brought into service by a two-man crew within 15 minutes. The system must meet all applicable TACAN Standards; STANAG 5034, MIL-HDBK-217, MIL-STD-461-F, MIL-STD-291C, MIL-STD-810G, ICAO Annex 10.

PHASE I: Establish feasibility of the proposed solution. Perform sufficient modeling and experimentation to determine high risk components are attainable. Perform tradeoffs to establish a preliminary design leading up to Phase II. Define a Phase II program plan. Identify potential transition partners. Provide a thorough understanding of the solution to the Government to enable a timely Phase II decision.

PHASE II: Finalize design of a demonstration prototype. Procure, develop, and integrate the solution prototype. Plan and coordinate one or more demonstrations to provide proof of concept determination. Perform experiments and analyze results to establish the adequacy of the solution approach and minimize transition risk. Contact potential customers and transition partners to support Phase III activities. Provide regular communication to the government sponsor to ensure understanding and risk mitigation.

PHASE III DUAL USE APPLICATIONS: Demonstrate this prototype Man-Portable Aircraft Navigation Aid.

NOTE: 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 proposed 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 questions to the Air Force SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

REFERENCES:

1. Department of Transportation and Department of Defense (March 25, 2002). "2001 Federal Radionavigation Plan" (PDF).
2. “GRAVITY GRADIOMETRY AND MAP MATCHING: AN AID TO AIRCRAFT INERTIAL NAVIGATION SYSTEMS”, USAF AFIT Thesis, Maj. Anthony DeGregooria
3. “AC 00-31A - United States (U.S.) National Aviation Standard for the Very High Frequency Omnidirectional Radio Range (VOR)/Distance Measuring Equipment (DME)/Tactical Air Navigation (TACAN) Systems”, 30 Sep. 1982 4. 9840.1 - U.S. National Aviation Handbook for the VOR/DME/TACAN Systems

AF212-0002 Artificial Intelligence Tool for Background Database Generation

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Space Platform; Air Platform; Battlespace

OBJECTIVE: Scene Generation tools are used to create synthetic image data representative of what a sensor on a weapon system would measure. Creating synthetic data is limited by lack of available models or lack of measured databases to capture the radiometric characteristics of the scene required. The objective of this topic is to develop a robust capability to approximate backgrounds at the resolution required in closed-loop simulations using a combination of geo-spatial information, required time of day and year, measured databases and trained artificial intelligence algorithms for image feature identification and construction.

DESCRIPTION: Scene generation tools provide in-band models of sensor output and input to simulators, allowing for the research and development of new weapon systems. These tools drive scene projectors during hardware-in-the-loop testing and provide synthetic output for software-in-the-loop testing and algorithm development for new sensor concepts. Scientists developing new munition seeker concepts and those responsible for executing test programs are limited to a small subset of geographic locations and environmental conditions. An example would be the limited ability to capture the scene changes due to weather, time of year, and time of day.

Another issue is the ability to create data at the resolution of a weapon seeker that is rapidly approaching the ground; the databases currently used are at a fixed resolution, which may be significantly courser than the seeker resolution. This intent of this topic is to establish an automated process that can generate an approximation of scene background data using topographical maps, transportation maps, maps of watershed features, knowledge of area vegetation, geographic features, weather and timeframe. All data available, including data from the public domain such a google earth should be considered. Real-data from high resolution assets should be used as a part of the scene construction process when appropriate to establish realism and to train the system in the sense of Deep Learning.

The goal is to create a capability that is global and multi-spectral, representing a user specified sensor waveband. The capability must be repeatable to allow duplication to the extent possible of test results. While the capability might be used in part as a preprocessor, the final stage must operate as a plug in to standard scene generation tools, such as FLITES, in order to integrate into the scene targets, people, moving vehicles, or other objects and perform the final radiometric discretization and image modeling.

PHASE I: Perform a preliminary demonstration creating background data from commonly available resources and knowledge of a given geographic region. The demonstration should provide the feasibility of a range of resolutions characteristic of a sensor moving from high-altitude to the ground. Narrowing scope to an IR band is acceptable to provide a proof of concept. A plan for Phase II development, and the role of artificial intelligence in that process, shall be established. Limitations of the planned capability shall be documented.

PHASE II: Finalize design of a demonstration prototype. Develop, integrate, and train the solution prototype. Establish and document relevant use-cases. Plan and coordinate one or more demonstrations to provide proof of concept determination. Perform experiments and analyze results to establish the adequacy of the solution approach and minimize transition risk. Contact potential customers and transition partners to support Phase III activities. Provide regular communication to the government sponsor to ensure understanding and risk mitigation. Deliver a prototype to AFRL/RWWG compatible with the FLITES simulation tool.

PHASE III DUAL USE APPLICATIONS: Add additional classified data sources and work with multiple end-users to provide additional specific capabilities required.

NOTE: 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 proposed 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 questions to the Air Force SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

REFERENCES:
1. Crow, Dennis & Coker, Charles & Keen, Wayne. (2006), “Fast Line-of-Sight Imagery for Target and Exhaust-plume Signatures (FLITES) scene generation program,” art. no. 62080J, Proceedings of SPIE, 10.1117/12.669306
2. Savage, James & Coker, Charles & Thai, Bea & Aboutalib, Omar & Pau, John. (2007), “Irma 5.2 multi-sensor signature prediction model,” Proc SPIE, 6965, 10.1117/12.778000
3. Bruce A. Wilcoxen and Harry M. Heckathorn "Synthetic scene generation model (SSGM R7.0)", Proc. SPIE 2742, Targets and Backgrounds: Characterization and Representation II,” (17 June 1996); 10.1117/12.243028 4. Jeevan Devaranjan, Amlan Kar, Sanja Fidler, “Meta-Sim2: Unsupervised Learning of Scene Structure for Synthetic Data Generation,” arXiv

KEYWORDS: FLITES; synthetic scene generation; hardware-in-the-loop; simulation; munitions; sensor; seeker

AF212-0003 Advances in Infrared Target Scene Projection for Munition Testing

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics; Battlespace

OBJECTIVE: Scene projectors are used in military test facilities to provide stimulus to seekers/sensors used by flight control and surveillance systems. The objective of this topic is to advance scene projection capabilities within government test facilities to achieve necessary accuracy and compatibility relative to advances in sensor technology requirements.

DESCRIPTION: Current scene projection technologies, e.g., resistor arrays, infrared LEDs, and liquid crystal arrays, have significant limitations. Resistor arrays are limited in temperature achievable and manufacturability in large formats, LED arrays have yet to be demonstrated with adequate efficiency and calibration characteristics, and liquid crystal arrays have been prone to degradation and lack of image quality. TI DMD’s have also been used successfully in many applications, but there are inherent diffraction limits at longer wavelengths. Sensor technology is significantly outpacing projector technology in terms of pixel format and framerate, to the point that full field-of-view projector solutions may never catch up. In the future, hybrid scene injection/projection solutions or pure scene injection solutions may become necessary that are very application specific. Even then, high-quality IR projectors will still be required, but they will be used in either unconventional ways or primarily as a means of validating a scene injection sensor model. Alternative solutions are sought that effectively mitigate the limitations of current technology. Solutions that improve the efficiency of emitters, thermal management solutions that maintain a stable predictable pixel temperature, and calibration methods that achieve requisite calibration accuracy are of interest. Technologies that are realizable, cost-effectively, over a range of wavebands are desired. Infrared scene projection systems typically include analog interface electronics, digital control systems, and real-time scene generation computers. Advancement of projection technology also requires advancement of the associated system components. Solutions that advance or leverage existing proven capabilities to achieve robust solutions compatible with leading edge Air Force system requirements are desired. The result of the proposed effort should be a product with a direct transition path to multiple end use applications or facilities. The solutions prototyped and provided are expected to be compatible with typical use cases associated with munition hardware-in-the-loop testing. If a projector technology is proposed, there should not be outstanding characteristics that would limit use on the target gimbal of a flight motion simulator or in configurations necessary for multi-mode or multi-band scene simulation. It is also desired that the technology be compatible with cryogenic space simulation chamber implementations. If an enabling control system or scene generation solution is proposed, they should be modular and readily upgradeable to enhance longevity and flexibility. Projector technologies proposed should be targeted for 2048 x 2048 at 200 Hz, with an NEDT of approximately 50 mK at ambient conditions.

PHASE I: Establish feasibility of the proposed solution. Perform sufficient modeling and experimentation to determine that high-risk components are attainable. Perform tradeoffs to establish a preliminary design leading for Phase II. Define a Phase II program plan. Identify and document endorsement from potential transition partners. Provide a thorough understanding of the solution to government in time to make a Phase II decision.

PHASE II: Finalize design of a demonstration prototype. Procure, develop, and integrate the solution prototype. Plan and coordinate one or more demonstrations to provide proof of concept determination. Perform experiments and analyze results to establish the adequacy of the solution approach and minimize transition risk. Contact potential customers and establish a transition plan with partners supporting Phase

III activities. Provide regular communication to the government sponsor to ensure understanding and risk mitigation.

PHASE III DUAL USE APPLICATIONS: Demonstrate an integrated scene projection system for a specific application, including a functional projector control system and image generation capability.

NOTE: 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 proposed 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 questions to the Air Force SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

REFERENCES:
1. Greg Franks, Joe Laveigne, et al., “Development of an Ultra-High Temperature Infrared Scene Projector at Santa Barbara Infrared Inc.,” proc. SPIE 9452, 94520Wv (2015).
2. Rodney McGee, Fouad Kiamilev, et al., “512x512, 100Hz Mid-wave Infrared LED Scene Projector,” GOMAC Tech Conference, P-50 (2015)
3. https://www.photonics.com/Articles/Infrared_Scene_Projection_Virtual_Reality_for_IR/a29074
4. Beasley, D., Matt Bender, J. Crosby, T. Messer and D. Saylor. “Dynamic IR scene projector based upon the digital micromirror device.” SPIE Defense + Commercial Sensing (2001)

KEYWORDS: Resistor Array; IRLED; Infrared LED; DMD; Hardware-in-the-Loop; HWIL; Seeker; Sensor

AF212-0004 Thermal Management of V-band Transmit Arrays

TECH FOCUS AREAS: Network Command, Control and Communications; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Space Platform

OBJECTIVE: Develop and demonstrate thermal management techniques for a V-band multi-element transmit subarray. The developed subarray should address wafer-scale antennas and front-end components for high-power SATCOM downlinks.

DESCRIPTION: Future military SATCOM concepts include V-band (71-76 GHz) downlinks and W-band (81-86 GHz) uplinks to support next-generation high-data-rate communications systems. While single-point RF power sources with gimbaled antennas address a potential V-band transmitter architecture, phased array architectures are also viable for these satellite communications concepts. Currently demonstrated array front-end components at V-band have relatively low output power. As higher transmit array power is demonstrated utilizing high-power density, high-power dissipation power transistor technologies and within the size constraints of array elements, greater thermal management challenges result. This Phase I SBIR focuses on the definition of a thermal management approach for an overall V-band downlink transmit array architecture, as well as the wafer-scale antennas and front-end components for a Phase II proof-of-concept multi-element demonstration vehicle. At a minimum, the array components/functions should include power amplification and beam steering. Due to high atmospheric attenuation at these frequencies, EIRP >75 dBW and per element power output >400 mW should be considered for the full transmit array architecture. Operating environment goals include a temperature range of -40 degrees to +85 degrees Celsius.

PHASE I: Conduct a feasibility study to determine thermal management and V-band phased array architecture definition, including the definition of the multi-element demonstration vehicle for Phase II.

PHASE II: Development of the thermally-managed wafer-scale antenna and front-end components in a multi-element V-band transmit subarray demonstrator.

PHASE III DUAL USE APPLICATIONS: Military millimeter-wave phased array applications include V-band satellite communications downlink electronics for future high-data-rate communications systems. Commercial: Commercial V-band phased array applications potentially include commercial satellite communications services. Technologies under this effort will further benefit applications in nearby frequency bands.

NOTE: 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 proposed 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 questions to the Air Force SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

REFERENCES:

1. S. Zihir, et al., A 60 GHz 64-element Phased-Array Beam-Pointing Communication System for 5G 100 Meter Links up to 2 Gbps, 2016 IEEE MTT-S International Microwave Symposium.
2. K. Tsukashima, et al., An E-band 1 W-class PHEMT Power Amplifier MMIC, Microwave Integrated Circuits Conference Digest, 2015 10th European Microwave Integrated Circuits Conference.
3. A. Brown, et al., High Power, High Efficiency E-Band GaN Amplifier MMICs, Wireless Information and Systems Digest, 2012 IEEE International Conference on Wireless Information Technology and Systems.
4. S. Shahramian ; M. J. Holyoak ; Yves Baeyens, A 16-Element W-Band Phased-Array Transceiver Chipset With Flip-Chip PCB Integrated Antennas for Multi-Gigabit Wireless Data Links, IEEE Transactions on Microwave Theory and Techniques, 2018.

KEYWORDS: E-band; V-band; phased arrays; thermal management; satellite communications

AF212-0005 Munition Development for Petroleum, Oil, and Lubricant (POL) Targets

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Ground Sea; Battlespace

OBJECTIVE: Develop an ordnance concept for the catastrophic defeat of Petroleum, Oil and Lubricant (POL) targets.

DESCRIPTION: The goal is to catastrophically defeat large petroleum, oil, and lubricant (POL) targets with small weapons by exploiting the flammability of the POL (References 1-3). Ideally, a single weapon would perform two events -- spill the fuel and ignite the fuel. Fire starting in POL targets is challenging for two reasons: (a) the time to spill and start a fire is quite long relative to the duration of a typical explosive event; and (b) POL fuels are fire resistant (i.e., low vapor pressures, narrow flammability limits) for safety reasons, and are difficult to ignite. A two weapon concept (i.e., strike and restrike) would be acceptable, but a single weapon concept is greatly preferred. The contractor should develop an air-delivered weapon concept that is robust against a wide variety of fuel types – including commercial fuels (e.g., diesel fuel) and military fuels (e.g., JP-8). The weapon concept should not be solely applicable to POL targets; it should also functions as a general-purpose bomb against blast-frag susceptible targets.

PHASE I: The contractor will develop a weapon concept and modeling capabilities for weapon initiation and target response. Small-scale testing is encouraged to (a) demonstrate proof-of-concept (feasibility), (b) validate the models, and (c) demonstrate fabrication and manufacturing techniques. Failure to start a fire in these tests is not disqualifying; their primary purpose is to identify critical issues early in the program and to show the contractor's capability to execute the Phase II program.

PHASE II: In Phase II, the contractor will refine the designs, develop additional modeling capability as needed, develop larger scale warhead prototypes, and demonstrate fire starting capability in a mid-scale tests (e.g., a 55-gallon drum). Targets of interest are commercial and military fuels.

PHASE III DUAL USE APPLICATIONS: In Phase III, the contractor will develop a full-scale prototype, and characterize weapon performance and effectiveness in large-scale arena tests. The contractor will also deliver an engineering-level code that simulates performance against POL targets.

NOTE: 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 proposed 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 questions to the Air Force SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

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3. Harry Foster et al., Toward a New Targeting Approach for Great Power Competition, http://dtlweb.au.af.mil/webclient/StreamGate?folder_id=0&dvs=1614175389650~131

KEYWORDS: warhead; weapon; combustion; explosive; petroleum; oil; lubricant; POL; flammable; fire

AF212-0006 W-Band Anti-Jam Receiver

TECH FOCUS AREAS: Network Command, Control and Communications

TECHNOLOGY AREAS: Sensors; Electronics; Space Platform; Information Systems

OBJECTIVE: Develop anti-jam receiver operating from 81 to 86 GHz suitable for future wideband satellite
communications (SATCOM) satellite applications.

DESCRIPTION: Expanding the availability of battlefield information for better situational awareness to the warfighter will require increased satellite communications (SATCOM) capacity. Due to the present frequency allocation restrictions in existing SATCOM bands, there is a continually increasing need to exploit frequency spectrum available in nontraditional bands such as 81 to 86 GHz for uplinks and 71 to 76 GHz for downlinks.

In order to access this spectrum, a new generation of transmitter and receiver microelectronics, will be required. The Air Force is interested in sponsoring research to develop anti-jamming 81 to 86 GHz block down converter receiver. Would support multiple high data rate channels using advanced signal modulation waveforms. Develop a low noise block down converter receiver with high dynamic range and high resistance to interfering signals. Investigate filtering or other techniques for Jammer mitigation. Demonstrate low noise, high linearity and Conversion gain to significantly improve the overall sensitivity of receiver.

PHASE I: Develop innovative 81-86 GHz block down converter receiver designs that are resistant to jamming. Validate design feasibility through modeling and simulation.

PHASE II: Fabricate one or more prototypes and characterize performance in areas of jamming resistance, NF, gain, bandwidth, operating frequency, and operating temperature range.

PHASE III DUAL USE APPLICATIONS: Next generation of Wideband High data rate satellite communications. Commercial applications include high speed wireless communications for backhaul for 5G and internet.

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1. C. Hofmann, A. Knopp, "Satellite Downlink Jamming Propagation Measurements at Ku-Band," 2018 IEEE MILCOM.
2. W. Ciccognani, et al., "Millimeter Wave Low Noise Amplifier for Satellite and Radio-astronomy Applications," 2012 IEEE First AESS European Conference on Satellite Telecommunications, Oct. 2012.

3. X.B. Mei, et al., "A W-band InGaAs/InAlAs/InP HEMT Low-Noise Amplifier MMIC with 2.5 dB Noise Figure and 19.4 dB Gain at 94GHz," 20th International Conference on Indium Phosphide and Related Materials, IPRM Digest, May 2008.
4. K.Y. Lin, et al., "W-Band InP Based HEMT MMIC Low Noise Amplifiers," JPL Technical Report Server, Nov. 2002

KEYWORDS: jammer; low noise amplifier; W-band; noise figure; satellite communications

AF212-0007 Algorithms for MIMO Techniques to Enable a Coherent Distributed Array from Multiple Airborne Platforms

TECH FOCUS AREAS: Microelectronics; Autonomy; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics; Air Platform; Battlespace

OBJECTIVE: Develop a set of algorithms to use sub-wavelength time and phase synchronization to increase performance of multiple, cooperating airborne sensors for multi-function RF applications.

DESCRIPTION: The ability to use Precision Navigation and Timing (PNT) on the order of picosecond and nanosecond accuracy can provide the needed phase synchronization to enable multiple airborne platforms to achieve phase coherence on receive and transmit. This phase coherence theoretically enables a constellation of UASs to perform as a large distributed aperture and provide performance gains to radar, jamming, and communications which have been up to this point unattainable. There are many efforts to provide the hardware architecture to enable the synchronization of time and phase across multiple channels and platforms. This effort will concentrate on developing the algorithms and methods necessary to process both the transmitted and received pulses of multiple platforms and aggregate them into a single radar detection or jamming waveform at the target location. After the algorithms are developed, a simulation that considers the sensitivity of algorithm performance due to both timing errors that can be modeled as a statistical mean and standard deviation of the clock delay and errors from an onboard INS/IMU that will provide position and velocity estimates of each source. Finally, the model should be improved to consider the traditional errors in a radar system that may include but are not limited to possible clutter effects, radar noise, and any propagation effects.

PHASE I: Demonstrate and model algorithms to prove the feasibility of using phase coherence to establish increased detection or jamming performance at a single STATIONARY point target from multiple platforms in flight.

PHASE II: Demonstrate and model algorithms that can use phase coherence to establish increased detection or jamming performance at multiple STATIONARY point target from multiple platforms in flight.

PHASE III DUAL USE APPLICATIONS: Demonstrate and model algorithms that can use phase coherence to establish increased detection or jamming performance at multiple MOVING point targets from multiple platforms in flight.

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KEYWORDS: MIMO; Cohere on Receive; Cohere on Transmit; Distributed Apertures; Distributed Coherent Array; Cooperative Radar; Cooperative Electronic Attack

AF212-0008 Next Generation Weapons Mission Planning

TECH FOCUS AREAS: AI/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Information Systems; Air Platform; Battlespace

OBJECTIVE: Demonstrate next generation Weapons Mission Planning software working in the Next-Generation Open Mission Systems (NOMS) architecture.

DESCRIPTION: Today's aircrews face increasingly complex and capable threat systems. Next generation weapons and tactics are in development to overcome and defeat these threats. These highly sophisticated systems of systems require large quantities of data seamlessly coordinated across multiple platforms at different classification levels. Due to this, workloads are placed on the planners that are orders of magnitude greater than past weapon systems, yet the planners have less time than ever to complete the work. To overcome these challenges; new mission planning capabilities with seamless data sharing, automated processes, and artificial Intelligence must be deployed faster than our adversaries can adapt to them.
Currently, the majority of the Air Force uses the Joint Mission Planning System (JMPS) to plan their flights. JMPS enables mission planners to create a flight plan based on multiple inputs including threats, targets, terrain, weather, aircraft performance capability and configuration. JMPS has been in the field for nearly 20 years, and is becoming increasingly outdated. The antiquated software architecture results in less than ideal planning times. To prepare for the future, the Air Force and Navy are jointly developing a next generation software architecture called Next-generation Open Mission Systems (NOMS). NOMS is a cloud-based architecture, in which Mission Planning software capabilities will be developed and fielded as microservices. As the Air Force transitions to this new architecture, the Mission Planning Program Office is seeking innovative solutions to improve weapons planning in NOMS. Areas include:

•Development of core weapons planning capabilities in microservices architecture to decouple dependencies of Mission Planning features resulting in a more robust and reliable planning experience that can be quickly updated when required
•Integrating machine learning and artificial intelligence to weapons delivery and threat avoidance, continuously improving and enhancing the planning workflow allowing for faster, more efficient, and better results
•Increasing process automation to eliminate manual weapons planning where possible in order to decrease planning times while improving quality of results
•Development of a next generation fly-out model (FOM) service enabling multiple planning microservices to share common weapon models in order to provide a common interface and architecture that enables quick and easy extension for new weapons
•Enhancing weapons planning user experience, including workflows and user interface improvements to provide intuitive and easy to use Mission Planning tools
•Seamless integration of weapon delivery planning, modeling and simulation, and weaponeering to include collateral damage assessment in order to provide greater fidelity and success rates when preparing a strike mission
•Develop tools to provide communication line of sight (LOS) analysis for network enabled weapons (NEW) ensuring controllers can communicate with the weapons when required throughout a mission
•Augmented reality/virtual reality (AR/VR) implementation for weapons planning to provide planners increased visibility for complex integrated 4D strike package planning
•Enhanced seamless cloud services linking target, weather, threat and other essential mission data from multiple sources to facilitate automated weapon planning processes

PHASE I: Investigate feasibility of one or multiple topic areas and provide innovative ideas to efficiently improve Mission Planning execution. The Phase I effort should also conclude with a sound understanding of the architectural approach required for development.

PHASE II: Phase I study will be leveraged to develop prototype software that can be integrated into the NOMS architecture providing enhanced weapons planning capability. The software should accomplish one or multiple goals that are addressed in the topic areas and be stable enough to show basic functionality.

PHASE III DUAL USE APPLICATIONS: Phase II prototype will be refined and developed into fully working, robust software. Phase III will also look to include additional functionality not present in the Phase II prototype.

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3. https://blog.sqreen.com/secdevops/

KEYWORDS: Mission Planning; Artificial Intelligence; Machine Learning; Automation; Weapons; Virtual Reality; Augmented Reality; cloud; microservices; weaponeering

AF212-0009 Design Tool for Multiple Electromagnetic Radome Problems

TECH FOCUS AREAS: Microelectronics; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Materials; Information Systems

OBJECTIVE: Develop a software tool for designing next generation military radomes that accounts for all aspects of the radome performance.

DESCRIPTION: Modern military radomes have many electromagnetic requirements. A holistic approach must be taken when designing radomes to meet the various performance requirements. The transmissivity and reflectivity of the radome is impacted by the materials used in the radome including frequency dependent, anisotropic, and metamaterials. Very thin coatings of anti-static material are often applied to the exterior surfaces of radomes to bleed off static electricity. Lightning diverter strips are used to protect the radome structure from physical damage due to lightning strikes, which are especially common for nosecone radomes. Structures behind the radome such antenna arrays, electronic units, cable harnesses, and bulkhead geometries must also be considered. Reflections internal to the radome from high power radars can couple into cable harnesses under the radome and cause interference to electronic devices or cause physical damage to the cables. Current commercial simulation tools address aspects of the radome design problem but no single tool exists that can be used to assess the performance of the radome with regards to transmissivity/reflectivity, precipitation static, direct and indirect effects of lightning strikes, and cable coupling. A solution is needed that can address the vast scale of the problem (ranging from nanometers to meters), complex material properties including frequency dependent and anisotropic materials, tapered layer thicknesses, complex cable harnesses composed of multiple conductors and multiple branches, and complex antennas/radars located behind the radome. The simulation tool also needs to be able to efficiently generate data for many frequencies as the phenomena to be studied cover a wide range of frequencies (lightning to high frequency radars). The tool must also be able to work with many different CAD formats and include capabilities for efficiently healing CAD models. Very often, CAD healing requires more engineering time than setting up and running the electromagnetic simulation.

PHASE I: Demonstrate a simulation tool that is capable of simulating lightning strikes, precipitation static, cable coupling, and transmissivity/reflectivity of a complex radome structure. The tool should employ the same simulation framework and CAD model for all types of simulations performed. Develop a product roadmap for additional features to improve the accuracy, speed, and usability of the tool to be implemented during the Phase II.

PHASE II: Implement the product roadmap features identified during the Phase I. Validate the performance of the simulation tool through comparisons with measured data collected for military radomes. Explore hybridization with other simulation tools to account for radome/platform interactions. Document the software design and validation results in a final report. Provide intensive training to Air Force personnel for the simulation tool.

PHASE III DUAL USE APPLICATIONS: Radomes are used for many commercial applications including aerospace, naval, and land applications. For example, the performance of autonomous radars for self-driving vehicles is an extremely important application area where such a tool would find widespread commercial application.

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KEYWORDS: radome; lightning; precipitation static; cable harness

AF212-0010 Innovative Engines for Small Unmanned Aerial Systems (SUAS)

TECH FOCUS AREAS: Autonomy

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: This topic is for innovative propulsion for SUAS (Group 2 thru small Group 4 UAS) that supports Global ISR missions such as: long range – persistent ISR, air launch – extended reach ISR, and time critical – responsive ISR. The topic shall address how innovative propulsion will allow for improved UAS capabilities, the use of UAS in mass, and consider air launch and performance at altitude (25,000 ft AGL). Objective: A concept design for innovative propulsion of GR2 (2 to 7 hp), GR 3 UAS (10 to 100 hp), and small GR 4 UAS (500 to 700hp). Small engines are defined as less than 1000 lbs thrust and under 1000 HP.

DESCRIPTION: To keep ahead of the changing global environment, improved capabilities for UAS systems for Global ISR are needed. The USAF 2030 Science and Technology Strategy seeks to: Develop and Deliver Transformational Strategic Capabilities: thru Global Persistent Awareness and Complexity, Unpredictability, and Mass. This objective can be achieved thru increased capabilities from SUAS with improved propulsion. Present day GR2 thru GR4 propulsion systems are slow, noisy, inefficient, and lose performance at altitude. These SUAS use piston and rotary engines which are gasoline operated and have limited life of approximately 200 hours and fly at 100 knots or less. Piston engines in this class have low thermal efficiencies, less than 20% and low specific power of approximately 0.5 hp/lb. What is needed is innovation in the UAS propulsion for quiet operation, performance at altitude, light weight, improved efficiency, and high power to weight.

PHASE I: The proposals should expand the technical enterprise upon teaming with “non-traditional experts” for propulsion innovations for GR 2 SUAS (less than 50 lbs GTOW), GR3 SUAS (less than 1350 lbs. GTOW), and GR4 UAS (less than 5000lbs). Non-traditional experts are those of authority/study that are outside of the UAS community/industry, but have novel concepts to meet the future S&T demands. Concepts in innovative propulsion are sought which include: internal combustion, detonation, and nuclear; which are more efficient, have higher specific power and more durable. The concept shall demonstrate the feasibility of the design, development and integration activities required for an operational SUAS. Small Propulsion are engines less than 1000 HP/1000 lbs thrust. Key design attributes are; Specific Power > 1.0 HP/lb; SFC < 0.5 lbs/hp-hr; and +500 hr life.

PHASE II: Builds off of the PH I effort and consists of the development of a prototype and takes the prototype to a ground test to demonstrate its power, efficiency, acoustics and durability. This phase shall have a design review prior to fabrication and identify risks with risk reduction tests completed before the final engine demonstration. Further, teaming with operational users should be established to show how the new UAS capabilities will improve Global ISR thru improved SUAS propulsion.

PHASE III DUAL USE APPLICATIONS: Integrate the innovative engine to a candidate UAS for flight testing. The innovative engine can be developed for commercial application for aviation, marine, and land-based power generation; hence being dual use in nature.

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2. Internal Combustion Engines: Applied Thermosciences by Colin Ferguson and Allan Kirkpatrick; ISBN: 978-1118926529; Wiley 2015.

3. Small Internal Combustion Engine Testing for Hybrid Electric RPA by Isseyas Mengistu; ISBN 978-1249599838; BiolioScholar.

KEYWORDS: Internal Combustion Engine; Combustion Strategies; specific power; variable cycle; hybrid propulsion; efficiency; thermal efficiency

AF212-0011 ASCENT Based Thruster Component and System Characterization and Optimization for Lifetime Extension

TECH FOCUS AREAS: Network Command, Control and Communications

TECHNOLOGY AREAS: Space Platform

OBJECTIVE: Mature advanced spacecraft energetic non-toxic (ASCENT), formerly referred to as AF-M315E, technology to meet or exceed the performance of state of the art chemical propulsion systems for air and space platforms requiring thrust levels from 1 N through 44.5 kN.

DESCRIPTION: The intent of this topic is to accelerate the proliferation of ASCENT monopropellant technology to be available to meet present and emerging mission needs. Current state of the art chemical propulsion for spacecraft, kick and upper stage platform applications rely upon extremely hazardous and sensitive propulsion technologies such as hypergolic or cryogenic bipropellants, granular catalytic reactors in the case of monopropellants, or sensitive solid rocket motors. ASCENT monopropellant provides a significant reduction in operational hazards due to its reduced vapor pressure contact hazard relative to hypergols, and electrostatic discharge sensitivity. Areas of technology maturation of interest are:

• Reactor or ignition approaches that reduce environmental control needs such as pre-heat and have flexibility to scale across the thrust levels of interest
• Reactor or ignition approaches that mitigate duty cycle and life limiting attrition mechanisms
• Long term compatibility and consistent operability of storage, feed, and flow control components for extended mission life applications
• Characterization and understanding of the impact of aging and extended exposure to state of the art propulsion component materials to ASCENT hazard and delivered performance
• Modeling and simulation tools capturing component behavior with ASCENT, reactive and non-reactive flow models, optimized catalytic or energy deposition ignition device characteristics such as pore size and density, dominant decomposition and combustion reaction paths to support design of increased life and thrust delivery
• Diagnostic approaches that support delivered performance and thruster state of health assessment that can provide accurate information from the high temperature and oxidation environment ASCENT produces under decomposition and combustion
• Thermal management approaches to decrease required pre-heat power for a given reactor configuration and propellant feed line stand-off distances in propulsion systems.

In regards to component optimization and long term compatibility, responsive manufacturing methods such as those that fall under additive manufacture techniques or coatings to impart desired characteristics are also of interest. Igniter or reactor configurations of interest are not limited to state of the art structure and composition. Approaches to maturation should include sufficient engineering analyses to provide confidence of feasibility and pathway to flight qualification. Supporting analyses should also consider limitations in the physical architecture so that the approach could satisfy current state of the art mission duty cycles and life as defined by propellant throughput associated with required delivered impulse across the thrust range of 1 N through 44.5 kN.

PHASE I: Demonstrate at minimum empirically via bench level heavyweight configuration for measured data feasibility of maturation approach for target platform application mission duty cycles and the critical aspects of the physical architecture that drive the requirements. Industrial base considerations should be included in the analysis. Lab bench validation to the extent feasible is also desired.

PHASE II: Demonstrate the viability of the Phase I concept performance and manufacturability of the architecture to a TRL 5/6 level with supporting empirical data and analysis.

PHASE III DUAL USE APPLICATIONS: Transition of Phase II technology to a flight demonstration program. This effort will include all necessary activities for flight qualification as well as support for on-orbit flight demonstration activities.

NOTE: 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 proposed 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 questions to the Air Force SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

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11. Ballinger, A.I., Lay, W.D., and Tam, W.H., "Review and History of PSI Elastomeric Diaphragm Tanks", 31st AIAA Joint Propulsion Conference, San Diego, CA, July10-12, 1995.
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KEYWORDS: ignition; energy; deposition; decomposition; injection; pressurization; catalyst; monopropellant; reaction; sinter; reactor; igniter

AF212-012 Rocket Landing on Irregular Surfaces

TECH FOCUS AREAS: Autonomy; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Space Platform; Air Platform

OBJECTIVE: Both Tactically Responsive Space Access as well as Rocket Cargo have the need to lift-off from and/or land on a non-improved, irregular surface. This could be anything from a parking lot to an irregular farm field. However, little work has been conducted in landing a rocket on flat, improved surfaces, let alone these types of surfaces. This topic seeks to develop strategies that can be used to enable landing on these surfaces as well as mitigations that can be potentially implemented to enable this capability. Mitigations can either be lightweight structures that can be placed on the landing surface or structures, strategies placed on the rocket, nozzle technologies that address the plume impaction, smart landing structures, and landing software.

DESCRIPTION: Although vertically landing a rocket on an improved, flat surface has been achieved by multiple launch vehicle companies (Masten Space, SpaceX, Blue Origin), landing a rocket vehicle on an irregular, unimproved surface has a number of challenges including, but not limited to the rocket sinking in the surface, the plume kicking up dust and creating an observable event, and the uneven footing causing the rocket to fall over. The terrain that the rocket vehicle may land in is also unpredictable and not known a priori. Any solution needs to be broad enough to handle multiple potential landing challenges and to be able to adjust to the situation seen at landing. This topic seeks to address these and other challenges at sub-scale levels in phase I and phase II and transition those technologies to a full-scale vehicle in Phase III.
The intent of this topic is to accelerate the development of technologies to vertically land a rocket on an irregular, un-improved surface. It is recognized that a number of different technologies are possible to achieve the overall objective. This can include (but is not limited to) sensor technology on the lander, nozzle technology to mitigate plume impingement, venting of gases and liquids from the vehicle as it is landing, as well as mitigating ground structures that can easily and quickly be applied to a surface.
It should be noted that it is necessary to balance precision in the landing location, speed of access to vehicle after landing with terrain avoidance, and minimizing potential observability issues such as the creation of dust cloud which can cause damage to nearby structures as well as allow for viewing of the landing site from a distance.

Approaches to maturation to full-scale should include sufficient engineering analyses to provide confidence of feasibility and pathway to feasibility at full scale. Supporting analyses should also consider limitations in the physical architecture of both the sub-scale and the potential full-scale systems.

PHASE I: Perform analysis and/or demonstrations of vertically landing a rocket on an irregular, non-improved surface in order to identify critical technical challenges and explore feasibility of the proposed concept.

PHASE II: Perform sub-scale testing to demonstrate feasibility of vertically landing a sub-scale rocket on an irregular, non-improved surface. Achieve TRL 6 for a sub-scale test article.

PHASE III DUAL USE APPLICATIONS: Transition of Phase II technology to a full-scale demonstration program. This effort will include all necessary activities for flight qualification as well as support for a full-scale test landing on an irregular, non-improved surface.

NOTE: 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

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2. G.P. Sutton & O. Biblarz, Rocket Propulsion Elements, 7th Ed., John Wiley & Sons, Inc., New York, 2001, ISBN 0-471-32642-9.
3. D.K. Huzel & D.H. Huang, Modern Engineering for Design of Liquid-Propellant Rocket Engines, Vol 147, Progress in Astronautics and Aeronautics, Published by AIAA, Washington DC., 1992, ISBN 1-56347-013-6.
4. Yang, V et. al, Liquid Rocket Thrust Chambers: Aspects of Modeling, Analysis, and Design, Vol 200, Progress in Astronautics and Aeronautics, Published by AIAA, Washington DC, 2004, ISBN 1-56347-223-6, pp 403-436.
5. Oberkampf, W.L. & Trucano, T.G. "Verification and Validation in Computational Fluid Dynamics", Vol. 38, Progress in Aerospace Sciences, 2002. Pp. 209-272.

KEYWORDS: liquid rocket engine; vertical landing; plume impingement; high temperature materials

AF212-0013 Mid-IR Satellite Communications

TECH FOCUS AREAS: Directed Energy; Network Command, Control and Communications

TECHNOLOGY AREAS: Space Platform

OBJECTIVE: The goal is to develop a high-speed infrared laser transmitter for ground-to-satellite and satellite-to-ground communications that is highly directional and covert.

DESCRIPTION: Military and often commercial satellites require high-speed ground-to-satellite and satellite-to-ground communications that are also covert. While radio frequencies are often used, they are easily intercepted since beam footprints are large. Thus, additional steps such as strong encryption are required. But even then, an adversary can tell when a transmission is taking place and is free to record the transmission and attempt to decrypt it later. Laser wavelengths offer a satellite communications solution where the beam footprint can be made much smaller thus preventing nearby signal interception. However, visible and near-IR laser wavelengths are undesirable for eye safety reasons. Also scattering of such wavelengths can be easily noticed by the human eye or night-vision type devices severely mitigating the desire to be covert. In contrast, a mid-infrared wavelength has many advantages. First of all, it is an eye-safe wavelength (light is absorbed by ocular media and not focused on the retina). Secondly, it is not detectable by the human eye nor by night-vision devices. And finally, wavelengths near 4 microns have optimum atmospheric transmission, avoiding aerosol scattering at shorter wavelengths and absorption at longer wavelengths. The topic would seek to develop a mid-IR laser transmitter with carrier wavelength of nominally 4 microns, > 1 Gbit/s data rate modulation, M2 5 W. The laser source should be space qualifiable. Beam quality and long-term operation shall be demonstrated as well as long-distance atmospheric transmission.

PHASE I: In Phase I one would design, fabricate and demonstrate a breadboard laser transmitter operating near 4-micron wavelength with modulation or pulse rate of 1 GHz. This would explore the feasibility of novel structural, laser material, and fabrication approaches via proof-of-principle experiments.

PHASE II: In Phase II, fabricate and demonstrate a prototype laser transmitter/receiver system operating near 4-micron wavelength with modulation or pulse rate of 1 GHz and average output power > 5 W.

PHASE III DUAL USE APPLICATIONS: The fundamental nature of AFOSR programs reflect the broad opportunity to commercialize science to both commercial and defense markets. Awardees will have the opportunity to integrate with prospective follow-on transition partners. The contractor will transition the solution to provide expanded mission capability to a broad range of potential Government and civilian users and alternate mission applications.

NOTES: 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 proposed 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 questions to the Air Force SBIR/STTR Contracting Officer, Ms. Kris Croake, kristina.croake@us.af.mil.

REFERENCES:
1. 2018 National Defense Strategy of the United States Summary. Retrieved from: https://www.Defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf

KEYWORDS: Space, IR, communication, satellite, Command and Control

AF212-0014 Simultaneous Harvesting of Incoming Solar and Outgoing Thermal Radiation in a Space Environment

TECH FOCUS AREAS: Network Command, Control and Communications

TECHNOLOGY AREAS: Sensors

OBJECTIVE: The objective of this topic is to develop technologies that enable harvesting of outgoing thermal radiation to generate useful work. Moreover, the incoming sunlight and outgoing thermal radiation typically occupy different spectral wavelength ranges. The sunlight is in the wavelength range spanning from approximately 2 micron to ultraviolet, whereas the thermal radiation is in the longer wavelength range. Therefore, it is conceivable that both solar and thermal radiation can be harvested using the same device in different operation modes, leading to the capability of simultaneous harvesting. Being able to do so could enhance the power generation capability of a spacecraft without increasing its weight.

DESCRIPTION: In a space environment the thermal balance of a spacecraft is dominated by radiations. These radiations include sunlight as well as the thermal radiation. To control the thermal balance of a spacecraft it is therefore of crucial importance to control the solar absorption and the thermal emission properties. Moreover, both the process of the absorption of sunlight and the emission of thermal radiation can be harvested to generate useful work such as electricity. However, while significant work has focused on developing high-efficiency photovoltaic cells for harvesting sunlight, far less work has been devoted to developing device that can harvest the outgoing thermal radiations.

PHASE I: Phase I of the project will explore the feasible device concepts and elucidate the theoretical and practical limits of simultaneous energy harvesting

PHASE II: Phase II of the project will demonstrate a viable scheme for simultaneous harvesting with generated power density exceeding that of a standard photovoltaic cell for the same physical area.

PHASE III DUAL USE APPLICATIONS: The fundamental nature of AFOSR programs reflect the broad opportunity to commercialize science to both commercial and defense markets. Awardees will have the opportunity to integrate with prospective follow-on transition partners. The contractor will transition the solution to provide expanded mission capability to a broad range of potential Government and civilian users and alternate mission applications.

REFERENCES:

1. 2018 National Defense Strategy of the United States Summary. Retrieved from: https://www.Defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf

KEYWORDS: solar; thermal radiation; space; temperature mitigation; power conversion; photovoltaic

AF212-0015 Meta-lens Filtering and Beam Forming for Mid-Wave and Long-Wave Infrared LEDs and Photodiodes

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors

OBJECTIVE: The objective of the topic is to develop meta-lens filtering and beam-forming for LED and PD packaging using novel materials such as chalcogenide as windows materials for patterning into meta-lenses.

DESCRIPTION: Compared to commercial visible optical packaging technology for LEDs and PDs, the mid-IR technology base is decades behind. This is because the transmissive and diffractive lenses and encapsulation materials for visible wavelengths are too absorptive or even opaque at mid-IR wavelengths. The objective of the topic is to develop meta-lens filtering and beam-forming for LED and PD packaging using novel materials such as chalcogenide as windows materials for patterning into meta-lenses. These will require designing and developing layers and structures for converting the Lambertian emission profile of LEDs into suitable narrow beams, estimating the tradeoff between light collection efficiency and beam divergence. Numerous applications are envisioned such as chip-scale on and off communications, bio-sensors, and gas detection of such species as methane and CO2 by band limiting the emission and reducing the opto-mechanical system requirements for optical gas sensing. One could imagine health and safety gas detection for Air Force systems such as wearable sensors for jet fuel vapor detection and other hazards. The beam-forming capabilities should be especially useful for point-to-point free-space communication links in the MWIR. The low-SWAP properties of such LED-PD paired devices for gas sensing lend themselves to needs in unmanned aerial vehicles. The higher-performance emitter configurations would also be useful for high-stability, on-platform calibration references for satellite-borne and other sensors.

PHASE I: A Phase I effort would determine the feasibility of optimizing the novel films and meta-lens geometries and characterize the transmission.

PHASE II: A Phase II project would adapt these meta-lenses to TO and surface mounted packages for LEDs and PD product prototypes, with the goal to design for additional wavelengths.

PHASE III DUAL USE APPLICATIONS: The fundamental nature of AFOSR programs reflect the broad opportunity to commercialize science to both commercial and defense markets. Awardees will have the opportunity to integrate with prospective follow-on transition partners. The contractor will transition the solution to provide expanded mission capability to a broad range of potential Government and civilian users and alternate mission applications.

REFERENCES:

1. 2018 National Defense Strategy of the United States Summary. Retrieved from: https://www.Defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf

KEYWORDS: optics; lens; sensing; space; satellite

AIR FORCE (AF)
21.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2) Proposal Submission Instructions – Amendment 3
11 May 2021

1. The AF 21.2 SBIR D2P2 Instructions as previously amended are hereby further amended as follows:

Trusted AI Pitch Day Topics AF212-D001, D002, D003, D004, and D006 (*titles below*), section entitled "Proposal Preparation and Evaluation", first paragraph, second sentence is changed to read "Proposals under this topic will have a maximum value of **$1,000,000** SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting."

AF212-D001, Transfer Learning of Control Policies Pitch Day for Trusted AI

AF212-D002, Assurance of Trusted AI/ML Systems Pitch Day for Trusted AI

AF212-D003, Applications of AI/ML Pitch Day for Trusted AI

AF212-D004, Explainable Decision-Making Pitch Day for Trusted AI

AF212-D006, Lifecycle Approaches to Transparency in Human-Autonomy Teams (HATs) for Generating Common Ground and Trust Calibration Pitch Day for Trusted AI

NOTE: The maximum SBIR-funded contract value for **Topic AF212-D005**, Behavioral Models, Methods & Metrics for Trust Establishment, Maintenance, and Repair in Human-Machine Co-Training Pitch Day for Trusted AI, was previously changed to $1,000,000 via Amendment 1 to this solicitation.

2. All other content remains unchanged and in full effect.

AIR FORCE (AF)
21.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2) Proposal Submission Instructions – Amendment 2
30 April 2021

1. The AF 21.2 SBIR D2P2 Instructions are hereby amended as follows.

The content of Topic AF212-D001, Transfer Learning of Control Policies Pitch Day for Trusted AI, is hereby deleted in its entirety and replaced with the following:

TITLE: Transfer Learning of Control Policies Pitch Day for Trusted Artificial Intelligence

TECHNOLOGY AREA(S): Transfer Learning of Control Policies

OBJECTIVE: The objective of this topic is to explore the development of transfer learning algorithms where an agent can learn decision-making policies in a fast surrogate environment (e.g., OpenAI Gym) and transfer the learned decision-making policy or information to a target environment (e.g., AFSIM, AWSIM). In particular, the proposed solutions should present some such algorithm and/or the development of transferability metrics by which an operator may determine suitable surrogate environments for a given target environment. The results of this work may be applied to the development of autonomous aircraft as part of a Phase III effort by enabling the adoption of state-of-the-art reinforcement learning and planning solutions. Such solutions have heretofore remained prohibitive due to the existing inefficient military modeling and simulation tools. This may also find applications in the commercial robotics sector, where training decision-making algorithms directly on physical robots is inefficient and thus learning over a surrogate simulation environment and transferring the learned information to the physical robots can improve productivity. This topic addresses challenges in the DoD technology area of Artificial Intelligence and Machine Learning as outlined in the National Defense Strategy and, more specifically, the focus area of Autonomy as listed in the USD (R&E) modernization priorities. This topic will reach companies that can complete a feasibility study and prototype validated concepts in accelerated Phase II schedules. This topic is specifically aimed at later stage development rather than earlier stage basic science and research.

DESCRIPTION: Current simulation environments are too slow for the adoption of state-of-the art machine learning approaches to decision-making, such as those proposed in the areas of reinforcement learning and planning. Recent noteworthy examples include Monte-Carlo Tree Search and actor-critic architectures which have been used to yield superhuman performance in games of precision and perception such as Go and StarCraft 2. These approaches require tens of millions of simulation runs or tens of thousands of years' worth of simulation data. As a point of reference, Air Force simulation environments such as AFSIM and AWSIM or other complex operational environments execute an individual simulation on the order of minutes and hours, respectively. These runtimes preclude the adoption of such data-hungry methods. However, the tremendous success of transfer learning in image classification and, more recently, natural language processing gives us hope that transferring learned information may be feasible from a surrogate fast simulation environment (e.g., PySC2, Lab2D, RAND's AFGYM, etc.) to our existing slow simulators (e.g. AFSIM, AWSIM). This remains an open problem in the aforementioned fields of reinforcement learning and planning. To this end, we seek to develop a transfer learning approach that can transfer decision-making information from a surrogate simulation environment to a target environment. This includes the development of similarity metrics by which a user can determine whether transfer between two environments is feasible or useful. Performance in the surrogate and target simulation environments after transferring learned decision-making information from the former should reflect the similarity metrics developed. That is, low similarity should lead to low or unpredictable performance when transferring from the surrogate to the target. Conversely, high similarity should yield high performance on the target. The performance metric is dependent on the environments chosen and can include things like maximizing a reward signal, yielding explainable actions, or establishing robust control policies, among others. While this motivates the foregoing from an Air Force perspective, prospective performers may choose non-military surrogate and target environments in developing their transfer learning approach and transfer similarity metrics. There is no required use of government materials, equipment data, or facilities.

PHASE I: The Phase I feasibility study should completely document 1) the modeling and transfer learning assumptions made in the proposed solution; 2) the approach to model, quantify and analyze the representation, effectiveness, and efficiency of the transfer learning solution; and 3) the feasibility of developing or simulating a prototype architecture.

PHASE II: Develop, install, integrate and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e,. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.
4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e., supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

PHASE III: The primary goal of SBIR is Phase III. The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential Government and civilian users and alternate mission applications. Direct access with end users and Government customers will be provided with opportunities to receive Phase III awards for providing the Government additional research and development, or direct procurement of products and services developed in coordination with the program.

PROPOSAL PREPARATION AND EVALUATION: Proposals awarded under this topic will include a maximum period of eighteen months, including 15 months technical performance and three months for reporting. The maximum SBIR funded award value will be $1,000,000. Please follow the Air Force-specific Direct to Phase II instructions under the Department of Defense 21.1 SBIR Broad Agency Announcement when preparing proposals.

Phase II proposals will be evaluated using a two-step process. After proposal receipt, an initial evaluation will be conducted IAW the criteria found in the AF-specific Direct to Phase II instructions as previously referenced. Based on the results of that evaluation, Selectable companies will be provided an opportunity to participate in the Air Force Trusted AI Pitch Day, tentatively scheduled for 26-30 July 2021 (virtual). Companies' pitches will be evaluated using the initial proposal evaluation criteria. Selectees will be notified after the event via email. Companies must participate in the pitch event to be considered for award.

REFERENCES:

a. Da Silva, Felipe Leno, and Anna Helena Reali Costa. "A survey on transfer learning for multiagent reinforcement learning systems." Journal of Artificial Intelligence Research 64 (2019): 645-703.
b. Gamrian, Shani, and Yoav Goldberg. "Transfer learning for related reinforcement learning tasks via image-to-image translation." International Conference on Machine Learning. PMLR, 2019.
c. Hanlon, Nicholas, et al. "AFSIM Implementation and Simulation of the Active Target Defense Differential Game." 2018 AIAA Guidance, Navigation, and Control Conference. 2018.

KEYWORDS: Transfer Learning, Planning, Reinforcement Learning, Autonomy, Autonomous Agents, Autonomous Capabilities, Command and Control

TPOC-1: REMOVED

2. All other content remains unchanged and in full effect.

AIR FORCE (AF)
21.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2) Proposal Submission Instructions – Amendment 1
26 April 2021

The AF 21.2 SBIR D2P2 Instructions are hereby amended as follows:

Topic AF212-D005, Behavioral Models, Methods & Metrics for Trust Establishment, Maintenance, and Repair in Human-Machine Co-Training Pitch Day for Trusted AI, the section entitled “Proposal Preparation and Evaluation”, first paragraph, second sentence is changed to read “Proposals under this topic will have a maximum value of **$1,000,000** SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting.”

Topic AF212-D008, Multi Domain Command, Control, Communications and Situational Awareness (MDC3SA) for Nuclear Missile Field Operations, the TPOC, REMOVED, phone number is changed to “REMOVED”.

All other content remains unchanged and in full effect.

AIR FORCE (AF)
21.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2)
Proposal Submission Instructions

AF D2P2 proposal submission instructions are intended to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Firms must ensure proposals meet all requirements of the 21.2 SBIR BAA posted on the DoD SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

For general information related to the AF SBIR/STTR program and these proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us. For questions regarding the DSIP electronic submission, contact the DoD SBIR/STTR Help Desk. at dodsbirsupport@reisystems.com. For technical questions about the topics during the pre-announcement and open period, please reference section 4.13 of the DoD 21.2 SBIR BAA. Complete proposal **must be** submitted via https://www.dodsbirsttr.mil/submissions/ on or before the date published in the DoD 21.2 SBIR BAA**.**

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 events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

All D2P2 proposals must be prepared in and submitted via DSIP, https://www.dodsbirsttr.mil/submissions/. Offerors are responsible for ensuring proposals comply with the requirements in the most current version of this instruction at the proposal submission deadline date/time.

Chart 1: Air Force 21.2 SBIR Direct to Phase II Topic Information at a Glance

Topic Number	Performance Period	Max SBIR Funding	Technical Volume Contents
Trusted AI Pitch Day			
AF212-D001 thru AF212-D006	18 months	$1,000,000	White paper NTE 25 pages/pitch deck NTE 15 slides
Non-Pitch Day D2P2			
AF212-D007	24 months	$750,000	White paper NTE 20 pages
AF212-D008	15 months	$1,250,000	White paper NTE 25 pages
AF212-D009	24 months	$750,000	White paper NTE 50 pages
AF212-D010	24 months	$750,000	White paper NTE 50 pages

The AF recommends early submission, as computer traffic gets heavy near the proposal submission date/time and could slow down the system. **Do not wait until the last minute.** The AF is not responsible for incomplete proposal submission due to system lag or inaccessibility. Please ensure contact information, i.e., names/phone numbers/email addresses, in the proposal is current and accurate. The AF is not responsible for ensuring notifications are received by firms for which this information changes after proposal submission without proper notification. Changes of this nature shall be sent to the Air Force SBIR/STTR site address, usaf.team@afsbirsttr.us.

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 DoD to make a SBIR Phase II award to a small business concern 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. AF is conducting a "Direct to Phase II" implementation of this authority for this 21.2 SBIR topic and does not guarantee D2P2 opportunities will be offered in future solicitation. Each eligible topic requires documentation to determine feasibility described in the Phase I section of the topic has been met.

II. INTRODUCTION:

Direct to Phase II proposals must follow the steps outlined below:

1. Offerors must create a Cover Sheet in DSIP; follow the Cover Sheet instructions in section 5.4.a. Offerors must provide documentation satisfying the Phase I feasibility requirement* to be included in the Phase II proposal. Offerors must demonstrate completion of research and development through means other than the SBIR/STTR Programs to establish the feasibility of the proposed Phase II effort based on the criteria outlined in the topic description.

2. Offerors must submit D2P2 proposals using the instructions below.

*NOTE: AF will not consider the offeror's D2P2 proposal if the offeror fails to demonstrate technical merit and feasibility have been established. It will also not be considered if it fails to demonstrate the feasibility effort was substantially performed by the offeror and/or the principal investigator (PI). Refer to the topics' Phase I descriptions for minimum requirements needed to demonstrate feasibility. Feasibility documentation MUST NOT be solely based on work performed under prior or on-going Federally funded SBIR and/or STTR work.

II. PROPOSAL SUBMISSION

The complete proposal, i.e., DoD Proposal Cover Sheet, technical volume, and cost volume, must be submitted electronically through DSIP. Ensure the 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

Volume 5: Supporting Documents, e.g., SBIR/STTR Environment, Safety and Occupational Health (ESOH) Questionnaire; DoD Form 2345, Militarily Critical Data Agreement (if applicable); etc.
Volume 6: Fraud, Waste, and Abuse Training Completion
Phase II proposals require a comprehensive, detailed description of the proposed effort. AF D2P2

efforts are to be proposed in accordance with the information in these instructions and Chart 1 (above). 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 D2P2 research or research and development (R/R&D) must be performed by the small business andits team members in the United States, as defined in the DoD SBIR 21.2 BAA. The Principal Investigator's (PI's) primary employment must be with the small business concern at the time of awardand during the entire period of performance. Primary employment means more than one-half the PI's time is spent in the small business' employ. This precludes full-time employment with another entity.

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.

III. PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

See Chart 1 (above). Advocacy letters, if any; SBIR / STTR Environment, Safety and Occupational Health (ESOH) Questionnaire; and the additional cost proposal itemized list, 17.a-j, should be included in Volume 5, Supporting Documentation. This documentation and the Cover Sheet will not count toward the technical volume limits. There is no set format requirement for white papers or slide decks, if required.

Please note the Fraud, Waste and Abuse Training must be completed prior to proposal submission. This is accomplished under Volume 6 within DSIP. When the training is complete and certified, DSIP will indicate so in the proposal, completing the Volume 6 requirement. The proposal cannot be submitted until the training has been completed. The complete proposal **must** be submitted via DSIP on or before **the date published in the DoD 21.2 SBIR BAA.** Submissions outside DSIP including, but not limited to, email, hardcopy, or other media will not be accepted.

A. Proposal Requirements. A Phase II proposal shall provide sufficient information to persuade theAF the proposed technology advancement represents an innovative solution to the scientific or engineering problem worthy of support under the stated criteria. All sections below count toward the page limit, unless otherwise specified.

B. Proprietary Information. Information constituting a trade secret, commercial/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, the Work Plan will be incorporated into the resulting contract by reference. Therefore, DO NOT INCLUDE PROPRIETARY INFORMATION. See Section 5.3 of the DoD BAAregarding proprietary information marking.

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. If included, such material will count toward the page limit.

D. Proposal Format. The technical proposal includes all items listed below in the order provided.

(1) **Proposal Cover Sheet:** Complete the 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) **<u>Table of Contents</u>:** A table of contents should be located immediately after the Cover Sheet.

(3) **<u>Glossary</u>:** Include a glossary of acronyms and abbreviations used in the proposal.

(4) **<u>Milestone Identification</u>:** Include a program schedule with all key milestones identified.

(5) **<u>Identification and Significance of the Problem or Opportunity</u>:** Briefly reference the specific technical problem/opportunity to be pursued under this effort.

(6) **<u>Phase II Technical Objectives</u>:** 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) **<u>Work Plan</u>:** The work plan shall be a separate and distinct part of the proposal package, using a page break to divide it from the technical proposal. It 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 work plan; begin this section on a new page. **DO NOT include proprietary information.**

a) <u>1.0 – Objective</u>: This section is intended to provide a brief overview of the specialty area. It should explain the purpose and expected outcome.

b) <u>2.0 – Scope</u>: This section should provide a concise description of the work to be accomplished, including the technology area to be investigated, goals, and major milestones. The key elements of this section are task development and deliverables, i.e., the anticipated end result and/or the effort's product. This section must also be consistent with the information in Section 4.0 below.

c) <u>3.0 – Background</u>: The offeror shall identify appropriate specifications, standards, and other documents applicable to the effort. This section includes information or explanation for, and/or constraints to, understanding requirements. It may include relationships to previous, current, and/or future operations. It may also include techniques previously determined ineffective.

d) <u>4.0 – Task/Technical Requirements</u>: The detailed individual task descriptions for accomplishing proposed work are considered to be legally binding on the offeror. 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 the work to be performed by subtask. The work plan MUST contain every task to be accomplished in definite, realistic, and clearlystated terms. Use "shall" whenever the work plan 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) **<u>Deliverables</u>:** 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 20 years after submission of the last contract deliverable. Upon expiration of the 20 year restrictive license, the Government has unlimited rights to the SBIR data.

   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 work's purpose, providing a brief description of the effort accomplished, and listing potential results applications. 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 project objectives met, work completed, results obtained, and technical feasibility estimates.

   ii. Status Reports: Status reports are due quarterly at a minimum.

   iii. Small Business Online Success Stories: Success Story submissions are dueat the end of the technical effort via http://launchstories.org. If selected, referto the Contract Data Requirements List (CDRL) in the contract for submission instructions.

b) Additional Reporting: AF may require additional reporting or documentation including:

   i. Software documentation andusers' 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 reviewersproviding comments regarding the offeror's knowledge of the state-of-the-art in the specificapproach proposed.

(10) Company Commercialization Report (CCR)/Commercialization Potential:

a) A Volume 4: CCR is required to be submitted with proposals in response to AF 21.2 SBIR topics. Please refer to the DoD 21.2 SBIR BAA for full details.

b) 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.

c) The commercialization strategy plan should briefly describe the commercialization potential for the proposed project's anticipated results, as well as plans to exploit it. Commercial potential is evidenced by:

   i. The existence of private sector or non-SBIR/STTR Governmental 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.

d) If awarded a D2P2, the contractor is required to periodically update the commercialization results of the project at https://www.dodsbirsttr.mil/submissions//. These updates will be required at completion of the effort, and subsequently when thecontractor submits a new SBIR/STTR proposal to DoD. Firms not submitting a new proposal to DoD will be requested to provide updates annually after the D2P2 completion.

e) **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 agencyhas expressed interest in, or commitment to, a non-SBIR, Federally funded Phase III effort. This section should involve not more than one to two paragraphs. Include agency point of contact names and telephone numbers.

E. Relationship with Future R/R&D Efforts:

a) State the anticipated results of the proposed approach, specifically addressing plans for Phase III, if any.
b) Discuss the significance of the D2P2 effort in providing a basis for the PhaseIII R/R&D effort, if planned.

F. **Key Personnel:** In the technical volume, identify all key personnel involved in the project. Include information directly related to education, experience, and citizenship. Atechnical 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. 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 held, and identify the tasks they are anticipated to perform.

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 BAA.

The following will apply to all projects with military or dual-use applications developing 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, andthe 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 thework 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.

G. **Facilities/Equipment:** Describe instrumentation and physical facilities necessary and available to carry out the D2P2 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.

H. **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 PolicyDirective, 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 copiesof 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 statements of work and detailed cost proposals. 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.

I. 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 forconsideration under numerous Federal program solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. Any potential for this situation must be disclosed to the solicitation agency(ies) before award. If a proposal submitted in response to BAA 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 proposal submission or award dates;
c) The proposal title;
d) The PI's name and title for each proposal submitted or award received; and
e) Solicitation(s) title, number, and date 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, orpending support for proposed work."

J. **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. Thisinformation will expedite award if the proposal is selected. Generally, firm fixed price contracts are appropriate for Phase II awards. In accordance with the SBA SBIR/STTR Policy Directive, Phase II contracts must include profit or fee.

Cost proposal attachments do not count toward 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 subcontract agreements. Agreement documents must adequately describe the work to be performed and cost bases. The agreement document should include a SOW, assignedpersonnel, 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-thirdof the total contract price, unless otherwise approved in writing by the Contracting Officer.

The prime contractor must accomplish price analysis, including reasonableness, of the proposed subcontractor costs. If based on comparison with prior efforts, identify the basis upon which the prior prices were determined reasonable. If price analysis techniques are inadequate or the FAR requires subcontractor cost or pricing data submission, provide a cost analysis. 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, as well as a short, concise resume.

f) Travel: Each effort should include, at a minimum, a kickoff or interim meeting. Travel costs must be justified as required for the effort. Include destinations, numberof trips, number of travelers per trip, airfare, per diem, lodging, ground transportation, etc. Per diem and lodging rates may be found in the Joint Travel Regulation (JTR),Volume 2, www.defensetravel.dod.mil.

g) Indirect Costs: Indicate proposed rates' bases, 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 are required.

h) Non-SBIR Governmental/Private Investment: Non-SBIR Governmental and/or private investment is allowed. However, it is not required nor will it be a proposal evaluation factor.

i) DD Form 2345: For proposals submitted under export-controlled topics (either ITAR or EAR), a 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 US/Canada Joint Certification Program website, http://www.dlis.dla.mil/jcp/. DD Form 2345 approval will be verified if the proposal is selected for award.

18. **Feasibility Documentation –** Should be uploaded to Volume 5, Supporting Documents
   a. If appropriate, include a reference or works cited list as the last page.
   b. Feasibility efforts detailed must have been substantially performed by the offeror and/or the PI. If technology in the feasibility documentation is subject to intellectual property (IP) rights, the offeror must provide IP rights assertions. Provide a good faith representation appropriate licensing rights to all other IP utilized in the proposal is ownedor possessed. Additionally, proposers shall provide a short summary for each item asserted with less than unlimited rights describing restriction's nature and intellectual property intended for use in the proposed research. Please see DoD SBIR 21.2 BAA for technical data rights information.
   c. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated and WILL be redacted.

IV. METHOD OF SELECTION AND EVALUATION CRITERIA

A. Introduction: D2P2 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. D2P2 proposals will be disqualified and not evaluated if the Phase I equivalency documentation does not establish the proposed technical approach's feasibility and technical merit.

B. Evaluation Criteria: Phase II proposals will be reviewed for overall merit based on the criteria discussed in the DoD 21.2 BAA Section 6.0 and 7.4.

NOTE: Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors: APEX, Peerless Technologies, Engineering Services Network, HPC- COM, Mile Two, REI Systems, MacB (an Alion company), and Infinite Management Solutions. In addition, only Government employees and technical personnel from Federally Funded Research and Development Centers (FFRDCs) MITRE and Aerospace Corporations working under contractto provide technical support to AF Life Cycle Management Center and Space Force may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. **Contact the AF SBIR/STTR Contracting Officer, Kris Croake, kristina.croake@us.af.mil, with concerns about any of these contractors**.

V. 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.

VI. FEEDBACK

The PI and Corporate Official indicated on the Proposal Cover Sheet will be notified by email regarding proposal selection or non-selection. The small business will receive one notification for eachproposal submitted. Please note the referenced proposal number and read each notification carefully. **Ifchanges occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF at usaf.team@afsbirsttr.us.**

Feedback requests will be provided to offerors with proposals determined “Not Selectable” ONLY. The proposal notification letter will include instructions for submitting a feedback request. A separate request must be submitted for each proposal feedback desired.

Attachment 1: SBIR/STTR Environment, Safety and OccupationalHealth (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 incorporatingthese 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 21.2 Topic Index

AF212-D001 Transfer Learning of Control Policies Pitch Day for Trusted AI

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The objective of this topic is to explore the development of explainable decision-making algorithms that address the challenges of deriving explanations of autonomous behavior in decision-making systems. In particular, there is (i) the challenge of handling the fact that autonomous decision-making agents can change future observations of data based on the actions they take and (ii) the challenge of reasoning over long-term objectives of the underlying agent mission.

The results of this work may be applied to the development of military recommender systems as part of a Phase III effort by enabling human-interpretable explanations of behavior in automated or autonomous planning solutions. This may also find applications in the commercial autonomous driving sector, where high-performing solutions still lead to unfortunate accidents and fatalities for which the derivation of explanations is difficult. In such settings, explainability not only eases understanding of learning outcomes, but can also be used to develop more effective machine learning algorithms.

This topic addresses challenges in the DoD technology area of Artificial Intelligence and Machine Learning as outlined in the National Defense Strategy and, more specifically, the focus area of Autonomy as listed in the USD R&E modernization priorities. This topic also addresses challenges in the DoD technology area of Artificial Intelligence and Machine Learning as outlined in the National Defense Strategy and, more specifically, the focus area of Autonomy as listed in the USD R&E modernization priorities. This topic will reach companies that can complete a feasibility study and prototype validated concepts in accelerated Phase II schedules. This topic is specifically aimed at later stage development rather than earlier stage basic science and research.

DESCRIPTION: Current simulation environments are too slow for the adoption of state-of-the art machine learning approaches to decision-making, such as those proposed in the areas of reinforcement learning and planning. Recent noteworthy examples include Monte-Carlo Tree Search and actor-critic architectures which have been used to yield superhuman performance in games of precision and perception such as Go and StarCraft 2. These approaches require tens of millions of simulation runs or tens of thousands of years' worth of simulation data. As a point of reference, Air Force simulation environments such as AFSIM and AWSIM or other complex operational environments execute an individual simulation on the order of minutes and hours, respectively. These runtimes preclude the adoption of such data-hungry methods. However, the tremendous success of transfer learning in image classification and, more recently, natural language processing gives us hope that transferring learned information may be feasible from a surrogate fast simulation environment (e.g. PySC2, Lab2D, RAND's AFGYM, etc.) to our existing slow simulators (e.g. AFSIM, AWSIM).

This remains an open problem in the aforementioned fields of reinforcement learning and planning. To this end, we seek to develop a transfer learning approach that can transfer decision-making information from a surrogate simulation environment to a target environment. This includes the development of similarity metrics by which a user can determine whether transfer between two environments is feasible or useful. Performance in the surrogate and target simulation environments after transferring learned decision-making information from the former should reflect the similarity metrics developed. That is, low similarity should lead to low or unpredictable performance when transferring from the surrogate to the target. Conversely, high similarity should yield high performance on the target. The performance metric is dependent on the environments chosen and can include things like maximizing a reward signal, yielding explainable actions, or establishing robust control policies, among others. While this motivates the foregoing from an Air Force perspective, prospective performers may choose non-military surrogate and target environments in developing their transfer learning approach and transfer similarity metrics. There is no required use of government materials, equipment data, or facilities.

PHASE I: Phase I should completely document 1) the AI-driven explainability requirements the proposed solution addresses; 2) the approach to model, quantify and analyze the representation, effectiveness, and efficiency of the explainable decision-making solution; and 3) the feasibility of developing or simulating a prototype architecture.

PHASE II: Develop, install, integrate and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.
4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e. supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

PROPOSAL PREPARATION AND EVALUATION: Please follow the Air Force-specific Direct to Phase II instructions under the Department of Defense 21.2 SBIR Broad Agency Announcement when preparing proposals. Proposals under this topic will have a maximum value of $1,500,000 SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting. Phase II proposals will be evaluated using a two-step process.

After proposal receipt, an initial evaluation will be conducted IAW the criteria DoD 21.2 SBIR BAA, Sections 6.0 and 7.4. Based on the results of that evaluation, Selectable companies will be provided an opportunity to participate in the Air Force Trusted AI Pitch Day, tentatively scheduled for 26-30 July 2021 (possibly virtual). Companies' pitches will be evaluated using the initial proposal evaluation criteria. Selectees will be notified after the event via email. Companies must participate in the pitch event to be considered for award.

REFERENCES:

1. Da Silva, Felipe Leno, and Anna Helena Reali Costa. "A survey on transfer learning for multiagent reinforcement learning systems." Journal of Artificial Intelligence Research 64 (2019): 645-703.
2. Gamrian, Shani, and Yoav Goldberg. "Transfer learning for related reinforcement learning tasks via image-to-image translation." International Conference on Machine Learning. PMLR, 2019.
3. Hanlon, Nicholas, et al. "AFSIM Implementation and Simulation of the Active Target Defense Differential Game." 2018 AIAA Guidance, Navigation, and Control Conference. 2018.

KEYWORDS: Transfer Learning; Planning; Reinforcement Learning; Autonomy; Autonomous Agents; Autonomous Capabilities; Command and Control

AF212-D002 Assurance of Trusted AI/ML Systems Pitch Day for Trusted AI

TECH FOCUS AREAS: Cybersecurity; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The objective of this topic is to explore the design of tools, techniques and methods necessary to support the development of trusted AI systems at speed and scale within modern development pipelines.

DESCRIPTION: A key element of trust in AI is our ability to impart and assess the classical security attributes of developed AI systems. Confidentiality, integrity, and availability of systems remain a key concern as we move toward increased AI, especially as such systems are imparted with the levels of autonomy necessary for speed and scale of action required for future missions. This need for assurance in our AI-based software must be weighed against the benefits (and risks) of agile, rapid development pipelines, such as continuous integration / continuous development (CI/CD) and integrated Development – Security – Operations (DevSecOps) approaches to development. Such pipelines often rely on external security measures, which may contain systemic failures and lack engineering rigor. Rectifying these competing concerns requires the development of comprehensive security engineering approaches that effectively reduce the introduction and exploitation of vulnerabilities in modern AI and AI-enabled developments.

This is a fundamental requirement of trusted AI, as it underlies the effectiveness of numerous AI/ML attack paths identified in literature (e.g. the Berryville Institute of Machine Learning). Technologies developed under this topic should focus on enabling trust through the systematic address of vulnerabilities that might arise in AI system design, development, and test. The key aspects addressed by this topic follow the security engineering approach outlined by NIST in SP800-160 as applied to machine learning and AI-based systems:

1. Technologies and methods that address the “problem-definition” context of AI system security. This would include the ability to model, quantify, and analyze threats and risks to AI systems; define and analyze AI-driven security requirements; and inform the efficient application of solution-focused technologies and processes.
2. Technologies and methods focused on the “solution-definition” context of secure AI systems. This could include capabilities focused on the secure development of AI-systems, the application/specialization of formal and semi-formal analysis in the design and architecture of AI systems, and the static and dynamic analysis of implementation artifacts (code & associated models/data) for vulnerabilities.
3. Technologies and methods that enable the “trustworthiness-assessment” context of AI systems, focused on the testing and evaluating systems against the stated solution and problem context goals and approaches (did I build the right system, and did I build it right?). This could include risk-driven test and evaluation of AI capabilities at the unit, component, and sub-system level; capabilities to perform vulnerability assessment on AI-based systems and data; and the means to measure the resulting AI system’s security properties.

Approaches sought as part of this effort may address one or more of these contexts, either as part of an integrated process or as a standalone technology focused on a particular aspects of security engineering for AI-based systems. Candidates will be evaluated based upon their novelty, uniqueness, and specificity to AI-based systems and the unique challenges faced when designing, developing, and fielding assured AI technologies within a mission context. There is no requirement for use of Government materials, equipment, data or facilities.

PHASE I: Phase I should completely document 1) the AI-driven explainability requirements the proposed solution addresses; 2) the approach to model, quantify and analyze the representation, effectiveness, and efficiency of the explainable decision-making solution; and 3) the feasibility of developing or simulating a prototype architecture.

PHASE II: Develop, install, integrate and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.
4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e. supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

PHASE III DUAL USE APPLICATIONS: The need for AI/ML systems that are robust, well-designed, minimize vulnerabilities, and exhibit resilience against external attack is a need shared between government and industry. Developments against this topic will support AI/ML assurance requirements in any agile development (e.g. DevSecOps) pipeline, and outcomes are likely to find inclusion in software development practices that support both commercial and government needs. The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

PROPOSAL PREPARATION AND EVALUATION: Please follow the Air Force-specific Direct to Phase II instructions under the Department of Defense 21.2 SBIR Broad Agency Announcement when preparing proposals. Proposals under this topic will have a maximum value of $1,500,000 SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting.

After proposal receipt, an initial evaluation will be conducted IAW the criteria DoD 21.2 SBIR BAA, Sections 6.0 and 7.4. Based on the results of that evaluation, Selectable companies will be provided an opportunity to participate in the Air Force Trusted AI Pitch Day, tentatively scheduled for 26-30 July 2021 (possibly virtual). Companies' pitches will be evaluated using the initial proposal evaluation criteria. Selectees will be notified after the event via email. Companies must participate in the pitch event to be considered for award.

REFERENCES:

1. McGraw, et al: An Architectural Risk Analysis of Machine Learning Systems: Toward More Secure Machine Learning. Berryville Institute of Machine Learning (BIML), 2019.
2. McGraw, et al: Security Engineering for Machine Learning. IEEE Computer, volume 52, number 8, pages 54-57. 2019.
3. Ross, R., McEvilley, M. and Carrier Oren, J.: NIST SP 800-160 — Systems Security Engineering: Considerations for a Multidisciplinary Approach in the Engineering of Trustworthy Secure Systems, November 2016.

KEYWORDS: Trustworthy Artificial Intelligence; Mission Assurance; Trusted AI; Trustworthiness; Secure AI; Autonomy; Autonomous Agents; Autonomous Capabilities

AF212-D003 Applications of AI/ML Pitch Day for Trusted Artificial Intelligence

TECH FOCUS AREAS: Cybersecurity; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The objective of this topic is to apply existing AI/ML solutions to operational Air Force problems. This topic will reach companies that can complete a feasibility study and prototype validated concepts in accelerated Phase II schedules. This topic is specifically aimed at later stage development rather than earlier stage basic science and research.

DESCRIPTION: The advent of modern AI/ML algorithms presents an opportunity for the Air Force to modernize various human-intensive and laborious processes that may be amenable to automation and autonomy. Areas of interest under this topic include the following:

1. Real Time Operational AI: Human operators are used across many airfield and flight operations that could potentially be performed or augmented by trusted AI systems. Intelligent systems could assist and reduce air traffic control workload, potentially reducing safe aircraft separation to increase sorties or reduce fuel consumption, while maintaining or improving safety of flight. AI could analyze flight paths, traffic volume/controller work load, range scheduling, etc. to determine the most efficient route/timing from airports to specific airspace, either for dynamic resource allocation or overall system optimization. Artificially intelligent precision approach radars could provide voice guidance for precision approach landings in agile combat operations without dedicated human controllers or modification of aircraft avionics. This emphasis area explores how real-time trusted AI could be applied to operational systems, either to augment and improve human and system performance or by acting autonomously.

2. Putting the Sec in DevSecOps for Machine Learning: PEO Digital seeks to take advantage of breakthroughs in machine learning in commercial technology with non-traditional partners. Under the hood, breakthroughs are enabled by leveraging common open-source machine learning frameworks such as PyTorch & TensorFlow. After training, these frameworks output serialized formats of a trained neural network that are optimized to run on hardware via model serving. However, these serialized formats are not well understood by common static code analysis (SCA) tools used in DevSecOps pipelines. This topic seeks to develop a static code analysis tool for neural network serialized graphs (ONNX, TensorFlow SavedModel format, etc) in order to automatically identify vulnerabilities and ensure that new and re-trained neural networks are secure to mitigate the risk of malicious neural networks within operations.

3. Automate Routine Battle Management Functions: Although modern architecture in AWACS and other platforms automates some of the functions, such as automatic track initiation, Air Battle Managers (ABM) still have to perform many routine functions. The AWACS SPO is interested in potential deploying AI to further automate many of the ABM’s functions, allowing for ABMs to concentrate on functions that truly require humans in the loop.

4. Computer Vision Threat Detection: PEO Digital seeks ML/AI based computer vision technology to perform real-time threat detection and classification using full motion video provided by CCTV and electro-optical/infrared (EO/IR) sensors. In addition to threat detection, applications would also be applied to reduce current system false/nuisance alarm rates. Proposed technologies would preferably be device/sensor agnostic and capable of integrating with external C2 systems.

5. AI for Tactical / Cognitive Radios (CR): Optimized rogue RF signal detection, classification and response to detection and jamming signals in space can be significantly enhanced with a trained neural network using machine learning and AI techniques. Improvements are expected to reduce signal processing timelines from minutes and seconds to milliseconds. Applying AI techniques to a deployed compact system in a field environment are expected to yield real-time response and collection of signals intelligence without the need

for significant offline processing and reduced power requirements. A demonstration of AI for tactical radios using COTS CR systems is preferred.

PHASE I: Phase I should completely document 1) the AI-driven explainability requirements the proposed solution addresses; 2) the approach to model, quantify and analyze the representation, effectiveness, and efficiency of the explainable decision-making solution; and 3) the feasibility of developing or simulating a prototype architecture.

PHASE II: Develop, install, integrate and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.
4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e. supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

PHASE III DUAL USE APPLICATIONS: The Primary goal of SBIR is Phase III. The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

PROPOSAL PREPARATION AND EVALUATION: Please follow the Air Force-specific Direct to Phase II instructions under the Department of Defense 21.2 SBIR Broad Agency Announcement when preparing proposals. Proposals under this topic will have a maximum value of $1,500,000 SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting. Phase II proposals will be evaluated using a two-step process.

After proposal receipt, an initial evaluation will be conducted IAW the criteria DoD 21.2 SBIR BAA, Sections 6.0 and 7.4. Based on the results of that evaluation, Selectable companies will be provided an opportunity to participate in the Air Force Trusted AI Pitch Day, tentatively scheduled for 26-30 July 2021 (possibly virtual). Companies' pitches will be evaluated using the initial proposal evaluation criteria. Selectees will be notified after the event via email. Companies must participate in the pitch event to be considered for award.

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KEYWORDS: Trustworthy Artificial Intelligence; Mission Assurance; Trusted AI; Trustworthiness; Secure AI; Operational AI; Autonomy; Autonomous Agents; Autonomous Capabilities; DevSecOps; Computer Vision

AF212-D004 Explainable Decision-Making Pitch Day for Trusted AI

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The objective of this topic is to explore the development of explainable decision-making algorithms that address the challenges of deriving explanations of autonomous behavior in decision-making systems. In particular, there is (i) the challenge of handling the fact that autonomous decision-making agents can change future observations of data based on the actions they take and (ii) the challenge of reasoning over long-term objectives of the underlying agent mission.

The results of this work may be applied to the development of military recommender systems as part of a Phase III effort by enabling human-interpretable explanations of behavior in automated or autonomous planning solutions. This may also find applications in the commercial autonomous driving sector, where high-performing solutions still lead to unfortunate accidents and fatalities for which the derivation of explanations is difficult. In such settings, explainability not only eases understanding of learning outcomes, but can also be used to develop more effective machine learning algorithms.

This topic addresses challenges in the DoD technology area of Artificial Intelligence and Machine Learning as outlined in the National Defense Strategy and, more specifically, the focus area of Autonomy as listed in the USD R&E modernization priorities. This topic will reach companies that can complete a feasibility study and prototype validated concepts in accelerated Phase II schedules. This topic is specifically aimed at later stage development rather than earlier stage basic science and research.

This topic addresses challenges in the DoD technology area of Artificial Intelligence and Machine Learning as outlined in the National Defense Strategy and, more specifically, the focus area of Autonomy as listed in the USD R&E modernization priorities.

DESCRIPTION: The field of explainable AI has gained significant traction in recent years as evidenced by the DARPA XAI program and other investments aimed at explaining why and how autonomous agents yield a given outcome for some given datum. While there has been much success in this area, it has been mostly limited to the classification problem where libraries such as LIME, SHAP, and Captum have been developed and proven useful in facilitating developer and user understanding of machine learning and AI. Naturally, the capacity to explain autonomous behavior is a conduit to trust in such systems. However, the problem of autonomous decision-making, wherein an agent must interact within an environment and make decisions which change the state of the same, has not been privileged to the same success when it comes to the explain ability of autonomous decision-making policies.

Given the importance and growth of this area as evidenced by great advancements in sub-fields like reinforcement learning and planning, including superhuman performance in various games of perception and precision, it is important to have such powerful decision aids explain their behavior in a human-interpretable form for their wider adoption and use, particularly in safety-critical and defense systems. This is particularly so given the interest from the defense sector in human-machine teaming and human-in-the-loop learning.

While the explainable AI approaches developed for the classification problem may similarly be leveraged for autonomous decision-making, two key challenges arise in the latter setting. First, the actions enacted by the agent(s) have the capacity to change the data observed in the future via changes in the environment. Second, the agent must reason about a long-term objective accomplished as the result of multiple actions. As such, we seek the derivation of explainable decision-making methods that address these issues. Furthermore, in order to establish trust in the explanations provided by autonomous agents, it is imperative that the uncertainty inherent in a given explanation be quantified or characterized so as to establish a degree of confidence in the explanation.

Indeed, this encapsulates two of the four principles of explainable AI developed by the National Institute of Standards and Technology (NIST): explanation accuracy and knowledge limits. These principles focus on the accuracy of the explanation from a learning process and the assurance that the learning system operates only when it has reached a sufficient level of confidence in its output. Intuitively, the fact that learning is closed-loop with decision-making requires an understanding and quantification of uncertainty to understand how an "amount" of uncertainty produces a "change" in decision. This informs the human operators' trust in the output of the explainable decision-making algorithms developed.

PHASE I: Phase I should completely document 1) the AI-driven explainability requirements the proposed solution addresses; 2) the approach to model, quantify and analyze the representation, effectiveness, and efficiency of the explainable decision-making solution; and 3) the feasibility of developing or simulating a prototype architecture.

PHASE II: Develop, install, integrate and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.
4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e. supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

PPROPOSAL PREPARATION AND EVALUATION: Please follow the Air Force-specific Direct to Phase II instructions under the Department of Defense 21.2 SBIR Broad Agency Announcement when preparing proposals. Proposals under this topic will have a maximum value of $1,500,000 SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting. Phase II proposals will be evaluated using a two-step process.

After proposal receipt, an initial evaluation will be conducted IAW the criteria DoD 21.2 SBIR BAA, Sections 6.0 and 7.4. Based on the results of that evaluation, Selectable companies will be provided an opportunity to participate in the Air Force Trusted AI Pitch Day, tentatively scheduled for 26-30 July 2021 (possibly virtual). Companies' pitches will be evaluated using the initial proposal evaluation criteria. Selectees will be notified after the event via email. Companies must participate in the pitch event to be considered for award.

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2. Arrieta, Alejandro Barredo, et al. "Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI." Information Fusion 58 (2020): 82-115.
3. Gunning, David, and David Aha. "DARPA's explainable artificial intelligence (XAI) program." AI Magazine 40.2 (2019): 44-58.

KEYWORDS: Explainable AI; Trustworthy AI; Trusted AI; Trust in AI; Planning; Reinforcement Learning; Autonomy; Autonomous Agents; Autonomous Capabilities; Interpretable AI

AF212-D005 Behavioral Models, Methods & Metrics for Trust Establishment, Maintenance, and Repair in Human-Machine Co-Training Pitch Day for Trusted AI

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems; Battlespace

OBJECTIVE: The objective of this topic is to explore the development of simultaneously training humans and machine partners to facilitate the establishment of trust, its maintenance, and its repair when failures occur. In particular, the proposed solutions should present some examples of failures and successes in human-machine trust through co-training. This topic will reach companies that can complete a feasibility study and prototype validated concepts in accelerated Phase II schedules. This topic is specifically aimed at development beyond basic science and research.

DESCRIPTION: Warfighters will continue to be partnered with increasingly capable intelligent systems to outwit and outpace adversaries. Rather than have warfighters and their autonomous partners independently acquire their needed skills and then come together to accomplish a mission, they will train together over time with increasingly complexity to emerge as tightly coupled cooperative agents with developed bi-directional human-machine trust. In this example, co-training involves partnering with an intelligent system throughout the individual and team skill acquisition processes, exposing team members to each other's strengths, weaknesses, communication styles, and how to maintain trust and repair it when needed.

To achieve this goal, developers must provide intelligent systems with some human-like cognitive capacities to facilitate the dynamic processes associated with the establishment, maintenance, and repair of trust. Example human-level capacities include acquiring mutual knowledge, beliefs, and assumptions to facilitate efficient communication (i.e., common ground), skill acquisition at the human-partner's pace, and human-level situation representations to facilitate interaction, team problem solving, responsibility shifting and sharing, et cetera. To achieve these goals, several facets of this emphasis need to be tackled (in no particular order):

• Behavioral/cognitive model development and evaluation of the required human-level capacities theorized to be important in trust establishment, maintenance, and repair;
• Methods developed and tested for co-training between humans and their autonomous counterparts to demonstrate the establishment of bi-directional trust and performance benefits;
• Metrics (objective and subjective) must be developed and validated to capture the dynamics of trust establishment, maintenance, and repair to better assess trust's relationship to, and influence on, task performance.

PHASE I: Phase I should completely document 1) the AI-driven explainability requirements the proposed solution addresses; 2) the approach to model, quantify and analyze the representation, effectiveness, and efficiency of the explainable decision-making solution; and 3) the feasibility of developing or simulating a prototype architecture.

PHASE II: Develop and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.

4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e. supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

PROPOSAL PREPARATION AND EVALUATION: Please follow the Air Force-specific Direct to Phase II instructions under the Department of Defense 21.2 SBIR Broad Agency Announcement when preparing proposals. Proposals under this topic will have a maximum value of $1,500,000 SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting. Phase II proposals will be evaluated using a two-step process.
After proposal receipt, an initial evaluation will be conducted IAW the criteria DoD 21.2 SBIR BAA, Sections 6.0 and 7.4. Based on the results of that evaluation, Selectable companies will be provided an opportunity to participate in the Air Force Trusted AI Pitch Day, tentatively scheduled for 26-30 July 2021 (possibly virtual). Companies' pitches will be evaluated using the initial proposal evaluation criteria. Selectees will be notified after the event via email. Companies must participate in the pitch event to be considered for award.

REFERENCES:

1. Kirk, J. R., & Laird, J. E. (2016). Learning General and Efficient Representations of Novel Games Through Interactive Instruction. Advances in Cognitive Systems, 4
2. Laird, J. E., Anderson, J., Forbus, K. D., Lebiere, C., Salvucci, D., Scheutz, M., … Kirk, J. R. (2017). Interactive Task Learning. IEEE Intelligent Systems, 32(4), 6-21 (invited). https://doi.org/10.1109/MIS.2017.3121552
3. van den Bosch, K., Schoonderwoerd, T., Blankendaal, R., & Neerincx, M. (2019). Six Challenges for Human-AI Co-learning. In International Conferenceon Human-Computer Interaction (pp. 572-589). Springer, Cham.

KEYWORDS: human-machine teaming; training; transparency; trust, Autonomy; Autonomous Agents; Autonomous Capabilities

AF212-D006 Lifecycle Approaches to Transparency in Human-Autonomy Teams (HATs) for Generating Common Ground and Trust Calibration Pitch Day for Trusted AI

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems; Battlespace

OBJECTIVE: The objective of this topic is to explore the development of transparency methods to promote common ground and calibrated trust between human and machine partners across a human-autonomy-team's (HAT) lifecycle. This topic will reach companies that can complete a feasibility study and prototype validated concepts in accelerated Phase II schedules. This topic is specifically aimed at later stage development rather than earlier stage basic science and research. Successful proposals will not only demonstrate useful concepts for transparency in HAT contexts, but will discuss the dynamic transparency needs across the HAT lifecycle.

DESCRIPTION: Transparency, i.e., methods for establishing shared awareness and shared intent between humans and intelligent machines, is the cornerstone for generating and maintaining appropriate trust in human-autonomy teaming interactions. Transparency methods have predominately taken a static view of the HAT relationship and have focused on one element of complexity – often times selecting the task execution phase (for a particular isolated task) as the key opportunity for engineering transparency into an interface. However, transparency methods should incorporate the full spectrum of the HAT relationship spanning the gamut from design; testing; technology introduction; training/learning/co-learning; implementation in a task context; and full implementation in a social context (wherein trust can exist as a shared social phenomenon).

This issue is exacerbated when considering machine learning technologies that: ingest diverse data sets during training (with various levels of bias inherent to them), are inherently nondeterministic, and are often brittle to environmental change/novel data. Another intelligent entity could be described in similar terms as the first two issues (diverse training data and nondeterministic) while it also displays incredible resilience to environmental perturbation – human beings.

While humans are highly variable, one might argue that our trust relationships with others are driven by stable factors – granted the values/importance of these factors change overtime in relation to a particular referent, yet the set remains constant in driving trust of others because it offers us an opportunity to have common ground with others and to anticipate their intent in relation to us. The same way humans do not hug a stranger and or recite one's detailed resume to a close friend, neither should we view HAT relationships as static and universal – the level of detail one needs in order to make an informed trust-based evaluation depends on a number of factors and we need transparency methods to convey this information and a higher-level model of transparency to guide the timing and implementation of these components. Example research could include:

• Interface methods to promote common ground of machine rationale/task awareness/states (e.g., confusion), predictability of machine intent, predictability of machine action, predictability of transfer of authority requests.
• Methods to categorize and compare learning affordances for ML systems as a means to facilitate transparency of the data, scenarios, and biases that exist in developing a ML algorithm – this essentially looks to the learning environment itself as a facet of transparency.
• Identify how transparency could be elicited via design (i.e., pedigree).
• Testing methods to generate shared knowledge of HAT limitations and capabilities (e.g., joint HAT experiences to fulfill human trust needs) and those to limit uncertainty and constrain the consequences of errors (e.g., assurance methods to govern HAT behaviors and minimize uncertainty).
• Integrated lifecycle approaches and models guide the appropriateness and effectiveness of one transparency over another dynamically.

PHASE I: Phase I should completely document 1) the AI-driven explainability requirements the proposed solution addresses; 2) the approach to model, quantify and analyze the representation, effectiveness, and efficiency of the explainable decision-making solution; and 3) the feasibility of developing or simulating a prototype architecture.

PHASE II: Develop and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.
4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e. supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

PROPOSAL PREPARATION AND EVALUATION: Please follow the Air Force-specific Direct to Phase II instructions under the Department of Defense 21.2 SBIR Broad Agency Announcement when preparing proposals. Proposals under this topic will have a maximum value of $1,500,000 SBIR funding and a maximum performance period of 18 months, including 15 months technical performance and three months for reporting. Phase II proposals will be evaluated using a two-step process.

After proposal receipt, an initial evaluation will be conducted IAW the criteria DoD 21.2 SBIR BAA, Sections 6.0 and 7.4. Based on the results of that evaluation, Selectable companies will be provided an opportunity to participate in the Air Force Trusted AI Pitch Day, tentatively scheduled for 26-30 July 2021 (possibly virtual). Companies' pitches will be evaluated using the initial proposal evaluation criteria. Selectees will be notified after the event via email. Companies must participate in the pitch event to be considered for award.

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1. Miller, C. (2021). Trust, transparency, explanation, and planning: Why we need a lifecycle perspective on human-automation interaction. In Nam and Lyons (Eds.), Trust in Human-Robot Interaction (pp. 234-254). Elsevier
2. Chen, J., Flemisch, F., Lyons, J., & Neerincx, M. (2020). Guest Editorial: Agent and System Transparency. IEEE Transactions on Human-Machine Systems, 50(3).
3. Chen J., Lakhmani S., Stowers K., Selkowitz A., Wright J., Barnes M. (2018). Situation awareness-based agent transparency and human-autonomy teaming effectiveness. Theoretical Issues Ergonomics Science 19(3), 259–282.

KEYWORDS: Human-machine teaming; training; transparency; trust; Autonomy; Autonomous Agents; Common Ground

AF212-D007 3D EO/SAR Reconstructions from Single and Limited Viewing Perspectives

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Sensors; Space Platform; Air Platform

OBJECTIVE: Improve three-dimensional electro optical/synthetic aperture radar (3D EO/SAR) reconstructions of both single objects of interest and 3D scenes from limited 2D input images at varying viewing perspectives from airborne and/or space borne EO and SAR sensors for scene exploitation to support Combat Identification (CID) and Intelligence, Surveillance, and Reconnaissance (ISR) missions.
DESCRIPTION: Current 3D SAR reconstruction techniques require many circular flight paths around an object of interest to sufficiently image for scene exploitation. Additionally, these imaging techniques require the fusion of many images acquired at multiple viewpoints to create an accurate 3D SAR reconstruction.

Neither of these requirements are feasible in a military operational scenario. Some 3D EO/SAR reconstruction techniques address flight path limitations through various sparsity-based techniques. These include either utilizing a sparse amount of apertures, increasing the sampling rates to adjust the resolution parameters of the object of interest, or using sparsity-based compressive sensing techniques to optimize the amount of used data points. However, limited work in 3D reconstruction techniques addresses the number of fused images required for accurate image formation, particularly in SAR. Exploratory work exists with EO and IR images, where limited two-dimensional (2D) viewpoints of a scene are used to create a 3D scene representation. This can be very useful for exploring unknown environments because it can lead to more accurate reconstructions through the environment, even if only a limited amount of views are given.

Government owned software for EO/IR image-based 3D reconstruction may be provided for use in this research as a baseline for further development of a multi-phenomenology EO/SAR 3D reconstruction capability. Potential solution(s) should provide the ability to produce a 3D representation of an object or region of interest given limited viewpoints. The solution(s) must be able to input 2D images and output a 3D representation of the target or scene. The solution(s) should be able to reconstruct single 3D objects of interests as well as 3D scene representations, such as scenes available from the GOTCHA dataset and multiple objects of interest therein. Solution(s) should allow for 3D representation refinement as additional 2D images at varying viewing perspectives are introduced. The solution(s) could involve implementing machine learning architecture to reconstruct volumetric data and perform 3D reasoning. Finally, the solution(s) should be extended to general 3D SAR imaging, be applicable to any arbitrary target/scenes and be computationally efficient. Solution(s) will be evaluated against known truth data – 3D reconstructions will be evaluated by their accuracy compared to the original object of interest/scene representation.

PHASE I: Determine the scientific and technical feasibility of the concept. Include a plan to demonstrate a 3D reconstruction given limited 2D input images for scene exploitation. Document progress in a final report and implement in a proof-of-concept software deliverable. This is a Direct to Phase II topic.

PHASE II: Develop, integrate, and demonstrate a prototype capable of 3D reconstruction given sample datasets. Initially, develop a prototype capable of imaging available 3D data domes for different objects of interest as desired. Extend capability to imaging 3D SAR scene reconstructions, such as available with the GOTCHA dataset. Deliver prototype software to include source code for all techniques developed under the contract.

PHASE III DUAL USE APPLICATIONS: Phase III efforts will focus on transitioning the developed technology to a working commercial or warfighter solution. If a viable business model for the developed strategy or algorithm(s) is demonstrated, the offeror or identified transition partners would be in a position to supply future processes to the Air Force and other DoD components as this new process is adopted.

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KEYWORDS: EO; SAR; 3D Reconstructions; Limited Data; Machine Learning; Bundle Adjustment; Structure from Motion

AF212-D008 Multi Domain Command, Control, Communications and Situational Awareness (MDC3SA) for Nuclear Missile Field Operations

TECH FOCUS AREAS: Network Command, Control and Communications

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Develop and apply technologies to fuse, analyze, and present new, secure, multi-domain (air, land, space, and cyber/spectrum/electronic), command, control, communications, and situational awareness capabilities for collaborative and efficient conduct of ICBM operations, including status monitoring, maintenance, security and missile launch.

DESCRIPTION: Fast, low-cost, effective, and efficient tactical command, control, communication, and situational awareness (C3SA) of a team for a single domain (e.g. ground) is a hard problem, but much harder is integrating adjacent domains (e.g. air, space, and cyber) into forward warriors' and rear leaders' scope of awareness and influence. Similarly, merging legacy stovepipe data sources, (e.g. logistics, maintenance, communications status, system status, mission requests, etc.) into a single, easily digestible format that can be used for command and control or planning is challenging.

Gen Goldfein, former Air Force Chief, directed a pivot to Multi-Domain Command and Control (MDC2) in 2017 and articulated the essential role that communications capabilities and battlespace situational awareness play in enabling effective MDC2, an integrated capability dubbed MDC3SA, MDC3SA information may be urgently needed by warfighters, but massive amount of divergent information risks overloading human awareness; a key question is whether effective MDC3SA can be enabled by technology for fusing and presenting only mission-essential information? Also, command centers currently hand-fuse significant amounts of information from legacy data sources in order to complete day to day operational planning and C2; can these processes and information sources be integrated to increase effectiveness?

This topic seeks to develop, prove in the field, and implement MDC3SA tools/capabilities in this fast, complex, area. The focus of this topic is operations in the nation's Minuteman III intercontinental ballistic missile (ICBM) system that provides a land-based nuclear deterrence and strike capability. The current system comprises 450 missiles and their associated C3 facilities located in several northern US states that stand on alert to provide a day-to-day, safe, secure, responsive, global nuclear strike capability to assure our allies, dissuade proliferation, deter adversaries, and, should deterrence fail, decisively defeat adversary targets and retaliatory capabilities. The operation of this capability encompasses a range of activities, including monitoring of health and status, transport and maintenance of missiles and launch hardware and software systems, physical and cyber security, training for and actual operation of, and if directed, missile launch operations.

Because of the strategic significance and nature of this mission, the coordination and conduct of these operations is of paramount importance requiring unprecedented communication and collaboration, shared situational awareness of ongoing and planned activities, assured integrity and timeliness of information, and man-power efficiency. Some examples of key operations that require coordination, tactical control and enhanced situational awareness include:

• The combined-forces 'Convoy Team' within a USAF Missile Wing involving dozens of vehicles, aircraft, and command center awareness, including coordination with civil authorities and law enforcement
• Daily, 2-person USAF Security Forces patrols across a typical base or region, and security response forces • Missile Wing Command Center operations planning and mission control This topic area is intended to explore architectural and functional aspects of these operations, including methods to maintain Shared Situational Awareness and Order of Battle, provide effective human interfaces for visualization and collaboration of

operational data, automate the mining, fusion, and presentation of data supporting commanding, controlling, and reporting status of assets and support systems/activities, and enable capabilities for operators to proactively plan and respond to events in real time.

PHASE I: This is a Direct to Phase 2 (D2P2) topic. Phase 1 like proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects the small business would have accomplished the following in a Phase I-type effort via some other means, e.g., independent research and development (IR&D) or other non-SBIR funded work). It must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to fuse multiple disparate data sources and present a unified picture.

Proposal may provide example cases of this new capability on a specific application. 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.

PHASE II: Design and develop command center systems to encompass the range of ICBM operations and functions, and provide the technical (hardware, software, communications) and physical (building, layout, human-machine interfaces) elements of such an operations center or Wing Command Center. These elements might include some or all of the following, categorized into two broad areas, for which the contract may propose to address either or both:

- Data Fusion and Information Processing
  a) Improved information systems to support enhanced operator awareness and efficiency; b) Tools that automate the mining, fusion, and presentation of data including legacy data systems and formats and communication infrastructure supporting commanding, controlling, and reporting status of ICBM assets;
- Architectural and Functional Modernization
  a) Effective human machine interfaces for enhanced understanding of situations and rapid decision making;
  b) Enhanced presentation capabilities for shared situational awareness, both large and small scale.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for potential government applications. There are potential commercial applications in a wide range of diverse fields that include cargo transport operations centers, industrial systems monitoring, and security response command centers.

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KEYWORDS: Command and Control; Human-Machine Interfaces; Data Processing; Data Mining/Fusion; Automation; Situational Awareness; Multi-Domain; Mobile Technology; Presentation

AF212-D009 Adaptive Filtering for Anti-Jamming of GPS, Wireless and Spread Spectrum

TECH FOCUS AREAS: Network Command, Control and Communications

TECHNOLOGY AREAS: Sensors

OBJECTIVE: This is a Direct to Phase II topic. Air Force tactical communications provide information and dataflow between various airbases involved in conflict and these airbases require communication back to central commands in the United States and in Europe. Tactical satellite communications play an important role connecting air bases, and air bases with central command. Ground to air to ground communications are important in airborne Mission Control and airspace management. [1]

DESCRIPTION: GPS is vulnerable to jamming and effective adaptive filtering techniques can detect and counter swept frequencies and continuous wave interferers.[2] [3] [4] [5] Adaptive filtering methods are needed in the setting of wireless communications where the received signal is interfered by additional transmitters and by multiple scattering due to multipath in the environment of use.[6] A third important application of adaptive filtering is the protection of spread spectrum communication systems from high power, frequency-mobile jamming.[7] [8]

This effort requires the evaluation of the use of adaptive filters in the three described instances involving jamming: GPS, wireless systems, and spread spectrum. In the setting of GPS and wireless systems, adaptive filtering shall be applied to detect the interferer and null it by using an array chancellor, adaptive notch filtering, and additionally, a process that leverages partial knowledge of the GPS or wireless signal structure when it is available. In the setting of spread spectrum, rapidly defined and acting notch filters shall be applied as well as more complex filter banks for multi-frequency interferers. In each of the three cases, the adaptive filter performance shall be evaluated in the setting of system models that represent all salient features of actual physical systems.

PHASE I: Focus of Phase I should be design and development of small-scale test articles and preliminary testing demonstrating concept feasibility.

PHASE II: Focus of Phase II should be further iterations on design and development resulting in functional or manufacturing scale up for larger test articles.

PHASE III DUAL USE APPLICATIONS: The fundamental nature of AFOSR programs reflect the broad opportunity to commercialize science to both commercial and defense markets. Awardees will have the opportunity to integrate with prospective follow-on transition partners. The contractor will transition the solution to provide expanded mission capability to a broad range of potential Government and civilian users and alternate mission applications.

REFERENCES:

1. Alan D. Campen, Information Systems and Air Warfare, in A. D. Campen, editor, The First Information War, AFCEA International Press, Fairfax, Virginia, 1992
2. Qiang Li, Dingjie Xu, Wei Wang, Xiangpeng Wamg and Zifa Han, Anti-jamming scheme for GPS receiver with vector tracking look and blind beamformer, Electronics Letters, vol 50, no 19, 2014
3. Li-wen Chen, Jian-sheng Zheng, Ming-kun Su, Jian-li Zhang, A Strong Interference Suppressor for Satellite Signals in GNSS Receivers, Circuits, Systems, Signal Processing, vol 36, 2017.
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5. Ying-Ren Chien, Design of GPS Anti-Jamming Systems Using Adaptive Notch Filters, IEEE Systems Journal, vol 9, no. 2, 2015.
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8. Qi Ling and Tongtong Li, Modeling and Detection of Hostile Jamming in Spread Spectrum Systems, 2007 IEEE Workshop on Signal Processing Applications for Public Security and Forensics.

KEYWORDS: GPS; jamming; adaptive filter; communications; wireless

AF212-D010 Image Segmentation for Target Attitude using a Priori Knowledge

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: This is a Direct to Phase II topic. Demonstrate contour, shape, optical-flow, or other image segmentation techniques for robust model based test and evaluation of target attitude determination, using perfect a priori knowledge of target geometry, for arbitrary cluttered backgrounds. A successful research effort will produce the following deliverables:

1) An image processing toolkit suitable for inclusion in current government-owned analysis tools,
2) A report detailing extensive verification of the toolkit using benchmark synthetic and real imagery, and
3) A paper accepted to a relevant scientific conference.

DESCRIPTION: Photogrammetric multi-view determination of target attitude (or pose) can be a simple machine vision problem, given sufficiently resolved imagery and benign backgrounds. For ground-based imagery of missiles in flight, however, resolution can be marginal and backgrounds are rarely benign. For cooperative tests, the external geometry of the missile can be known a priori to whatever accuracy is desired. Additionally, the location of the target missile can generally be localized in the image a priori as well. This is not a tracking issue. What is needed is an evaluation algorithm that provides the "best" overlay of the known physical target on top of the measured scene. Marginal resolution, varying lighting conditions, cluttered backgrounds, and poor target contrast contribute to the difficulty of segmenting the image, and determining the best monocular pose for the target missile. A significant portion of the effort should involve selecting and or creating relevant bench mark test data sets for comparison against other state of the art approaches and methods.

PHASE I: Focus of Phase I should be design and development of small-scale test articles and preliminary testing demonstrating concept feasibility.

PHASE II: Focus of Phase II should be further iterations on design and development that result in functional or manufacturing scale up for larger test articles.

PHASE III DUAL USE APPLICATIONS: The fundamental nature of AFOSR programs reflect the broad opportunity to commercialize science to both commercial and defense markets. Awardees will have the opportunity to integrate with prospective follow-on transition partners. The contractor will transition the solution to provide expanded mission capability to a broad range of potential Government and civilian users and alternate mission applications.

REFERENCES:

1. "Spatially variant mixture model for natural image segmentation," Can Hu, Wentao Fan, Ji-Xiang Du, Nan Xie, SPIE J. Electronic Imaging 26 (4), 11 July 2017
2. "Automatic Image Registration Based on Shape Features and Multi-scale Image Segmentation, " Haigang Sui et al., IEEE 2017 2nd International Conference on Multimedia and Image Processing (ICMIP)C. Das, Naresh & Olver, Kim & Towner, F. (2005). High emissive power MWIR LED array. Solid-State Electronics. 49. 1422-1427. 10.1016/j.sse.2005.06.018.
3. Interactive image segmentation based on object contour feature image," Qiang Chen et al., 2010 IEEE International Conference on Image Processing, pp. 3605-3608
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KEYWORDS: Image Analysis; Image Segmentation; Pose Estimation; Missile Attitude

CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM
FY21.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

The approved FY21.2 topics included in the Chemical and Biological Defense (CBD) Small Business Innovation Research (SBIR) Program are listed below. Offerors responding to this Announcement must follow all general instructions provided in the Department of Defense (DoD) Program Announcement. Specific CBD SBIR requirements that add to or deviate from the DoD Program Announcement instructions are provided below.

Please read the entire DoD Announcement and these CBD SBIR instructions carefully prior to submitting your proposal. Also go to https://www.sbir.gov/about/about-sbir#sbir-policy-directive to read the SBIR/STTR Policy Directive issued by the U. S. Small Business Administration (SBA).

General Information

In response to Congressional interest in the readiness and effectiveness of U.S. Nuclear, Biological and Chemical (NBC) warfare defenses, Title XVII of the National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160) requires the Department of Defense (DoD) to consolidate management and oversight of the Chemical and Biological Defense (CBD) Program into a single office – Office of the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense Programs. The Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD), located at the Defense Threat Reduction Agency (DTRA), provides the management for the Science and Technology component of the Chemical and Biological Defense Program. Technologies developed under the Small Business Innovation Research (SBIR) Program have the potential to transition to the Joint Program Executive Office for Chemical Biological Radiological and Nuclear Defense (JPEO-CBRND) if the appropriate level of technology maturity is demonstrated. The JSTO-CBD Science & Technology programs and initiatives improve defensive capabilities against Chemical and Biological Weapons of Mass Destruction. The SBIR portion of the CBD Program is managed by the JSTO-CBD.

The mission of the Chemical and Biological Defense Program is to ensure that the U.S. Military has the capability to operate effectively and decisively in the face of chemical or biological warfare threats at home or abroad. Numerous factors continually influence the program and its technology development priorities. Improved defensive capabilities are essential in order to mitigate the overall impact of chemical and biological threats. The U.S. military requires the finest state-of-the-art equipment and instrumentation available to permit our warfighters to 'detect to warn' and avoid contamination, if possible – and to be able to sustain operations in a potentially contaminated environment. Further information is available at the Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs homepage at https://www.acq.osd.mil/ncbdp/cbd/

The overall objective of the CBD SBIR Program is to improve the transition or transfer of innovative Chem-Bio technologies to the end user – the warfighter – in addition to commercializing technologies within the private sector for mutual benefit. The CBD SBIR Program targets those technology efforts that maximize a strong defensive posture in a biological or chemical environment using passive and active means as deterrents. These technologies include chemical and biological detection for both point and stand-off capabilities; individual and collective protection; hazard mitigation (decontamination); medical pre-treatments (e.g., vaccine development and delivery); medical therapeutics (chemical countermeasures and biological countermeasures); medical diagnostics; Digital Battlespace Management (aka information systems technology) to include but not limited to modeling and simulation (e.g., meteorological dispersion), disease surveillance, data fusion, and health & human effects to include wearable technologies.

Proposals not conforming to the terms of this Announcement will not be considered. CBD SBIR reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by CBD SBIR will be funded. CBD SBIR reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, or other related issues).

Use of Foreign Nationals (also known as Foreign Persons), Green Card Holders, and Dual Citizens

See the "Foreign Nationals" section of the DoD SBIR Program Announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, 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 the project. You may be asked to provide additional information during contract 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)).

Submitting Your Phase I CBD SBIR Proposal

Your entire proposal submission must be submitted electronically through the Defense SBIR/STTR Innovation Portal (DSIP) located at: https://www.dodsbirsttr.mil

A hardcopy is NOT required and will not be accepted by the Chemical and Biological Defense SBIR Program. Hand or electronic signature on the proposal is NOT required.

Any questions pertaining to the DoD SBIR/STTR submission system should be directed to the DoD SBIR/STTR Help Desk at: DoDSBIRSupport@reisystems.com.

Questions pertaining to the CBD SBIR program and these proposal preparation instructions should be directed to: Mr. Larry Pollack, Chemical and Biological Defense (CBD) SBIR Program Manager, Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD), e-mail: lawrence.p.pollack2.civ@mail.mil

The Proposal Technical Volume must be 20 pages or less in length. No other information included in the other proposal volumes counts against the 20-page Proposal Technical Volume page limit. Pages provided in excess of this length will not be evaluated or 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 maximum dollar amount for a Phase I proof-of-concept/feasibility study is $167,500 for a period of performance of up to six (6) months. **The CBD SBIR Program will not accept Phase I proposals which exceed $167,500 for the Phase I effort**. The total SBIR funding amount available for Phase II activities from a resulting Phase II contract is not to exceed $1,100,000.

Selection of Phase I proposals will be based upon the three evaluation criteria discussed in this Program Announcement. The CBD 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. All SBIR contract awards, both Phase I and Phase II, are subject to availability of funding.

Companies should plan carefully for any research involving animal or human subjects, chemical agents, biological agents, etc. The brief Period of Performance available for a Phase I project precludes plans that include these elements, as all DoD requirements and necessary approvals associated with animal and/or human use must be strictly adhered to, and require considerable coordination and significant time for final protocol approvals. See Section below for further information regarding all research that will include animal and/or human subjects.

Proposals not conforming to the terms of this Announcement, and any unsolicited proposals, will not be considered. All awards are subject to the availability of funding and successful completion of contract negotiations. The Chemical and Biological Defense Program is not responsible for any funds expended by the proposer prior to contract award.

CBD Program Phase II Proposal Guidelines

Phase II is the demonstration of the technology that was found feasible in Phase I. Phase I awardees may submit a Phase II proposal without invitation; however, it is strongly encouraged that a 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. Therefore, it is suggested that a Phase II proposal be submitted no sooner than five months from date of Phase I contract award. **All Phase II proposal submissions must be submitted electronically through the Defense SBIR/STTR Innovation Portal system at: https://www.dodsbirsttr.mil**

At the proposal submission website, Phase II proposals MUST be submitted to '**CBD** SBIR' regardless of which DoD contracting office negotiated and awarded the Phase I contract. Additional instructions regarding the Phase II proposal submission process including submission key dates will be provided to Phase I awardees after the Phase I contract is awarded; additional information may also be found at http://www.cbdsbir.net.

The Phase II proposal must include a concise summary of the Phase I project including the specific technical problem or opportunity addressed and its importance, the objective of the Phase I project, the type of research conducted, findings or results of this research, and technical feasibility of the proposed technology. Due to limited funding, the CBD SBIR program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

All proposers are required to develop and submit a commercialization plan describing feasible approaches for marketing and manufacturing the developed technology. Proposers are required to submit a budget for the entire 24-month Phase II Period of Performance. During contract negotiation, the Contracting Officer may require a Cost Volume for a base year and an option year; thus, proposers are advised to be aware of this possibility. These costs must be submitted using the Cost Volume format (accessible electronically on the DoD SBIR/STTR submission site). The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. At the Contracting Officer's discretion, Phase II projects may be evaluated for technical progress prior to the end of the base year, prior to extending funding for the option (second) year.

The CBD SBIR Program is committed to minimizing the funding gap between Phase I and Phase II activities. The CBD SBIR Program typically funds a cost plus fixed fee Phase II award, but may award a firm fixed price contract at the discretion of the Contracting Officer.

It is recommended that Phase II awardees have a Defense Contract Audit Agency (DCAA) approved accounting system. If you do not have a DCAA approved accounting system, this could delay/prevent a Phase II contract award. Visit https://www.dcaa.mil/Customers/Small-Business for more information on DCAA approved accounting systems.

Technical Assistance

At this time, the CBD SBIR Program is not participating in the Technical and Business Assistance (TABA) Program.

Protest Procedures

Refer to the DoD SBIR Program Announcement for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Mr. Larry Pollack, Chemical and Biological Defense (CBD) SBIR Program Manager, Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD), lawrence.p.pollack2.civ@mail.mil

CBD SBIR Projects Requiring Animal and Human Subjects

Companies should plan carefully for any research involving animal and/or human subjects in addition to the use of any chemical or biological warfare agents, and use of any agents associated with "Dual Use Research of Concern (DURC)". The brief Phase I Period of Performance precludes plans requiring the use of many of these materials as well as animal and/or human subjects prior to obtaining all necessary DoD approvals.

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 U.S. 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 as part of the CBD SBIR program will be issued after contract award 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 CBD SBIR awards involving the use of human subjects, to include the use of human anatomical substances or human data, shall not be proposed for any Phase I Period of Performance. If Human Subjects research is proposed during the Phase II Period of Performance, the studies may not begin until the DTRA Research Oversight Board (ROB) provides authorization that the research protocol may proceed. Written approval to begin research protocol will be issued from the ROB, under separate notification to the recipient. Written approval from the ROB is also required for any sub-recipient that will use funds obtained from any CBD SBIR awards to conduct research involving human subjects.

Changes in research involving human subjects shall be conducted in accordance with the protocol submitted to and approved by the ROB. Non-compliance with any provision may result in withholding of funds and or termination of the award.

Notification of Selection or Non-selection

Proposing firms will be notified of Selection or Non-selection for a Phase I award within 90 days of the closing date of the BAA. For each proposal submitted, the individual named as the Corporate Official on the Proposal Cover Sheet will receive an email from *notification@dtrasubmission.net* with their official notification of proposal Selection or Non-selection decision. Please check your Spam folder for the notification e-mail, should you not receive the notification to your inbox within the 90 day time period.

CBD 21.2 Phase I Topic Index

CBD212-001 TITLE: Multi-Modal Detection of Chemical Threats Using Deep Learning

KEY TECHNOLOGY AREA(S): Chemical/Biological Defense; Battlespace Environments; Sensors

OBJECTIVE: Develop a Deep Learning (DL) threat detection solution using a fusion of imaging sensors and chemical/biological sensors to detect and locate concealed chemical threats (with potential capabilities for both biological and explosives threats). The developed architecture must be deployable on edge computing platforms for use in real time (better than 60 second detection, 60 frames per second for video sensors) standoff threat detection platforms (50 m) such as Unmanned Aerial Vehicles (UAVs) and Unmanned Ground Vehicles (UGVs).

DESCRIPTION: Detection of concealed chemical threats through the development of sensor technology has improved over the last decade. Automated threat identification and location remains a challenge in operational environments. Multi-modal sensing promises to provide greater threat detection capability, as well as identification of threat location and type than individual sensing modalities can provide. Imaging solutions, such as infrared sensors, LIDAR, and RADAR, provide threat detection and location capabilities but cannot adequately differentiate chemical threat types. Chemical sensors provide remarkable capability of threat identification, and general vicinity detection but cannot adequately spatially locate chemical threats. A multi-modal approach to threat detection will provide improved situational awareness and inform appropriate threat response.

DL algorithms have significantly improved the ability to autonomously detect a wide range of threats. Recent developments of DL algorithms combine audio and visual representations of a state to increase the correlation of input data to a specific target. Extrapolating from visual and auditory inputs to other sensing modalities will drive automated detection algorithms for chemical/biological threats for environmental awareness of operational environments. Development of a DL architecture that jointly exploits the signature from a chemical sensor with a threat signature from an imaging sensor has multiple benefits over single mode detection modalities by increasing threat detection confidence, as well as threat identification/classification. Additionally, multi-modal DL architectures have shown promise of being less vulnerable to adversarial examples, inputs modified by introducing small perturbations to deliberately fool a target model into outputting incorrect results, bringing an additional layer of security to Department of Defense (DoD) threat detection technologies.

Phase I proposals should advance the state-of-the-art of automated chemical threat detection, location, and identification by incorporating multi-modal sensor inputs to a DL detection/identification process. To advance to a Phase II project, performers must demonstrate improved detection/identification rates higher than single mode detection techniques. It is expected that in Phase I and Phase II, performers will utilize Commercial-Off-the-Shelf (COTS) or novel sensor technologies.

PHASE I: Develop and test a DL architecture that jointly exploits multi-modal sensor inputs for chemical threat detection and identification. Demonstrate the improved detection performance of the multi-modal DL architecture over single mode DL automated detection algorithms. During the Phase I project, the proof-of-concept demonstration should focus on the discrimination of at least two or more chemical threats with a clear path forward on implementing the DL architecture with low size, weight and power (SWaP) computing hardware for edge computing. Chemical warfare threats of all classes are of interested for threat detection and localization (better than 5 meter accuracy). Examples of chemical threats of interest include, but are not limited to, chlorine; tear gas/pepper spray; and nitrogen oxides.

The Phase I deliverable should explain the algorithms tested, software concepts, hardware requirements, results of single mode and multimodal detection tests, and potential use cases and limitations identified within the Chemical and Biological Defense program.

PHASE II: Phase II will focus on the development and testing of an embedded multi-modal DL algorithm on a field portable computational platform that can accept multiple sensor inputs. Design of the DL architecture will enable low SWaP requirements of the computation platform to enable ease of deployment to operational environments on small unmanned vehicles (UxV). Evaluation of the multi-modal DL chemical detection algorithms will be extended to multiple threat vectors and demonstrate improved threat detection and identification over single mode DL architectures. Laboratory based characterization and validation of the embedded DL algorithm will be required for a successful completion of Phase II. Technical demonstration and validation of the developed technology in operationally relevant environments will take place with government personnel.

PHASE III: The expected Phase II end-product is a well-designed, deployable edge computing device with an embedded DL algorithm trained for detection of chemical threats that can be used on ground and aerial vehicles. Follow-on government and civilian activities are expected to be pursued by the offeror. Transition of the developed technology will require refined algorithm training and testing to optimize the threat detection capability for the chemical threats of concern, as well as extending the number of trained threats and modalities that can be identified. Edge case testing will also be explored and defined.

PHASE III DUAL USE APPLICATIONS: Multi-modal target discrimination DL algorithms can support and enhance medical diagnostic applications for increased prognostic assurance. Additionally, leveraging multiple sensor inputs improves perception of a vehicle’s immediate environment.

REFERENCES:

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2. Alshemali, Basemah, and Jugal Kalita. "Improving the reliability of deep neural networks in NLP: A review." Knowledge-Based Systems 191 (2020): 105210.
3. Ortega, Juan DS, et al. "Multimodal fusion with deep neural networks for audio-video emotion recognition." arXiv preprint arXiv:1907.03196 (2019).
4. Le, Minh Hung, et al. "Automated diagnosis of prostate cancer in multi-parametric MRI based on multimodal convolutional neural networks." Physics in Medicine & Biology 62.16 (2017): 6497.
5. Giering, Michael, Vivek Venugopalan, and Kishore Reddy. "Multi-modal sensor registration for vehicle perception via deep neural networks." 2015 IEEE High Performance Extreme Computing Conference (HPEC). IEEE, 2015.

KEYWORDS: Deep Learning, Chemical/Biological Threat Detection, Multi-Modal Sensing, Scene Perception, Algorithms

CBD212-002 TITLE: Augmented Reality CBRN Threat Display for Mounted Situational Awareness

KEY TECHNOLOGY AREA(S): Chemical/Biological Defense; Information Systems Technology; Human Systems

OBJECTIVE: To provide a real-time, geospatially accurate, augmented reality display of various CBRNE sensor data to mounted and dismounted warfighters.

DESCRIPTION: CBRN (Chemical, Biological, Radiological, Nuclear) sensors are present throughout the armed forces. The Stryker Nuclear Biological Chemical Reconnaissance Vehicle Sensor Suite Upgrade (NBCRV SSU) provides CBRN mounted reconnaissance capability for both manned and unmanned Stryker systems. Newer, smaller CBRN and EO/IR sensors are also increasingly being deployed to small Unmanned Ground Vehicles (UGV) or Unmanned Air Systems (UAS). Much of the effort is focused on collecting situational awareness at mission-speed. The increased amount and variety of data can be challenging to interpret, especially in a moving vehicle for a mounted reconnaissance mission. While strides have been made to populate CBRN sensor data into situational awareness tools such as the Android Team Awareness Kit (ATAK), additional real-time capabilities to present information at mission speed are desired. Augmented Reality (AR) capabilities such as the Integrated Visual Augmentation System (IVAS) are being developed to provide individual warfighters with real-time heads-up viewing capabilities for a variety of applications.

This development program seeks to join CBRN sensors and emerging Augmented Reality displays together to provide a detailed, unified real-time CBRN-centric view of the battlespace. Back-end integration with other existing C2 systems such as the Android Team Awareness Kit (ATAK), Inertial Navigation Systems (INS), and support for future higher-performance sensors utilizing AI/ML is desired. Support for open standards is also highly desired.

Of particular interest is the potential to integrate and display real-time sensor information coming from a downrange, vehicle-mounted, portable mass spectrometer device as well as a handheld radioisotope identification device (RIID) to show the capability to map chemical vapors and radiation fields in real-time by directly connecting the sensors to the Heads-up Display (HUD).

PHASE I: Phase I will consist of a proof-of-concept system utilizing existing CBRNE sensors, AR HUDs and other displays, user interface concepts, and accompanying system architecture showing the growth path to future sensors, phases, and capabilities. A key deliverable of Phase I will be a proof-of-concept showing direct communication of mature RIID and Mass Spectrometer data to a HUD device to generate an AR display of sensor data with localization of threats.

PHASE II: Phase II will consist of maturation of the concept and integration of the system onto a representative platform and show integration with geo-referenced, off-board sensor systems, greater fidelity on the display, and increased usability to include use while on-the-move. The key deliverable of Phase II will be the demonstration of the system in a relevant platform combining the sensors on a vehicle exterior with the real-time AR view on a HUD device from the interior of a vehicle to demonstrate real-time CBRNE situational awareness.

PHASE III: Phase III will transition the program to an operationally relevant environment, including testing and validation to certify the program for Department of Defense use (Joint Chemical and Biological Defense Program). The system has the potential to be installed on reconnaissance vehicles such as the Stryker or in other tactical vehicles and on unmanned reconnaissance platforms. The platform will be further extendable to other types of fielded sensors for situational awareness.

PHASE III DUAL USE APPLICATIONS: The same system could be installed on vehicles used by other agencies responsible for CBRN and EO/IR systems for surveillance missions such as the Department of Homeland Security (DHS).

REFERENCES:

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2. Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV) — Stryker Sensor Suite. https://asc.army.mil/web/portfolio-item/cbd-nuclear-biological-chemical-reconnaissance-vehicle-nbcrv-stryker-sensor-suites/
3. Army conducts major milestone tests in development of next gen fighting system
4. https://www.army.mil/article/240584/army_conducts_major_milestone_tests_in_development_of_next_gen_fighting_system

KEYWORDS: CBRN, Augmented Reality, ATAK, UAV, radioisotope, Heads-Up Display

CBD212-003 TITLE: Field Portable Bioaerosol Identification via Mass Spectrometry

KEY TECHNOLOGY AREA(S): Chemical/Biological Defense, Biomedical

OBJECTIVE: Develop a field portable, mass spectrometry-based system that rapidly identifies aerosolized biological particulate, arising from the breath of a warfighter, or from their surrounding environment and the identification technology must be adaptable to the evolution of pathogens both natural and synthetic.

DESCRIPTION: Aerosolized biological particles are a major vector causing the spread of disease from human to human and from animal to human [1]. This is particularly true for respiratory pathogens such as adenoviruses, influenza viruses, *Mycobacterium tuberculosis* and coronaviruses such as SARS-CoV-2. Currently, global healthcare systems and governments are in acute crisis because of the worldwide spread of SARS-CoV-2 and the COVID-19 pandemic disease caused by this virus - that arose from animal-to-human transmission. The ability to rapidly, accurately and affordably screen the environment for a wide range of aerosolized pathogens arising from agricultural sources (live animal markets) and human exhaled breath could revolutionize the discovery of emerging pathogens and the ability to identify spreaders of these diseases.

The ability to identify bioaerosols enables a system that could pinpoint persons who are actively shedding pathogen and spreading a disease. Identification of these spreaders, and superspreaders [2], is a vital tool aimed at shutting down the infectious cycle. The enormity and constancy of such a screening protocol argues for testing that is non-invasive, extremely low cost and requires little or no consumables.

In a patient care setting a bioaerosol identification system could be used to monitor the air surrounding the patients for the presence of infectious agent. Constant analysis of the levels of these agents in the air could be used to determine the efficacy of protective measures such as advanced filtration and ventilation on the patients and staff of the facility. Excursions of these measurements above an established baseline could alert personnel to dangerous situations, triggering responses such as donning of enhanced PPE or increasing technical measures such as the air exchange rate in the facility.

Finally, while a bioaerosol identification device has great utility against existing disease states, the tool could provide critical information on potential new organisms originating in agricultural or wildlife settings. Constant monitoring of the air in these environments could provide critical early stage biosurveillance as organisms mutate, potentially resulting in a future pandemic. This mode of operation could be used as a biosurveillance tool and could provide early warning of the rise of a new pandemic threat. If a potential new threat is detected, the signatures of that threat could be propagated through a distributed system of biosurveillance devices.'
This technology development focuses on mass spectrometry because it has the potential to meet the following requirements that would enable wide spread use of the technology:

- Direct, non-invasive sampling
- Rapid automated sample preparation (< 1 min)
- Very fast analysis (< 1 min)
- High sensitivity (10’s of organisms)

- High specificity using biomolecular signatures
- Rapid adaptability to new/unknown threats through electronic signature updates
- Very low cost of analysis (<$1 per test)

PHASE I: Phase I entails the design of a concept for a rapid identification system of aerosolized pathogens, identification of key system components and initial testing of those components. The drivers for a technically and commercially successful system will be adaptability, sensitivity, specificity, speed, and cost-per-test. The performer will perform a detailed literature search on the aerosol concentration of pathogens in and around sources of infectious particles to determine the operative sensitivity threshold within proposed use scenarios for their specific detection technology. For certain highly desirable use scenarios, particularly high-throughput screening using human breath samples, an analysis time that is in the 1 minute or less range is preferred. Such a rapid analysis drives a base detection/identification technology that is extremely sensitive, yet it must have sufficient specificity so as not to have unacceptable false alarm rates. Finally, given the massive screening use scenarios, the cost-per-test must be very low. The initial effort in Phase I will be the development of a concept that incorporates the speed, sensitivity, specificity, and cost elements described here. Critical elements or components of the design should be chosen and tested for applicability in the proposed overarching design. Finally, a refined preliminary design should be developed to lead to a proposed Phase II prototype.

PHASE II: In Phase II, the small business will develop, demonstrate and validate a system for aerosolized biopathogen identification using non-pathogenic simulants of bacterial and viral disease vectors.

Following a Preliminary Design Review (PDR), the performer will assemble and test a breadboard system that has the initial versions of the sampling, analysis, and data reporting subsystems interoperating. This system will be tested using aerosolized biopathogen simulants in relevant laboratory backgrounds. The system will be benchmarked against standard laboratory techniques of biopathogen identification. The key detection/identification parameters will be assessed, and necessary improvements identified. An initial analysis of the commercial applications of the system will be conducted focusing on the baseline cost of the system, the cost-per-test, and the market space addressed by the technology development.

Following the completion of the preliminary design system, the performer will upgrade the breadboard system with modifications that address deficiencies identified in testing and analysis, and leading to a Critical Design Review (CDR). Following this review, a complete prototype system will be fabricated and tested in a relevant environment. Depending on the ultimate use case for the technology, this could be a human disease sampling effort, or it could be an environmental testing scenario in a hospital unit or in an agricultural setting. The performer will provide a detailed test plan that must contain human usage approvals, if such testing is anticipated. A refined analysis of the commercial opportunities for the technology also will be completed.

PHASE III: Phase III work is typically oriented towards technology transition to Acquisition Programs of Record and/or commercialization of SBIR research or technology. In Phase III, the performer is expected to seek funding from non-SBIR government sources and/or the private sector to develop or transition the prototype into a viable product or service for sale in the military or private sector markets. The Phase III description must include the "vision" or "end-state" of the research. It must describe one or more specific Phase III military applications and/or supported S&T or acquisition program as well as the most likely path for transition of the SBIR from research to operational capability. Additionally, the Phase III section must include (a) one or more potential commercial applications OR (b) one or more commercial technology that could be potentially inserted into defense systems as a result of this particular SBIR project.

PHASE III DUAL USE APPLICATIONS: A rapid, sensitive, specific, low-cost approach to identification of bioaerosol components will have application beyond DoD needs. The ability to rapidly screen persons transmitting disease could revolutionize the control of infectious disease spread. For instance, Homeland Security components such as Transportation Security Agency (TSA) and Customs and Border Protection (CBP) could employ such a system to screen disease spreaders at transportation hubs and border crossings. In agricultural applications, such a system could signify the spread of a disease through a feedlot or even the emergence of a potential new vector for human disease.

REFERENCES:

1. *Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infections in Health Care*. Geneva: World Health Organization; 2014. (https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions)
2. Frieden, T. R., & Lee, C. T. (2020). Identifying and Interrupting Superspreading Events—Implications for Control of Severe Acute Respiratory Syndrome Coronavirus 2. Emerging Infectious Diseases, 26(6), 1059-1066. (https://dx.doi.org/10.3201/eid2606.200495).
3. Yadana, S., Coleman, K. K., Nguyen, T. T., Hansen-Estruch, C., Kalimuddin, S., Thoon, K. C., Low, J., & Gray, G. C. (2019). Monitoring for airborne respiratory viruses in a general pediatric ward in Singapore. *Journal of public health research, 8*(3), 1407. (https://doi.org/10.4081/jphr.2019.1407)

KEYWORDS: Aerosolized pathogens, breath sampling, environmental sampling, biosurveillance

CBD212-004 TITLE: Development and Testing of a Multi-dose Vial for Scopolamine Hydrobromide Trihydrate Formulation for Intramuscular Injection

KEY TECHNOLOGY AREAS: Chemical/Biological Defense, Biomedical

OBJECTIVE: To develop a multi-dose, scopolamine hydrobromide trihydrate vial containing a formulation that is stable, injectable, and suitable for GMP manufacture.

DESCRIPTION: The Joint Project Manager for Chemical, Biological, Radiological, and Nuclear Medical (JPM CBRN Medical) is developing scopolamine hydrobromide trihydrate (Scop-HBT) under the Improved Nerve Agent Treatment System - Centrally Acting (INATS CA) program. Scop-HBT is an anticholinergic medical countermeasure (MCM) that temporarily blocks severe or life-threatening muscarinic effects caused by organophosphorus nerve agent (OPNA) poisoning. The improved OPNA treatment regime will consists of the Scop-HBT intramuscular (IM) injection as an adjunct to the standard of care autoinjectors containing atropine and 2-PAM (2-pyridine aldoxime methyl chloride (Pralidoxime). The combined therapeutic action will help to decrease morbidity and mortality of military personnel and civilians exposed to OPNAs. Currently, the JPM CBRN Medical is developing Scop-HBT in an autoinjector format; the concentration is not yet final, but a concentration between 0.8 mg/ml and 2.0 mg/ml is anticipated. The autoinjector in development is suitable for use by an individual to deliver immediate treatment. However, the use of single dose devices and/or vials represents a significant logistical burden to military first responders that will need to deliver multiple injections during a mass casualty event. A multi-dose vial with Scop-HBT for IM injection, 20 ml total volume containing 10-20 doses, will significantly decrease logistical burden associated with having to use multiple single dose vials to treat during mass casualty OPNA exposure incidents, as well as for treating single OPNA exposure casualties over a prolonged period of time.

PHASE I: Establish preliminary specifications for a multi-dose formulation under International Conference on Harmonization (ICH) Pharmaceutical Development Guidelines**.** The active drug substance to be employed will be Scop-HBT (United States Pharmacopeia (USP) grade or Department of Defense (DoD) supplied). Initial test vials will contain a total of 20 ml of drug solution volume, containing a concentration range of 0.8 mg to 2.0 mg of Scop-HBT per ml in an appropriately sealed, pharmaceutical grade light-restricting glass vials, as designed for injectable drug formulations. Based on the single dose formulation ranging from 0.8 mg/ml to 2.0 mg/ml, the target pH of the formulation is approximately 3.00 ± 0.10 in pharmaceutical grade buffer, and tonicity adjusted to approximate isotonicity (270 to 310 mOsm (milliosmole). The test formulations will evaluate added U. S. Food and Drug Administration (FDA) approved, effective antimicrobial preservatives (e.g., 0.9% benzyl alcohol or 0.5% chlorobutanol) against analytical parameters established for the DoD single dose formulation (currently in development). Stability assessments could employ forced degradation and initial real time testing for the scopolamine drug substance, and development of degradants at targeted temperatures and relative humidity conditions: refrigerated (2-8°C), room temperature (25 ± 2°C / 60% ± 5% RH), and stressed (40 ± 2°C / 75% ± 5% RH).

PHASE II: Conduct further evaluation, improvements, and stability enhancements of selected candidate. Subsequent analytical testing is to be performed to determine the presence and concentrations of extractables and leachables. Real-time stability is to be evaluated to achieve a targeted shelf-life of two years at 25 ± 2°C / 60% ± 5% RH. Subsequent studies may determine the effects of potential stability enhancement techniques as needed, such as utilization of head-space nitrogen purge, vacuum seal, or other to promote extended stability to two years. A syringe needle puncture study is to be performed to evaluate required 28 day drug stability (28 days at 2-8°C and 25°± 2°C / 60% ± 5% RH (relative humidity)). The performer may evaluate the use of lyophilization as a dry powder stability enhancer after reconstitution, with bacteriostatic saline or sterile water for injection. This may be accomplished with variable addition of the antimicrobial agent as needed. The performer may determine the shelf-life stability of the lyophilized powder as needed under vacuum seal or nitrogen purge. A 28 day stability study will be evaluated to determine shelflife after reconstitution. The last developmental step is analytical analysis to demonstrate equivalence to the single dose IM Scop-HBT formulation currently being developed by the DoD (final concentration and comparator to be provided at time of contract award).

PHASE III: Develop scale-up processes and technology transfer protocol for the pilot lot and good manufacturing practice (GMP) production. Develop regulatory strategy, and initiate interactions with the FDA.

PHASE III DUAL USE APPLICATIONS: The Department of Health and Human Services (HHS) has a similar need for improved anticholinergic therapeutics, including multi-use vialed Scop-HBT for use in civilian casualty situations. Successful completion of all three phases under this solicitation will support small business valuation by confirming technical merit that invites further investment. This award mechanism will bridge the gap between laboratory-scale innovation and entry into a recognized FDA regulatory pathway leading to commercialization.

REFERENCES:
1. Selection of the Appropriate Package Type Terms and Recommendations for Labeling Injectable Medical Products Packaged in Multiple-Dose, Single-Dose, and Single-Patient-Use Containers for Human Use. Guidance for Industry. *Division of Drug Information, Center for Drug Evaluation and Research, FDA*. FDA-2015-D-3438. 2018.
2. Allowable Excess Volume and Labeled Vial Fill Size in Injectable Drug and Biological Products. Guidance for Industry. *Division of Drug Information, Center for Drug Evaluation and Research, FDA.* June 2015 Pharmaceutical Quality/CMC. 2015.
3. International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use. *ICH Harmonized Tripartite Guideline*. Pharmaceutical Development Q8 (R2). 2009.

KEYWORDS: atropine, scopolamine, chemical nerve agent, medical countermeasure, drug formulation

CBD212-005 TITLE: Improved Technologies for Protection and Treatment of Dermal Injuries Caused by Sulfur Mustard

KEY TECHNOLOGY AREAS: Chemical/Biological Defense, Biomedical

OBJECTIVE: To develop capabilities and obtain FDA approval for dermal dressing technologies that provide multiple advantages over current wound dressings for treating dermal injuries caused by sulfur mustard.

DESCRIPTION: Sulfur mustard (military designation HD or H) is a chemical warfare agent that affects multiple tissues, and causes blistering of the skin and mucous membranes on contact. The dermal lesions caused by HD resemble burn lesions, and can cover large portions of exposed skin surfaces. Like burn injuries, HD dermal lesions are extremely painful, can lead to fluid loss, and are highly susceptible to infection. Battlefield management of these wounds by military first responders can be especially challenging due to the high potential for mass casualties, the necessity to treat during ongoing operations in austere environments, and delays in medical evacuation.

The Joint Project Manager for Chemical, Biological, Radiological, and Nuclear Medical (JPM CBRN Medical) is interested in developing technologies (dressings, treatments, etc.) to treat HD dermal injuries in a battlefield environment. Candidate technologies for this application need to provide physical protection to burn-like injuries, be stable in a large range of conditions (temperature and humidity), be easy to apply, be suitable for application to various surface areas, allow inspection of injuries without removal, provide antimicrobial protection, and pain relief. The ultimate goal is to demonstrate efficacy in treating HD dermal injury in appropriate animal models of HD injury (see Phase II). In addition to being efficacious in protecting and treating HD dermal injuries to allow faster healing, top candidates for consideration will also possess additional desirable properties mentioned above. Among these are ease of application to facilitate use in a mass casualty event, and low logistical footprint (not cumbersome to carry, minimal cold chain storage requirements, sufficient shelf life, etc.). Other desirable properties sought are selective permeability to prevent fluid loss through the wound(s), antimicrobial properties to protect against infections, providing pain relief, and relative ease of removal for performing required treatments after application. These technologies have a broad potential application beyond just HD injuries; hence, they are expected to reduce logistical burden to the military first responder.

PHASE I: If the proposed technologies have been previously tested for other injury types, provide *in vivo* data demonstrating the efficacy of the product when used to treat similar injuries such as burns, severe abrasions, and/or other comparable injuries. Quantitative data that provides clear metrics that allow the comparison of the candidate to other products or standard medical care (wound size reduction over time, time to restoration of dermal layers, etc.) is preferred. Generate and provide a regulatory plan to obtain an FDA approval or an HD dermal injury indication. The plan should align with the timing and funding levels expected for SBIR Phase I and II, with the balance of funding and studies conducted in Phase III of the project. Obtain confirmation from the FDA, via pre-IND, Q-submission or pre-submission, that the regulatory plan is acceptable to obtain the HD dermal injury approval or indication for the candidate technology. A research partner should be identified that can perform the needed pre-clinical animal studies using sulfur mustard. No animal studies are permitted during the Phase I period of performance.

PHASE II: Perform an efficacy study in a small animal model. Provide a report of the small animal study to determine if the product should proceed to testing in a large animal model. Plan the large animal study, and submit an estimate of cost for conducting Phase III objectives. If feasible, perform packaging/container designs to allow treatment of larger surface areas and for multiple casualties. At this stage, accelerated stability studies to obtain estimates on storage shelf life and operational conditions should be performed.

PHASE III: Perform the efficacy study in a large animal model. Prepare regulatory strategy and submit FDA documentation to add HD injury indication to the product. Submit final reports that include the results of the animal studies, and any relevant FDA information/documents to the JPM CBRN Medical.

PHASE III DUAL USE APPLICATIONS: The technologies proposed for development are also applicable to a broad range of battlefield injuries. This significantly increases the value of the technologies and reduces the burden on military first responders since it eliminates the need to carry equipment solely dedicated to chemical agent injuries. Furthermore, the Department of Health and Human Services (HHS) has a similar need for technologies that allow treatment of HD and burn injuries in a mass casualty event. Successful completion of all three phases under this solicitation will support small business valuation by confirming technical merit that invites further investment. This award mechanism will bridge the gap between laboratory-scale innovation and entry into a recognized FDA regulatory pathway leading to commercialization.

REFERENCES:

1. Etemad L, Moshiri M, Balali-Mood M. Advances in treatment of acute sulfur mustard poisoning - a critical review. *Crit Rev Toxicol.* 2019; 49(3):191-214.
2. Rose D, Schmidt A, Brandenburger M, Sturmheit T, Zille M, Boltze J. Sulfur mustard skin lesions: A systematic review on pathomechanisms, treatment options and future research directions. *Toxicol Lett.* 2018; 293:82-90.
3. Poursaleh Z, Ghanei M, Babamahmoodi F, Izadi M, Harandi AA, Emadi SE, Taghavi NO, Sayad-Nouri SS, Emadi SN. Pathogenesis and treatment of skin lesions caused by sulfur mustard. *Cutan Ocul Toxicol.* 2012; 31(3):241-249.
4. Dachir S, Cohen M, Kamus-Elimeleh D, Fishbine E, Sahar R, Gez R, Brandeis R, Horwitz V, Kadar T. Characterization of acute and long-term pathologies of superficial and deep dermal sulfur mustard skin lesions in the hairless guinea pig model. *Wound Repair Regen.* 2012;20(6):852-861.
5. Ghanei M, Poursaleh Z, Harandi AA, Emadi SE, Emadi SN. Acute and chronic effects of sulfur mustard on the skin: a comprehensive review. *Cutan Ocul Toxicol.* 2010; 29(4):269-277.
6. Dachir S, Cohen M, Fishbeine E, Sahar R, Brandies R, Horwitz V, Kadar T. Characterization of acute and long-term sulfur mustard-induced skin injuries in hairless guinea-pigs using non-invasive methods. *Skin Res Technol.* 2010;16(1):114-124.
7. Laskin JD, Wahler G, Croutch CR, Sinko PJ, Laskin DL, Heck DE, Joseph LB. Skin remodeling and wound healing in the Gottingen minipig following exposure to sulfur mustard. *Exp Mol Pathol.* 2020; 115:104470.

8. Barillo DJ, Croutch CR, Reid F, Culley T, Sosna W, Roseman J. Blood and Tissue Silver Levels Following Application of Silver-Based Dressings to Sulfur Mustard Chemical Burns. *J Burn Care Res.* 2017; 38(5):e818-e823.

KEYWORDS: sulfur mustard, blister agent, vesicant, dermal, topical, wound healing, dressing

CBD212-006 TITLE: Development of Small Molecule Therapeutics Specifically Targeting Members of the Bunyavirales Order

KEY TECHNOLOGY AREA(S): Chemical/Biological Defense, Biomedical

OBJECTIVE: Develop an antiviral drug to be used as a therapeutic in the event of disease or as a prophylactic medical countermeasure (MCM) following exposure or threat of exposure to viruses of the Bunyavirales order.

DESCRIPTION: The *Bunyaviridae* are a very large family of single-strand, enveloped RNA viruses (more than 300 viruses) and consists of five genera of viruses: *Orthobunyavirus, Phlebovirus, Nairovirus, Hantavirus*, and *Tospovirus* (Tospoviruses infect only plants). They are found in and transmitted by arthropods (e.g. mosquitoes, ticks, sand flies) and rodents, and can occasionally infect humans. Several viruses of the *Bunyaviridae* virus family can produce mild to severe disease in human, in animals, and sometimes in both.[1]

Hantaviruses were first observed in the early 1950's among troops deployed in the Korean conflict. Eventually named Hantaan virus after the nearby Hantaan River where the human cases occurred, the field mouse (Apodemus agrarius) was discovered to be the specific rodent host for the virus. The disease is actually known as Hemorrhagic fever with renal syndrome (HFRS) and described in the Old World. Following a cluster of cases of severe illness, called Hantavirus Pulmonary Syndrome (HPS), in the American southwest in 1993, a newly identified virus, called the Sin Nombre virus, was isolated. Related viruses, but responsible for the same clinical disease, are described in the New World (North, Central and South America).[1]

Emerging Viruses posing a threat to the warfighter include members of the Bunyavirales order (e.g. Rift Valley Fever virus [RVFV], Severe Fever with Thrombocytopenia Syndrome virus [SFTSV], Crimean-Congo Hemorrhagic Fever virus [CCHFV]; Sin Nombre virus [SNV]). Outbreaks of several of these viruses have occurred during 2018 in global areas of U.S. military presence.

The presence of vectors in new areas where these viruses are not currently endemic could lead to expansion of endemic areas or pose sporadic outbreak risks. For example, SFTSV is a new emerging Phlebovirus in China, Japan, and South Korea that causes hemorrhagic fever with mortality rates of up to 30%, and the tick vector for SFTSV recently has been isolated in the United States. Autochthonous infection has been demonstrated for CCHFV, a Nairovirus whose global distribution in over 30 countries is second to Dengue virus. For some viruses, animal models have not been fully developed; thus, use of transgenic mouse or hamster lines or immunosuppression may be required for initial, in vivo assessments. [2, 3, 4]

This topic seeks to identify small molecule inhibitors of any phase of virus replication. The preferred therapeutic is a small molecule that exhibits broad activity across virus families. Ideally the therapeutic can be self-administered orally or at least by administration within a reasonably short time frame in clinical settings.

PHASE I: Identify small molecule inhibitors of Bunyavirus replication. A) Identification and development of working stocks of appropriate strains of virus(es) for testing. Alternatively, surrogate assays (e.g. pseudotyped particles, replicase assays) in lower safety containment laboratories are sufficient for early screening. Modeling data for potential broad-spectrum inhibition of Bunyavirus replication can be used to support intermediate development at the Phase II stage. B) Using high throughput screening of existing or novel libraries, identify small molecule inhibitors to virus replication of one or more of the members of the Bunyavirales order. The screening should assess antiviral activity and cytotoxicity. Studies that include any animal use will not be permitted during Phase I; obtaining all necessary DoD Animal Care and Use Review Office (AUCRO) approvals before any animal use may commence requires significant time and will preclude completing the Phase I project beyond the allowed six-month Phase I Period of Performance.

PHASE II: The objective of this phase is to assess the antiviral properties of a target small molecule for eventual IND filing. This will be accomplished by: A) Using compounds identified through high throughput screening, or for compounds in more advanced development stages, confirm the mechanism of action of optimized candidates; B) Develop clinical material for determining the PK/PD and ADME (absorption, distribution, metabolism, and excretion) of the compound and half maximal effective concentration(s) (EC50); C) In a single or series of pilot experiments, determine appropriate dose (using PK/PD modeling informed by successive experimental approaches) in an applicable animal model and assess toxicity and efficacy against one or more viruses. This stage will require development of working stocks of appropriate strains of virus(es) for testing (if not developed in Phase I), and performance within high containment laboratories.

PHASE III: Preclinical development of down-selected candidates to support submission of an application for an Investigational New Drug (IND). Construction of a Development Plan through consultation with a sponsor and the Food and Drug Administration (FDA). Discussions and preparations would include identification of appropriate virus strains, animal models, and if applicable, clinical trial location and development.

PHASE III DUAL USE APPLICATIONS: The viral agents listed in this SBIR topic lack treatment options, and any therapeutic derived from this research will be of significant use for both civilian and military populations at risk.

REFERENCES:

1. https://www.cdc.gov/vhf/virus-families/bunyaviridae.html
2. Matsuno K, Orba Y, Maede-White K, Scott D, Feldmann F, Liang M and Ebihara H (2017) Animal Models of Emerging Tick-Borne Phleboviruses: Determining Target Cells in a Lethal Model of SFTSV Infection. Front. Microbiol. 8:104.
3. Haddock E, Feldmann F, Hawman DW, Zivcec M, Hanley PW, Saturday G, Scott DP, Thomas T, Korva M, Avšič –Županc T, Safronetz D, & Feldmann H. (2018) A cynomolgus macaque model for Crimean–Congo haemorrhagic fever. Nature Microbiology 3:556–562 (2018).
4. Wonderlich ER, Caroline AL, McMillen CM, Walters AW, Reed DS, Barratt-Boyes SM, Hartman AL. 2018. Peripheral blood biomarkers of disease outcome in a monkey model of Rift Valley fever encephalitis. J Virol 92:e01662-17.

KEYWORDS: antiviral, small molecule, medical countermeasure (MCM); therapeutic; Bunyavirus, Bunyavirales, Rift Valley Fever virus [RVFV], Severe Fever with Thrombocytopenia Syndrome virus [SFTSV], Crimean-Congo Hemorrhagic Fever virus [CCHFV], Sin Nombre virus [SNV], Hantavirus (HV)

VERSION 2

DEFENSE LOGISTICS AGENCY (DLA)
21.2 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 J68 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 or these proposal preparation instructions, 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 DSIP website at https://www.dodsbirsttr.mil/submissions/login prior to the close of the pre-release. To obtain answers to technical questions during the open period; submit your questions through the online DSIP Topic Q&A System https://www.dodsbirsttr.mil/submissions/login.

For questions regarding the DoD SBIR/STTR electronic submission system, contact Department of Defense (DoD) SBIR Help Desk at DoDSBIRSupport@reisystems.com.

PHASE I KEY DATES The Dates and times on https://www.dodsbirsttr.mil/submissions/login are official.

Complete proposals must be submitted on or before the date published in the DoD 21.2 SBIR BAA.

PROGRAM BROAD AGENCY ANNOUNCEMENT (BAA) 21.2

PHASE I GUIDELINES

DLA is committed to improving the time to award new projects. As such, all DLA Phase I topics are subject to pilot efforts intended to meet legislative goals.

All selections recommended award may be subject to an Oral presentation prior to the final award.

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 follow the guidelines listed in the topic.
- Proposal Cost Estimates are topic dependent, and each topic has a specified ceiling.
- Phase I proposals may not exceed the 20-page limit.
- Volume 5 Proposal attachments, appendices, or references are not included in the Page count.

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- Volume 6 FWA Training Certificate is required for proposal submission.
- The PI and CO listed in the Proposal will receive notification of selection or non-selection electronically via e-mail (NLT 90 days from the closing date of this BAA). The Notification will include the debrief comments.

For detailed proposal submission guidance, refer to U.S. Department of Defense (DoD) Instructions 21.2 SBIR at: https://www.dodsbirsttr.mil/submissions/login

Phase I Proposal Instructions

a. **Proposal Cover Sheet (Volume 1)**

All DLA proposals must be submitted to the Defense SBIR/STTR Innovation Portal (DSIP) located at https://www.dodsbirsttr.mil/submissions/. 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)**

The format and specific details of the Phase I proposal Volume 2 are included in the DoD BAA Preface.

c. **Content of the Cost Volume (Volume 3)**

Complete the Cost Volume by using the DLA provided template which is available on the DSIP Site.

d. **Company Commercialization Report (Volume 4)**

CCR is required to be submitted with proposals in response to DLA SBIR topics. Please refer to the current DoD SBIR BAA for full details.

e. **Supporting Documents (Volume 5)**

The use of Volume 5 is Optional. Volume 5 is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2), and the Cost Volume (Volume 5).

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. 15 Page Power Point Presentation (If Applicable)
8. Other

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f. **Fraud, Waste and Abuse Training (Volume 6)**

Fraud, Waste and Abuse (FWA) training is required for Phase I and Direct to Phase II proposals. Please refer to the current DoD SBIR BAA for full details.

PHASE II GUIDELINES

Phase II eligibility is based on the following guidance:

- All Phase I awardees may submit a Phase II proposal without invitation.
- Use the Phase I Template as a guideline with these exceptions.
  - Proposal period of performance not to exceed 24 months, this should include a base with an option period.
  - Volume 2 of Phase II proposals may not exceed the 40-page limit.
  - Volume 5 Proposal attachments, appendices, or references are not included in the 40-Page count.
  - Commercialization Strategy Requirements:
    - Business Case highlighting benefits to the DoD/DLA.
    - Transition Strategy and Key Tasks
    - Time-Phased Transition Plan
    - Projected Transition Cost Analysis

EVALUATION CRITERIA

Phase I and Phase II proposals will be evaluated based on the criteria outlined in the current DoD SBIR BAA.

Final Selection may require an oral presentation. This may include an in-person meeting or a Zoom.gov meeting.

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 21.2 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 within 30 days of the BAA close date.

Part II: If selected for an oral presentation, Offerors shall submit a slide deck not to exceed 15 PowerPoint slides to DLASBIR@dla.mil.

- There are no set format requirements other than the 15-page maximum page length.
- 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.

Selected Offerors will receive an invitation to present a slide deck (15-minute presentation time / 15-minute question and answer) in a technical question and answer forum to the DLA evaluation team via electronic media. The tentative date for the presentations is 1 Sept 2021. This presentation will be evaluated by a panel against the criteria listed under Section 6.0 of the DoD SBIR 21.2 BAA.

Notification of the selection/non-selection decision will occur NLT the next day.

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Input on technical aspects of the proposals may be solicited by DLA 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. Further, these advisors are expressly prohibited from competing for DLA 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.

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.

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 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. A format will be provided at the PAC.
- The TPOC and PM will determine a meeting schedule at the PAC. Phase I awardees can expect Monthly (or more frequent) Project Reviews C)
- 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, 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

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Phase II Proposals should anticipate a combination of any or all 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. A format will be provided at the PAC.
- Meeting schedule to be determined by the Technical Point of Contact (TPOC) and PM at the PAC
  - Phase II awardees expect Monthly (minimum) Project Reviews (format provided at the PAC)
- Draft Final Report including major accomplishments, commercialization strategy and transition plan and timeline.
- Final Report including major accomplishments, commercialization strategy, 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.

PHASE III GUIDELINES & INSTRUCTIONS

Phase III is any proposal that “Derives From”, “Extends” or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply. More specific Instructions may be available when a firm submits a Phase III proposal

PRE-RELEASE COMMUNICATION: During the pre-release period it is highly recommended that applicants communicate with the Technical Points of Contacts (TPOCs) provided in this topic. Best method of scheduling the dialogue is via e-mail.

VERSION 2

DLA 21.2 SBIR Phase I Topic Index

VERSION 2

DLA212-001 TITLE: Engaging the Manufacturing Industrial Base in Support of DLA's Critical Supply Chains

RT&L FOCUS AREA(S): Nuclear; General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Ground Sea; Nuclear; Weapons; Materials; Air Platform

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 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: Expand the Small Business Manufacturer (SBM) base to address the Agency's need to develop qualified sources of supply to improve DLA product availability, provide competition for reduced lead time and cost, as well as address lifecycle performance issues. Through participation in DLA SBIR, SBMs will have an opportunity to collaborate with DLA Weapons System Program Managers (WSPMs) and our customer Engineering Support Activities (ESAs) to develop innovative solutions to DLA's most critical supply chain requirements. In the end, the SBM benefits from the experience by qualifying as a source of supply as well as from the business relationships and experience to further expand their product lines and readiness to fulfill DLA procurement requirements.

DESCRIPTION: Competitive applicants will have reviewed the parts list provided on DLA Small Business Innovation Program (SBIP) site, (Reference 4) as well as the technical data in the cFolders of DLA DiBBs, (Reference 3). Proposals can evolve in one of four ways depending on the availability of technical data and NSNs for reverse engineering as follows. Information on competitive status, RPPOB, and tech data availability will be provided on the website, Reference

a. Fully Competitive (AMC/AMSC-1G) NSNs where a full technical data package is available in cFolders. The SBM proposal should reflect timeline, statement of work and costs associated with the manufacturing and qualification of a representative article.

b. Other than (AMC/AMSC-1G) NSNs where a full Technical Data Package (TDP) is available in cFolders. These items may also require a qualification of a Representative Article. The SBM proposal should reflect timeline, statement of work, and costs associated with producing a Source Approval Request (SAR) and (if applicable) qualification of a Representative Article. Contact the TPOC if necessary. The scope and procedures associated with development of a SAR package are provided in Reference 1.

c. Repair Parts Purchase or Borrow (RPPOB) may be an option for other than 1G NSNs where partial or no technical data is available in cFolders. NSNs, if available, may be procured or borrowed through this program for the purposes of reverse engineering. The instructions for RPPOB can be found on the websites, Reference 5. The SBM proposal should reflect timeline, statement of work and costs associated with the procuring the part and reverse engineering of the NSN. Depending on complexity, producing both the TDP and SAR package may be included in Phase I.

d. Reverse Engineering (RE) without RPPOB is when the NSN will be provided as Government Furnished Material (GFM) if available from the ESA or one of our Service customers. In this case, contact the TPOC to discuss the availability of the NSN prior to starting the proposal. The SBM proposal should reflect timeline, statement of work and costs associated with the reverse engineering of the NSN and depending on complexity producing a TDP and SAR package in Phase I.

Specific parts may require minor deviations in the process dependent on the Engineering Support Activity (ESA) preferences and requirements. Those deviations will be addressed post award.

PROJECT DURATION and COST:

PHASE I: NTE 12 Months $150K- Base NTE $100K base 6 Months, Option 1 NTE $50K base 6 Months. All work should be planned to be completed during the base period. Our intent of the option is to cover unforseen testing requirements or circumstances that arise during the course of base execution.

PHASE II: Phase II – NTE 24 Months $1.6M - Base 18 months, $1M Option 6 Months NTE $.6M
PERIOD OF PERFORMANCE: The phase one period of performance is not to exceed 12 months total. However, the project schedule should plan to complete the TDP and SAR in the first six months. The options need to be reserved for lead time for TDP and SAR approval and or representative article manufacturing and qualification. Options are not automatic. Approval is at the discretion of the DLA SBIP Program Manager. The decision is based on Project Performance, Priorities of the Agency, and/or the availability of funding.

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 "SBIR203C". If the data is incomplete, or not available, the effort will require reverse engineering.

PHASE I: The goal of phase I is for the SBM to qualify as a source of supply for the DLA NSN(s) to improve DLA NSN availability, provide competition for reduced lead time and cost, and address lifecycle performance issues. In this phase, manufacturers will request TDP/SAR approval from the applicable Engineering Support Activity (ESA), if required, for the NSN(s). At the Post Award Conference, the awardee will have the opportunity to collaborate with program, weapon system, and/or engineering experts on the technical execution and statement of work provided in their proposal. All Phase I Proposals should demonstrate an understanding of the NSN(s) and the general challenges involved in their manufacture. Proposals that fail to demonstrate knowledge of the part will be rejected.

PHASE II: The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, SBM innovation and engineering capability and the availability of appropriate requirements. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

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There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The SBM will pursue commercialization of the various technologies and processes developed in prior phases through participation in future DLA procurement actions on items identified but not limited to 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 “SBIR211A”
4. DLA Small Business Innovation Programs web site: http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms
5. DLA Aviation Repair Parts Purchase or Borrow (RPPOB) Program: https://www.dla.mil/Aviation/Offers/Services/AviationEngineering/Engineering/ValueEng.aspx

KEYWORDS: Nuclear Enterprise Support (NESO), Source Approval, Reverse Engineering

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VERSION 2

DLA212-002 TITLE: Unique Identifier Tags for Supply Chain Tracking Modernization for Mark 39 Expendable Mobile Anti-Submarine Warfare (ASW) Training Target (EMATT)

RT&L FOCUS AREA(S): Warfighter Requirements (GWR)

TECHNOLOGY AREA(S): Ground Sea

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 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 system to positively mark, scan, and uniquely identify the system and subsystem sections of EMATT vehicles.

DESCRIPTION: Developed as a low cost, expendable, open ocean training target, EMATT allows combined training of submarine, aircraft, & ship crews in search, detection & tracking of submarines. Its “A-size” sonobuoy shape means the target can be launched from surface ships or fixed and rotary winged aircraft. EMATT offers advanced ASW training capability with minimal maintenance, training, and logistics to operate and its expendability allows exercises to occur in littoral or blue waters, day or night, and in high or low sea-states. As the EMATT technology options expand, and production volumes increase, there exists a need for improved track and trace capability, at both the fully assembled system level, as well as the subsystem or section level. A unique tag technology, that could be visually and RFID scanned would allow for improved supply chain track and trace, not only at the OEM production facility, but also as EMATTs arrive at Navy distribution points, surface ships and submarines, and overseas deliveries for foreign military sales.

As innovations and new technologies are implemented into acoustic systems, tail section propulsion, payloads and sensors on this platform, it becomes increasingly complex to differentiate between the myriad of potential vehicle and section options, performance and endurance capabilities, and battery status and shelf life. A unique tag technology would simplify and confirm the mission set, when in use by operators in the field in preparation for deployment, launch and recovery.

PROJECT DURATION and COST:

PHASE I: NTE 12 Months $150K- Base NTE $100K base 6 Months, Option 1 NTE $50K base 6 Months.

PHASE II: Phase II – NTE 24 Months $1.6M - Base 18 months, $1M Option 6 Months NTE $.6M

PERIOD OF PERFORMANCE: The phase one period of performance is not to exceed 12 months total. Options are not automatic. Approval is at the discretion of the DLA SBIP Program Manager. The decision is based on Project Performance, Priorities of the Agency, and/or the availability of funding.

PHASE I: Goal of Phase I: Design a unique identifier tag technology for track and trace of modular UUV systems and subsystems throughout the production supply chain

- Identify present “state of the art” technologies available.

VERSION 2

- Establish both optical and electro-magnetic scanning approaches (identifying scanning ranges as well as abilities to scan through materials present in the EMATT hulls and systems).
- Demonstrate the tag technology's ability to provide UUV tracking and tracing throughout the production supply chain, mission use, and recovery.
- Document technology recommendations to be prototyped in Phase II

All Phase I Proposals should specify a mature technology capable of achieving the Phase I goals. Proposals that fail to demonstrate that they have a technology prepared to achieve the goals will be rejected.

PHASE II: Goal of Phase II: Develop and integrate prototype unique identifier tags technology for track and trace of modular UUV systems and subsystems
- Build QTY 25 prototype tags leveraging the resulting design from Phase I.
- Integrate prototype tags into system and subsystem components, perform pilot track and trace evaluation and testing
- Establish transition plan, and commercialization strategy

The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, SB engineering capability and innovation, the technical maturity of the proposed technology, as well as applicability to the requirement.

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The SB will pursue commercialization of the various technologies and processes developed in prior phases through participation in future DLA procurement actions on items identified but not limited to this BAA.

REFERENCES:
1. A-Size Autonomous Underwater Vehicles web site: https:///www.lockheedmartin.com/en-us/products/a-size-autonomous-underwater-vehicles.html

KEYWORDS: Track and Trace, Sonobuoy

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VERSION 2

DLA212-003 TITLE: Thermoplastic forming of metallic glasses

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials

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 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 thermoplastic forming of metal components for military applications in aeronautical and space platforms.

DESCRIPTION: The Defense Logistics Agency (DLA) is looking for a domestic capability to manufacture metallic components rapidly and affordably with complex shapes for air and space platforms. Manufacturing such parts currently requires many steps, including forming, machining, and joining, that dramatically increase cost and delivery times, negatively impacting the logistic supply chain. Metallic glasses are a class of alloys with exceptional strength and hardness, and they are the only metallic materials that can be processed by thermoplastic methods such as injection molding and blow molding. These methods allow parts to be manufactured in seconds rather than days or weeks, and complex shapes are produced in a single step.

Initial work will identify candidate components that will benefit most from reduced manufacturing time and cost. R&D tasks include developing and demonstrating component design, die design and heating methods to manage the thermal budget specified by the metallic glass alloy being used. These efforts will be demonstrated on impactful applications in military air and space platforms. Applications that improve space access, mobility or logistics are especially desired. The processes developed should be scalable to commercially significant production rates.

PHASE I: The research and development goals of Phase I are to provide eligible Small Business firms the opportunity to successfully demonstrate the viability of manufacturing complex metallic aircraft and spacecraft components using thermoplastic forming methods such as blow forming and injection molding. The vendor will identify and prioritize candidate components, considering impact to mission capabilities and logistic concerns such as cost and production time. The main effort will be to conduct preliminary studies to propose details of manufacture, showing feasibility and benefit to the USAF or USSF. A plan to demonstrate the thermoplastic manufacture of metallic parts and address implementation approaches for near term insertion into Department of Defense (DoD) systems, subsystems, components, or parts will be included in the Phase I effort. Relationships with potential customers and systems integrators will be established to aid in component identification, guide design efforts, and support the impact and insertion analyses. The deliverables for this project will include a final report describing the results from these analyses.

Phase I – 6 Months $100K

Phase II – 24 Months $1.6M

VERSION 2

PHASE II: Based on the results of PHASE I, the research and development goals of PHASE II will demonstrate commercial viability by successfully producing target metallic components via thermoplastic processing. Tasks to be accomplished include component design, die design, development of design tools to manage the unique thermal budget provided by the selected metallic glass alloy, and design and production of heating systems. These tools will be used to produce the target components. Sufficient validation trials will be conducted to support analyses of manufacturing at commercial scale, including cost, cycle time and commercial benefit of the innovation. Remaining technical gaps will be identified. Manufactured components shall be used for component level testing. Innovative processes should be developed with the intent to readily transition to production in support of DoD needs. A partnership with a current or potential DoD supplier, OEM, or another suitable partner is highly desirable.

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The vendor will pursue commercialization of the thermoplastic forming of metallic glasses developed in prior phases, as well as potential commercial sales of any parts or other items.

REFERENCES:

1. https://doi.org/10.1002/adma.200902776
2. https://www.researchgate.net/publication/51120951_Beating_Crystallization_in_Glass-Forming_Metals_by_Millisecond_Heating_and_Processing
3. E. Pekarskaya and J Schroers, Development of Bulk Metallic Glass Components for Spacecraft Applications Using Thermoplastic Forming, AFRL-RX-WP-TR-2018-0262, http://www.dtic.mil

KEYWORDS: metallic glass, thermoplastic forming

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VERSION 2

DLA212-004 TITLE: Rare Earth Metals Production

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials

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 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 stand up a rare earth metal production process. The process should be able to produce metal from commercially available oxides or carbonates. It should be scalable to meet changes in industrial demand. The price should be commercially viable. The major elements of interest are neodymium (Nd), praseodymium (Pr), gadolinium (Gd), samarium (Sm).

DESCRIPTION: DLA requires a domestic processing ability to produce rare earth metals from commercially available precursors. These materials are essential to a wide range of both essential civilian and military technologies. Domestic manufacturing of these material is essential for DLA to support the warfighter.

The process should be able to take multiple commercially available precursors and produce high purity metal. It must be environmentally compliant with all federal, state, and local laws. Ideally the process and equipment could be used for more then a single element.

The material should be at least 99.9% pure.

The process should be scalable and modular to allow for rapid scale up if necessary.

PHASE I: The below actions would be required to successfully accomplish Phase I:
- At a minimum, develop a process flow sheet and design a lab scale of material processed of at least 2kg to confirm its accuracy.
- Material produced at the required purity level.
- Breakdown of cost structure for industrialization including required capital expenditures and per unit production costs.

Phase I – 6 Months $100K

Phase II – 24 Months $1.6M

PHASE II: The below actions would be required to successfully accomplish Phase II:
- Deliver a lab scale prototype (TRL 6) with a minimal low-rate production for at least 1 of the listed materials.
- Using the metal produced to make a magnet alloy and test magnet blocks made from it.
- Detail a plan on how to increase to full commercial production for as many of the materials as is possible with the same hardware.

VERSION 2

- Outline the economic business case for full scale commercialization.

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

PHASE III DUAL USE APPLICATIONS: these materials have dual-use commercial or military applications in many complex systems.

REFERENCES:

KEYWORDS: Rare Earth Metals, Reduction, Refining, Rare Earth Alloys

TPOC-1: Nathan Cardinell
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VERSION 2

DLA212-005 TITLE: Enhancing the separation technology to recover rare earths (REs) from chemical concentrates or industrial waste feedstock.

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials

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 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 stand up a rare earth separation and refining process. The process should be able to produce rare earth oxides (or similar) from commercially available RE concentrates, ores, or industrial waste feedstock. It should be scalable to meet changes in industrial demand. The price should be commercially viable.

DESCRIPTION: DLA R&D is looking for a domestic capability that demonstrates a new novel RE extraction and separation process from chemical concentrates, ores, or industrial waste feedstock. Defense weapon systems use various REs and there is currently no domestic production of these materials and therefore a risk of foreign reliance. Developing an economically viable, environmentally friendly process for enhancing the recovery of REs from the existing industrial waste feedstock, such as red mud, electronic devices, could facilitate the establishment of a viable, competitive domestic supply chain. DLA R&D seeks to prove the recovery demonstration for marketable REs from varied feedstock and facilitate commercialization of that process. R&D tasks include identifying feedstock sources in the existing domestic supply chain and developing process for extracting and processing the REs that demonstrates a significant cost advantage versus standard processing. It must be environmentally compliant with all federal, state, and local laws. Ideally the process and equipment could be used for more then a single element. The material should be at least 99.9% pure. The process should be scalable and modular to allow for rapid scale up if necessary.

PHASE I: The below actions would be required to successfully accomplish Phase I:

- At a minimum, develop a process flow sheet and design a lab scale of material processed of at least 2kg to confirm its accuracy.
- Material produced at the required purity level.
- Breakdown of cost structure for industrialization including required capital expenditures and per unit production costs.

Phase I – 6 Months $100K

Phase II – 24 Months $1.6M

PHASE II: The below actions would be required to successfully accomplish Phase II:

- Deliver a Lab scale prototype (TRL 6) with a minimal low-rate production for at least one of the rare earths and find a domestic supplier to reduce the rare earth oxide (REO) into metal/alloy.
- Detail a plan on how to increase to full commercial production for as many of the materials as is possible with the same hardware.

VERSION 2

- Outline the economic business case for full scale commercialization.

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

These materials have dual-use commercial or military applications in many complex systems

REFERENCES:

KEYWORDS: Rare Earth Oxides, Concentrates, Red Mud, Reduction, Refining, Rare Earth Elements

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VERSION 2

DLA212-006 TITLE: Automation-Robotics to support/supplement Dining Facilities

RT&L FOCUS AREA(S): Autonomy; Artificial Intelligence/ Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials

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 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 industry partnership with technology companies who are developing automated robotic solutions for food production, mechanized distribution on-site in a “ghost kitchen” environment, which supplement Back-of-the-House (BOH) operations to support Front-of-the-House (FOH) serving and dining operations. This project promotes the opportunity for industry technology to be developed, tested and potentially used in military food & beverage operations. Conduct market research on technology capable of assisting with the preparation, processing, and/or cooking of food. This research seeks to identify and test solutions to improve efficiency and will permit the Services to better allocate labor resources within military dining facilities. Added benefits of reducing food and life safety risks with robotics using “contactless” food preparation in situations such as COVID-19 should be a highlighted benefit.

DESCRIPTION: Defense Logistics Agency (DLA) Troop Support (TS) Subsistence topic of interest is research focused on the use of automation-robotics in dining facilities. This research shall cover the areas involving the preparation, processing, and cooking of food. Specific areas of interest include:

- Identify technology and robotic solutions which can be utilized to perform BOH tasks that prepare food for service in FOH dining systems
- Once identified, provide the characteristics/capabilities of the equipment and any solutions on how robotics could be used within Food & Beverage operations
- If your firm is currently developing this type of equipment, provide the function the equipment will be executing and any timeframe for commercial testing and production.

PHASE I: The research and development goals of Phase I are to provide Small Business eligible Research and Development firms the opportunity to successfully demonstrate how automation can be utilized in military dining facilities to reduce costs and increase efficiency. A concept of operations (CONOPs) or a process will be created by the vendor to show how the equipment can be utilized within the dining facilities. The deliverables for this project will include a final report to include a cost breakdown of the equipment to include, but not necessarily limited to, product cost, shipping, installation, training, parts kits, etc.

Phase I – 6 Months $100K

Phase II – 24 Months $1.6M

PHASE II: Based on the research and development results and the CONOPs developed during PHASE I, the research and development goals of PHASE II will emphasize the actual use of the equipment within a military dining facility at a location mutually agreed upon between DLA Troop Support Subsistence, the Vendor and the Military Partner.

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

Progress documented from PHASE I and PHASE II should result in a vendor's qualification as an approved source for automation-robotics to support and supplement Dining Facilities in future procurements.

COMMERCIALIZATION: The vendor will pursue commercialization of the various processes and technologies associated with the automation-robotics to support and supplement Dining Facilities project in prior phases as well as potential commercial sales of any parts or other items.

REFERENCES:

1. DoD Manual1338.10, DoD Food Service Manual;
1. http://www.dtic.mil/whs/directives/corres/pdf/133810m.pdf
2. TB MED 530/NAVMED P-5010-1/AFMAN 48-147_IP, "Tri-Service Food Code," October 7, 2013; http://www.med.navy.mil/directives/Pub/5010-1.pdf
3. Defense Logistics Agency: DLA Troop Support Subsistence. https://www.dla.mil/TroopSupport/Subsistence.aspx

KEYWORDS: automation-robotics, dining facilities

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VERSION 2

DLA212-007 TITLE: Research and Testing of a Robotic Arm Embedded with Artificial Intelligence (AI) for use within Defense Logistics Agency (DLA) Distribution Center Warehouses

RT&L FOCUS AREA(S): General Warfighter Requirements (GWR)

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 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: Concept statement: DLA is exploring the use of robots to include robot arms to better understand what capability these machines provide to leverage human tasks in materiel handling. One approach DLA wants to explore is to incorporate Artificial Intelligence into individual robots to provide autonomy to resolve current issues in materiel handling.

Develop a Robotic Arm that utilizes an Artificial Intelligence (AI) solution (with deep learning if applicable) to provide a state-of-the-art capability to identify items, and pick, pack, and arrange picked items within selected boxes and operate within the DLA Distribution Warehouse environment. Additionally, the AI-embedded Robotic Arm must provide the adaptive pushing displacement required for the tight packing of items within shipping boxes, and must communicate with various warehouse systems (*e.g.*, Internet of Things (IoT)) as needed. The desired solution should minimize infrastructure modifications to enable the artificial intelligence embedded robotic arm to operate within the warehouse environment.

The goal of this effort is for the vendor to develop a capability an AI-embedded robotic arm system operating in the warehouse, that addresses the requirements for integrating with warehouse communications systems onsite (if required), such as the Warehouse Execution System (WES) at the specific warehouse. As such, this capability provides for the seamless execution of the AI-embedded Robotic Arm and its subsequent interactions with any future Smart Warehouse systems that may be developed and employed.

Provide a report with a detailed analysis that captures concepts on using robotics to include robotic arms which incorporate features of artificial intelligence. The study and analysis can include concepts and approaches that are innovative and may not be known from current market research, or individual development through industry or academia.

Prospective vendors should organize the objectives by priority as shown below:

- Explore using methods and schemes that allow for least cube space.
- How the robot system adapts or can be integrated into existing Warehouse Management System (WMS).
- How the robotic system seamlessly integrates into communications and equipment like current Internet of Things (IoT), 5G communications, and knowledge systems to manage warehouse operations.
- Future communications systems and equipment beyond 5G, and IoT.

The state-of-the-art AI-embedded Robotic Arm solution must integrate into the existing warehouse communications systems to communicate with the WES system to allow for the embedded AI Robotic Arm to receive automated tasking instructions to pick and pack boxes, crates, and bins and use AI to accurately identify boxes, cases, crates, and individual end-items using loaded configuration information and task instructions. The provided packing instructions will be pushed to the Robotic Arm by the WES. The robotic arm should be able to operate continually as needed, and report back to the WES on the programmed Robotic Arm's task success or failure.

At a minimum, the prospective vendors should:

- Explore what systems in a robotic arm or other mechanism can offer the best way to identify materiel correctly that matches with materiel transaction requests (i.e., machine vision).
- Recommend methods and schemes that impact or complement robotic functionality like accurate transactions using block chain.
- Discuss methods where robots and robotic arms adapt to random materiel requests regardless of timeframe, location, or item request.
- Discuss methods and schemes as to the flexibility of robot tasks that mimic human tasks like packing, moving parts and equipment, wrapping, and other tasks in warehouse operations.

In support of routine warehouse robotic arm operations, this research seeks to identify and test a Robotic Arm utilizing AI technology used to intelligently pack boxes within the DLA distribution warehouse environment. Importantly, the selected vendor must address the DLA-identified cybersecurity requirements by testing and evaluating the government's security control. The vendor should leverage the current technologies found in both the Robotic Arm and the AI industries. This research project will operate in locations at designated DLA Distribution Centers in the United States.

DESCRIPTION: Defense Logistics Agency (DLA) Distribution Modernization Program (DMP) topics of interest are research focused on a Continental United States-based robotic arm with an Artificial Intelligence (AI) solution in support of the routine warehouse end-item picking for box packing operations. The resulting solution must be integrated with existing WES communications suites and integrate with warehouse navigation systems, that:

1. Supports a joint effort between DLA Research and Development (R&D) and DLA J4 Distribution Headquarters to conduct research and test an AI-embedded warehouse Robotic Arm system that works during warehouse operations.
2. Significantly addresses an AI-embedded Robotic arm's capabilities within an operational distribution warehouse environment.
3. Features an AI-embedded Robotic Arm that can implement repetitive box packing tasks with high precision and accuracy for regular use in warehouse operations.
4. Can be integrated into warehouse communications systems such as a WES to receive tasking and report on performance status.
5. Demonstrates a state-of-the-art operational capability when operating within the distribution warehouse environment through the application of AI-embedded Robotic Arm technology and seamlessly integrates with robust communications network technologies in a distribution warehouse environment shared with warehouse workers.
6. Provides for a reliable and robust technology solution that allows DLA Distribution Warehouses to perform automated tasks without significantly lowering operating speeds per existing industry trends.
7. Demonstrates compatibility with a Government data cloud environment to store and retrieve warehouse-generated data without relying on a separate commercial data cloud environment to navigate successfully.
8. Conclusively demonstrates the use of new AI technology and concepts for application and integration with a Robotic Arm to improve the distribution and delivery of material and goods during representative distribution warehouse operations in an innovative way.
9. All robotic/AI software control remains within the DLA server and does not

transfer/communicate out to a vendor server.
10. Robotic arm needs to safely maneuver around humans without the need of a safety cage.

PHASE I: Perform a design study to determine how to use a robotic arm that utilizes artificial intelligence to optimize DLA Distribution Warehouse operations, sustainment, and logistics support. Deliver a final design of a Robotic Arm with AI capability, a simulation model of DLA Distribution assets, and a demonstration of an AI-infused Robotic Arm model capable of making intelligent trade-off decisions to meet specified PM requirements. A successful design optimizes support, minimizes DLA Distribution Warehouse system downtime, and maximizes system availability using logistics inputs (component failure rates, shipping times, repair times, maintenance man-hours, and warehouse staffing).

The SBIR Phase I expectation is to provide and successfully demonstrate how their proposed AI-embedded Robotic Arm concept of operations (CONOPS) improves the packing and arrangement of boxes. This automation provides for the more efficient distribution of goods and materials within the DLA distribution enterprise and effectively lessens the time to provide needed supplies to the Warfighter. The selected vendor will conduct a feasibility study to:
1. Address the requirements described above in the Description Section for AI-embedded Robotic Arm operations.
2. Identify capability gap(s) and the requirement for DLA to use an AI-embedded Robotic Arm in the DLA Distribution Operations environment.
3. Develop the vendor's Concept of Operations (CONOPS) to utilize an AI-embedded Robotic Arm and clearly describe how the requirements develop.

The vendor must create a CONOPS for an AI-embedded Robotic Arm to support both routine and wartime distribution warehouse operations. The concept of operations covers the utilization of artificial intelligence with Robotic Arms within DLA distribution warehouses during routine box packing procedures, precisely describing all operational requirements as part of this process.

The vendor must provide a CONOPS that includes the following tasks:
- Picking, placing, and relocating items where needed
- Perform packing operations mimicking human actions to complete the same steps.
- Wrapping tasks to protect materiel, food, perishables, or consumables.
- Distinguish in how to perform operations that have hazardous materials, or containers with volatile, caustic, corrosive, or possible explosive content.
- Other operations in a warehouse as may be described with end users.

This project's deliverables include a final report, including a cost breakdown of the proposed courses of action (COAs).

Phase I – 6 Months $100K

Phase II – 24 Months $1.6M

PHASE II: Based on the research and the concept of operations developed during Phase I, Phase II's research and development goals emphasize the development of the AI-embedded Robotic Arm system following the typical DLA Distribution Warehouse concept of operations for materiel handling. During Phase II, the vendor will:
1. Address the specific user requirements, functional requirements, and system requirements as defined and provided by DLA.
2. Develop a prototype AI-embedded Robotic Arm system for Developmental Test and Evaluation (DT&E) and Operational Test and Evaluation (OT&E).

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3. Implement government cybersecurity controls in the prototype design, and secure all necessary cybersecurity certifications to operate the AI-embedded Robotic Arm equipment in the DLA warehouse environment with DOD cloud connections.

The DLA AI-embedded Robotic Arm system will operate across the United States at various DLA Distribution Center sites mutually agreed upon between DLA R&D and DLA Distribution HQ. This project's deliverables include a final report, including a cost breakdown of courses of action (COAs).

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or Completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

During Phase I and Phase II, the progress made should result in a vendor's qualification as an approved source for an AI-embedded Robotic Arm system and support participation in future procurements.

COMMERCIALIZATION: The manufacturer will pursue the commercialization of the AI-embedded Robotic Arm technologies and designs developed to apply to the warehouse environment-- the processes developed in preliminary phases and potential commercial sales of manufactured mechanical parts or other items. The first path for commercial use is at DLA's twenty-six Distribution Centers and twenty Disposition Centers. When fielded, DLA estimates 20 - 26 units, but the number of units could be more.

REFERENCES:

1. J. J. Enright and P. R. Wurman, "Optimization and Coordinated Autonomy in Mobile Fulfillment Systems," in AAAIWS'11-09, 2011.
2. F. Wang and K. Hauser, "Stable bin packing of non-convex 3d objects with a robot manipulator," in IEEE ICRA, 2019, pp. 8698–8704.
3. F. Wang and K. Hauser, "Robot packing with known items and nondeterministic arrival order," in R: SS, 2019.
4. A. Sahbani, S. El-Khoury, and P. Bidaud, "An Overview of 3D Object Grasp Synthesis Algorithms," RAS, vol. 60, no. 3, 2012.

KEYWORDS: Artificial Intelligence, AI, Robotic Arm, Wi-Fi, Warehouse, Distribution, Logistics, Simulation, Modeling and Simulation, Sustainment, Availability, Reliability, Picking, Packing, Maintainability, Supportability, Software Development, Machine Learning, Neural Networks, Real-time Computational Intelligence, Data Science, Software Architecture, Deep Learning.

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VERSION 2

DEFENSE THREAT REDUCTION AGENCY (DTRA)
Small Business Innovation Research (SBIR) Program
SBIR 21.2 Proposal Instructions

1. INTRODUCTION

The Defense Threat Reduction Agency (DTRA) mission is to enable the DoD, the U.S. Government, and International Partners to counter and deter Weapons of Mass Destruction (WMD – Chemical Biological, Radiological and Nuclear) and Improvised Threat Networks. The DTRA SBIR program is consistent with the purpose of the SBIR Program, i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns and Research Institutions through Federal-funded research or research and development (R/R&D).

The approved FY21.2 list of topics solicited for in the Defense Threat Reduction Agency (DTRA) Small Business Innovation Research (SBIR) Program are included in these instructions followed by full topic descriptions. Offerors responding to this Broad Agency Announcement must follow all general instructions provided in the related Department of Defense Program BAA and submit proposals by the date and time listed in the DoD Program BAA. Specific DTRA requirements that add to or deviate from the DoD Program BAA instructions are provided below with references to the appropriate section of the DoD document.

The DTRA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the DTRA Program Office. Specific questions pertaining to the administration of the DTRA SBIR Program and these proposal preparation instructions should be submitted to:

Mr. Mark Flohr
DTRA SBIR/STTR Program Manager
Mark.D.Flohr.civ@mail.mil
Tel: (571) 616-6066

Defense Threat Reduction Agency
8725 John J. Kingman Road
Stop 6201
Ft. Belvoir, VA 22060-6201

For technical questions about specific topic requirements during the pre-release which begins April 21, 2021 through May 18, 2021 contact the DTRA Technical Point of Contact (TPOC) for that specific topic. To obtain answers to technical questions during the formal BAA open period, visit: https://www.dodsbirsttr.mil.

For questions regarding the DoD SBIR/STTR electronic submission system, contact the DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com.

Proposals not conforming to the terms of this announcement will not be considered. DTRA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DTRA will be funded. DTRA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

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Please read the entire DoD announcement and DTRA instructions carefully prior to submitting your proposal as there have been significant updates to the requirements.

The SBIR/STTR Policy Directive is available at:
https://www.sbir.gov/sites/default/files/SBIRSTTR_Policy_Directive_2019.pdf.

2. SMALL BUSINESS ELIGIBILITY REQUIREMENTS

2.1 The Offeror

Each offeror must qualify as a small business at time of award per the Small Business Administration's (SBA) regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Those small businesses selected for award will also be required to submit a Funding Agreement Certification document prior to award.

2.2 SBA Company Registry

Per the 2019 SBIR-STTR Policy Directive, all SBIR applicants are required to register their firm at SBA's Company Registry prior to submitting a proposal. Upon registering, each firm will receive a unique control ID to be used for submissions at any of the eleven (11) participating agencies in the program. For more information, please visit the SBA's Firm Registration Page: https://www.sbir.gov/user/login/.

2.3 Use of Foreign Nationals, Green Card Holders and Dual Citizens

See the "Foreign Nationals" section of the DoD SBIR Broad Agency Announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Offers must identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For those 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. 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)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens or green card holders listed will be subject to security review during the contract negotiation process (if selected for award). DTRA reserves the right to vet all uncleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export-controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed person is found ineligible by the government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale. In the event a firm is found ineligible to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

3. EXPORT CONTROL RESTRICTIONS

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/ddtc_public.

The technology within some DTRA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. The offeror must ensure that their firm complies with all applicable export control regulations.

NOTE: Export control compliance statements found in these 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.

4. CYBER SECURITY

Any Small Business Concern receiving a 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.

5. PHASE I PROPOSAL GENERAL INFORMATION

5.1 Proposal Evaluation

DTRA will evaluate Phase I proposals using the criteria specified in Section 6.0 of the DoD SBIR Program BAA during the review and evaluation process. The criteria will be in descending order of importance with technical merit, soundness, and innovation of the proposed approach being the most important, followed by qualifications, and followed by the commercialization potential. With other factors being equal, cost of the proposal may be included in the evaluation. DTRA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues). Phase I contracts are limited to a maximum of $167,500 over a period not to exceed seven months. For clarity, the stated maximum dollar amount is exclusive of the Discretionary Technical and Business Assistance (TABA) that firms may request.

DTRA participates in one DoD SBIR BAA each year and anticipates funding two Phase I contracts to small business concerns for each topic.

5.2 DTRA Support Contractors

Select DTRA-employed support contractors may have access to contractor information, technical data or computer software that may be marked as proprietary or otherwise marked with restrictive legends. Each DTRA support contractor performs under a contract that contains organizational conflict of interest provisions and/or includes contractual requirements for nondisclosure of proprietary contractor information or data/software marked with restrictive legends. These contractors require access while providing DTRA such support as advisory and assistance services, contract specialist support, and support of the Defense Threat Reduction Information Analysis Center (DTRIAC). The contractor, by submitting a proposal or entering into this contract, is deemed to have consented to the disclosure of its information to DTRA's support contractors.

The following are, at present, the prime contractors anticipated to access such documentation: Cherokee Nation Strategic Programs, LLC (contract specialist support), Kent, Campa, and Kate, Inc. (contract closeout support), Engility Corporation (a company under SAIC, Inc), (advisory and assistance services), Quanterion Solutions, Inc. (DTRIAC), Kforce Government Solutions, Inc. (financial/accounting support), and CACI (contract writing system administration). This list is not all-inclusive (e.g., subcontractors) and is subject to change.

6. PHASE I PROPOSAL SUBMITTAL

Detailed guidance on registering in DSIP and using DSIP to submit a proposal can be found at https://www.dodsbirsttr.mil/submissions/learning-support/training-materials. If the proposal status is "In Progress" or "Ready to Certify" it will NOT be considered submitted, even if all volumes are added prior to the BAA close date. The proposer may modify all proposal volumes prior to the BAA close date.

Although signatures are not required on the electronic forms at the time of submission the proposal must be certified electronically by the corporate official for it to be considered submitted. If the proposal is selected for award, the DoD Component program will contact the proposer for signatures at the time of award.

Proposals addressing the topics will be accepted for consideration if received no later than the specified closing hour and date in the DoD Announcement . The Agency requires your entire proposal to be submitted electronically through the DoD Submission Web site https://www.dodsbirsttr.mil/submissions/. A hardcopy is NOT required and will not be accepted. Hand or electronic signature on the proposal is also NOT required.

Proposals are required to be submitted in Portable Document Format (PDF), and it is the responsibility of submitters to ensure any PDF conversion is accurate and does not cause the Technical Volume portion of the proposal to exceed the 20-page limit. **Any pages submitted beyond the 20-page limit, will not be read or evaluated.** If you experience problems uploading a proposal, email DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com

MAXIMUM PHASE I PAGE LIMIT FOR DTRA IS 20 PAGES FOR VOLUME 2, TECHNICAL VOLUME

DTRA's objective for the Phase I effort is to determine the merit and technical feasibility of the concept. The contract period of performance for Phase I shall be seven (7) months (approx. 6 months technical work plus 1 month final report preparation) and the award shall not exceed $167,500. A list of topics currently eligible for proposal submission is included in these instructions, followed by full topic descriptions.

Animal and Human Research

Companies should plan carefully for research involving animal or human subjects, biological agents, etc. (see Sections 4.7 - 4.9 in the DoD Program Announcement). The few months available for a Phase I effort may preclude plans including these elements unless coordinated before a contract is awarded.

Profit or Fee on Travel Costs

Travel shall not be a profit or fee bearing cost element.

7. DECISION and NOTIFICATION

DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

Following the EA decision, the DTRA SBIR/STTR office will release notification e-mails for each accepted or rejected offer. E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official. Offerors may request a debriefing of the evaluation of their not selected proposal and should submit this request via email to: DTRA.belvoir.re.mbx.sbir@mail,mil and include "SBIR 21.2 / Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions that if successfully completed will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or without opportunity for revision for proposals that are reasonable and complete.

8. PHASE II PROPOSAL GUIDELINES

8.1 Phase II Proposal Introduction

Small business concerns awarded a Phase I contract are permitted to submit a Phase II proposal for evaluation and potential award selection. The Phase II proposals are best submitted no later than (NLT) 30 days AFTER the end of the 7 month Phase I period of performance.

All SBIR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

DTRA has established a **40-page limitation** for the Technical Volume submitted in response to its topics. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), or the Cost Volume, or the Company Commercialization Report. The Technical Volume includes, but is not limited to: table of contents, pages left blank, references and letters of support, appendices, key personnel biographical information, and all attachments.

Further details on the due date, content, and submission requirements of the Phase II proposal will be provided either in the Phase I award or by subsequent notification.

8.2 Phase II Proposal Instructions

Each Phase II proposal must be submitted through the DoD STTRSBIR Submission Web site by the deadline as specified in the Phase II Proposal Guidelines, or in the Phase I award or subsequent notification. Each proposal submission must contain a Proposal Cover Sheet, Technical Volume, Cost Volume, a Company Commercialization Report (see Sections 5.4.c.and 5.5 of the BAA Announcement), Volume 5, and Volume 6. The format should be similar to Phase I proposal except the Phase II Technical Proposal is limited to 40 pages. The Commercialization Strategy Volume should more specific than was required for Phase I.

As instructed in Section 5.4.e of the DoD SBIR Program BAA, the CCR is generated by the **submission website based on information provided by you through the "Company** Commercialization Report" tool.

8.3 Commercialization Strategy

See Section 7.3 of the DoD SBIR 21.2 BAA.

8.4 Phase II Evaluation Criteria

Phase II proposals will be reviewed for overall merit based upon the criteria in Section 7.0 of this Broad Agency Announcement and will be similar to the Phase I process.

8.5 Profit or Fee on Travel Costs

Travel shall not be a profit or fee bearing cost element.

9. PUBLIC RELEASE OF AWARD INFORMATION

If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released via the Internet. Therefore, do not include proprietary or classified information in these sections. For examples of past publicly released DoD SBIR/STTR Phase I and II awards, visit https://www.dodsbirsttr.mil.

10. PROTESTS

Service of Protest (Sept 2006)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed to Mr. Herbert Thompson, Contracting Officer, as follows) by obtaining written and dated acknowledgement of receipt from (if mailed letter) Defense Threat Reduction Agency, ATTN: AL-AC (Mr. Herbert Thompson), 1680 Texas Street, SE, Kirtland AFB, NM 87117. If Federal Express is used for the transmittal, the appropriate address is: Defense Threat Reduction Agency, ATTN: AL-AC (Mr. Herbert Thompson), 8151 Griffin Avenue, SE, Building 20414, Kirtland AFB, NM 87117-5669.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

VERSION 2

DTRA 21.2 Phase I Topic Index

VERSION 2

DTRA212-001 TITLE: Edge Computing for AI/ML based in forward deployed Cell Phones and associated equipment.

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning; Cybersecurity; Network Command, Control and Communications

TECHNOLOGY AREA(S): Battlespace; Electronics; Information Systems; Sensors

OBJECTIVE: Explore novel approaches to increase sense making for deployed forces using equipment they already carry and use. This will enable AI/ML Sense Making closer to the user with fewer delays, and reduced communications requirements, leading to a reduction of the human factors burden and physical burden by augmenting capabilities in their existing equipment.

DESCRIPTION: Develop, or demonstrate existing capabilities to create virtual processing networks using the increasing computational capabilities built in to commercially available cell phones. The ability to do secure processing close to the end user presents a rich resource for moving advanced and distributed processing AI/ML closer and closer to the end user. This will decrease the communications burden or bandwidth required while decreasing the time from potential detection to final action.

There is a movement to use inexpensive commercial equipment to enable operators in the field. The Android Tactical Assault Kit and it variants are now standard equipment for deploying forces. More specific to DTRA the Joint CTTSO DTRA Joint Operation Center/Tactical Assault Kit project provides sharing of imagery, planning tools, planning fragments, standard formatted request and report messages, language translation, and many additional operator developed capabilities. The old Galaxy S10 phones used with JOCTAK include dual CPU processors, 16 megapixel cameras, and at least 128 GB of ram1. The newer S21 version includes the faster dual processors, up to 512 GB of ram, a 40 MP Camera, dual encryption chips, and 5G capability2.

Each generation provides more capability without development cost to the end user.
The goal of this SBIR/SSTR topic is to explore harvesting and applying computational capabilities available in the current and next generation of cell phones used in DTRA Tactical Assault Kits, the Joint Operations Center Tactical Assault Kit (JOCTAK) and with the AI/ML capabilities under research in other parts of CX.

The emerging application and use of TAK/ATAK with the emergence of Civilian Tactical Assault Kit or the Team Awareness Kit is indicative of the commercial application of this research.

PHASE I: PHASE I: Shall execute an Analysis of Alternatives (AofA) and produce a Proof of Concept (PoC) implementation and architecture for creating secure virtual processing networks across commercially available cell phone used in the TAK/JOCTAK3 projects.

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PHASE II: Shall mature and fully integrate the architecture for the virtual network application with the continuous integration, continuous delivery (CICD) automated build process, located at the DI2E collaboration portal (www.di2e.net).

PHASE III DUAL USE APPLICATIONS:

All the deliverables of this topic shall be provided within the applicable laws and directions to include all allowed "government purpose rights", to the depository site. Use and sale of the developed capabilities for commercial or State, Local, Territorial, and Tribal depend to the performer as prescribed by law.

REFERENCES:

1. https://www.samsung.com/global/galasxy-s10-/specs/;
2. https://www.samsung.com/global/galasxy-s21-ultra-5g/specs/;
3. https://www.civtak.org/tag/socom;

KEYWORDS: Edge Computing Android Tactical Assault Kit, Tactical Assault Kit Joint Operations Center Tactical Assault Kit Artificial Intelligence, Virtual Operating Systems Civ/TAK, TEam Awareness Kit

VERSION 2

DTRA212-002 TITLE: Distributed, Cooperative, Learning for Subterranean Robotic Autonomous Systems

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning; Autonomy

TECHNOLOGY AREA(S): Electronics; Sensors

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: DTRA seeks the capability for its robotic systems, developed to explore and exploit, in GPS denied and communications limited environments, to learn from each other.

DESCRIPTION: Under the Modular Autonomous CWMD Systems (MACS) program, among others, DTRA is developing robotic and autonomous systems (RAS) to map, explore, and characterize subterranean facilities such as tunnels, caves, urban underground, and military purpose bunkers. These facilities can be extensive and include multiple levels, elevation changes, obstacles, dim and variable lighting, and other challenging conditions. In addition, GPS is unavailable in such locations and communications between users and RAS, and amongst RAS platforms, is limited in bandwidth and range. The primary mission of these RAS is to explore, map, and catalog in these environments. However, autonomous resupply, payload delivery, network forming, and other mission scenarios should be considered. The environment and missions dictate that various types of robotic platforms are necessary and the communications challenge dictates that a high degree of autonomy is necessary on each platform with the associated sensors and data load. The communication challenge also limits the amount of data that may be passed from platform - to - platform and platform - to – user which makes application of a centralized learning concept less feasible. Distributed learning solutions, such as combinations of federated learning, transfer learning, and/or distributed multi-agent reinforcement learning are approaches that enable model training on a large amount of decentralized data. That is, they enable the model to be passed over the network rather than the data. This could be extremely beneficial to the underground exploration mission of DTRA if telemetry, health and status, map and environmental information (such as air flow, air quality, lighting, traction), as well as mission specific information such as the presence or concentration of certain chemicals or radiological information, could be encoded into a model that could be more easily distributed among platforms and users that have only intermittent connectivity. This could allow platforms to more quickly navigate in areas that have already been explored by other platforms and allow more effective decisioning by each platform individually.

PHASE I: Design and develop both the models and a learning architecture for robotic platforms exploring and cataloging a subterranean environment such as a tunnel or cave. In simulations of subterranean areas with communication challenges, demonstrate the capability for multiple platforms to be controlled by humans and to learn from that control as to what are obstacles, what is of interest, what is not, etc. Locally train models on the data being collected and then update the models and for other platforms to receive and benefit from those updated models. Similarly, show platforms learning from each other by locally training models and then updating the shared model. A final demonstration should show at least more efficient path planning being developed by platforms that receive an updated model after a different platform has already explored an area.

PHASE II: Continue to develop the learning system and adapt it to the DTRA mission and DTRA platforms for incorporation into the group. Incorporate decisioning into the models that mitigates or adds information to the environmental conditions determined. Develop a tasking capability such that one platform may task other specialized platforms. Tasking may be dependent on specific object recognition or some other queue. Specializations may include carrying additional lighting, communications repeaters, CBRNE sensors, or other. Demonstrate the capability for the platforms to learn about the environment as well as the capabilities and limitations of the other systems in the group. A penultimate simulation demonstration should show autonomous tasking and path finding. For example, a UAV may be tasked to find the best route for a UGV to take given a particular set of obstacles and a system with specialized equipment will be called upon as required. Additionally, develop and simulate a small scale demonstration to be performed on actual hardware. Determine the hardware requirements and identify, develop, or otherwise procure it and perform a small scale demonstration in the same or similar environment that was included in the simulation.

PHASE III DUAL USE APPLICATIONS: Continue to develop and refine the Phase II product into a useful asset for DTRA. Adapt the product application for DTRA specific testing to include development or application of safety and security measures as required.

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KEYWORDS: robotic and autonomous systems, GPS-denied, subterranean, artificial intelligence, communications, CBRNE sensors, repeaters, learning architecture, distributed learning, federated learning, transfer learning, distributed multi-agent reinforcement learning

VERSION 2

DTRA212-003 TITLE: Global Nano Aerial Terrestrial Sensing (GNATS)

RT&L FOCUS AREA(S): Autonomy; Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Air Platform; Sensors

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: To develop and demonstrate an innovative robotic system showcasing a nano aerial vehicle (NAV) marsupial concept with a GPS-denied guidance capability to advance the state of Counter Weapons of Mass Destruction (C-WMD) missions.

DESCRIPTION: Long-range delivery of sensors and strategic capabilities to support C-WMD activities are required by DTRA and supported DOD components. Currently, small UASs are restricted by their size and power which limits their ability to both travel over long distances and perform C-WMD missions of sufficient duration at a site once they arrive. This SBIR seeks research on a multi-layered/multi-platform (marsupial) system utilizing existing commercial/government off-the-shelf (COTS/GOTS) small Unmanned Aerial System (sUAS) vehicle capable of coordinated, GPS-denied, marsupial deployment and recovery to meet specific C-WMD missions in the objective area.
The overall intent is to develop or identify a NAV that can be carried in multiples, deployed to carry out a specific mission, and recovered by a larger robotic platform such as a sUAS (referred as a mothership). The coordination between the mothership and the NAV's is of critical importance to be investigated and defined early as the NAV's may be limited in their onboard computing and sensing capability due to SWAP requirements. As such, solutions that centralize the guidance and coordination on the mothership, leveraging the more extensive sensing and compute capabilities available to the larger platform along with some type of remote path planning and guidance of the NAV's, will be considered along with solutions that feature more autonomous NAV's. An architecture that allows flexibility in this mothership-NAV relationship as to where the NAV guidance autonomy and sensing resides is desired so as to enable different NAV variants to eventually be developed and employed. The system architecture, both physical and algorithmic, shall be open to encourage future development. Possible remote guidance concepts include laser guided NAV's with mothership instructions or autonomous remote control with the mothership relying on its own sensors to guide the NAV's. (new paragraph) While the desire is for an adaptable system, the specific problem to be designed to is a chemical sampling mission. In a GPS denied area, the system is to deploy NAV's that carry a material sampling detector (equal to or less than one ounce) to discover a chemical agent. A number (desired threshold of 5) of NAVs will be deployed to different locations, sample an area, and be recovered by the mothership in order to demonstrate this concept. The focus is on the ability of

the NAVs to navigate to target areas, recover a chemical sample, and return to the mothership after mission completion. The mothership may move to new areas after recovery of the initially deployed NAVs in order to deploy the other NAVs in separate areas. The command and control and mission planning of this system shall be made as intuitive as possible.

PHASE I: The focus of Phase I is to identify and mitigate the highest risks areas. Specific attention should be placed on identifying the overall system architecture to include command and control concepts and determining how to leverage advances in technology for the best balance of autonomy and sensing between the mothership and NAVs. Platforms that may be utilized for both the mothership and NAVs for the chemical sampling mission shall be identified and an analysis of alternatives shall be performed that discusses the physical, sensing, and computational capabilities of the platforms and any integration or adaptation efforts required. It is highly recommended to use GOTS or Blue UASs as possible as a waiver process will be required for others. Design or identify and prototype and demonstrate the carry, deploy, and capture mechanisms and procedures. Identify the navigation and guidance methodology to be utilized and identify and mitigate the highest risks. Specifically identify the autonomy stack necessary for the mothership and the NAV to perform the chemical sampling mission and document the open architecture communications and interfaces necessary between the NAV and mothership.

PHASE II: Refine the system design to include mission planning and overall command and control capability. Build the system to include a desired threshold of 5 NAVs and one mothership.

Design and execute a technical demonstration that showcases the system with the mothership from a significant standoff that is well outside the NAVs range away from the initial target area. The NAV release point must be in range close enough to allow the NAVs enough time to conduct chemical sampling and return to the sUAS within their flight time constraints. There may be multiple sites for the mothership to carry the NAVs and there may be multiple chemical collection sites at each deployment location. The chemical sampling mission will consist of a non-toxic chemical collected by a standard method provided by the Government (M9 paper or other chemical sampling that can be carried by a NAV).

The sensing, computing, and autonomy balance demonstrating guidance and coordination between the mothership and NAVs is the major deliverable. For the demonstration to be successful, it must show the capability of the system to accurately position the NAVs to perform their mission, in three dimensions, in a GPS denied environment. GOTs platforms may be available and should be considered along with other options. The final report should include all considerations used to prove the concept and all technical challenges that the experimental team were not able to overcome. The final report will also include videos and a briefing of all demonstration outcomes.

PHASE III DUAL USE APPLICATIONS: Finalize and commercialize NAV marsupial system with mothership platform/SUAS for use by customers (e.g. DTRA, DoD agencies, Warfighter, industry). Although additional funding may become available from DoD sources, the awardee

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should look to other public or private sector funding sources for assistance with transition and commercialization.

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KEYWORDS: Microelectronics, small Unmanned Aerial Systems, autonomy, autonomous, semi-autonomous, nano micro-aerial vehicles or nano-MAVs, Vertical take-off and landing or VTOL

VERSION 2

DTRA212-004 TITLE: FRAMEWORK FOR APPLICATION LIFECYCLE MANAGEMENT AND CONTINUOUS INTEGRATION FOR PRE-EXASCALE HPC ARCHITECTURES

RT&L FOCUS AREA(S): 5G, General Warfighting Requirements (GWR); Nuclear

TECHNOLOGY AREA(S): Information Systems; Materials; Weapons

OBJECTIVE: The objective of this project is to develop a secure Application Lifecycle Management (ALM) and Continuous Integration / Continuous Delivery (CI/CD) framework for legacy codes. Such a capability would integrate existing tools into a cohesive framework to automate a series of steps such as test suites, ensuring code coverage of testing, version control e.g. Git & GitLab, streamlining of build process and bookkeeping of these steps/tests/versions. Once built and tested, deploy the application code using a Singularity software container on multiple physical systems, and eventually in a “cloud”.

DESCRIPTION: The Defense Threat Reduction Agency (DTRA) uses High-Fidelity computer codes to investigate weapon effects phenomenology and techniques for countering WMD. The High-Fidelity codes have in some cases evolved over many decades. This topic will begin to bridge the gap from legacy practices to modern practices that combine security, software development and information technology operations (SecDevOps) that test the security of the software as part of a continuous integration/continuous delivery (CI/CD) pipeline.

The government-owned computational fluid dynamics code, Second-order Hydrodynamic Automatic Mesh Refinement Code (SHAMRC), is heavily used by many of the DTRA programmatic areas utilizing High-Fidelity computer codes. It is a particularly challenging application for containerized deployment because a pre-processor reads user input and generates unique source code for each problem. The code is then compiled prior to execution. SHAMRC capabilities include non-responding and responding structures, interactive particles, several atmosphere models, multi-materials, many high explosive detonation models, a K-Epsilon turbulence model, a particle surface heating model, non-equilibrium radiation diffusion, water vaporization, and dust non-equilibrium chemistry. SHAMRC is second-order accurate in both space and time, is fully conservative of mass, momentum, and energy, and runs in parallel using Message Passing Interface (MPI). Because SHAMRC is export-controlled software, another large legacy FORTRAN High Fidelity code may be used as a SHAMRC proxy in Phase I.

Typically, ALM tools might include capabilities related to Requirements, Software & Hardware Development, Quality Assurance & Test Management, Release & SecDevOps. Because this effort is targeted towards existing legacy High Fidelity application codes, the emphasis should be on Quality Assurance & Test Management, Release & SecDevOps. Component integrations should be modular so that one tool such as GitHub for example, could be replaced with use of GitLab, to meet the needs of a different commercial customer in Phase III. The entire framework must run in user space without root access, although it may utilize existing underlying tools that are installed by the system administrators such as Git, GitLab and Singularity.

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PHASE I: Develop an approach for design of a secure ALM, CI/CD framework. The Framework design should encompass innovative use of existing open-source tools, such as Git, GitLab and the Singularity container using the fake root capability, with targets of Red Hat Enterprise Linux and SUSE Linux Enterprise Server. At the end of Phase I the performer should have a completed architecture and an early prototype with limited capabilities as proof of concept to demonstrate feasibility of the technical approach. For each component of the framework that is not an encapsulation of an existing tool, a stub may be used as a placeholder for capabilities to be added in Phase II.

PHASE II: Develop a production ready framework based on the Phase I approach and integrate with selected existing tools. Implement additional capabilities not available in existing tools to address other proposed features. Demonstrate the use of the framework on Department of Defense (DoD) High Performance Computing Program (HPCMP) systems on several High-Fidelity application codes, to include the SHAMRC code. The ability to migrate the ALM workflow and application code in a Singularity container from a DoD HPCMP physical system to a Cloud Service Provider is desirable. Cloud migration is subject to availability of cloud resources at Impact Level 5. An open research proxy may be used for development on Impact Level 2 resources.

PHASE III DUAL USE APPLICATIONS: The secure ALM, CI/CD framework and associated workflows developed for use on very demanding application codes will be well suited, once refined, for use on more general HPC workloads on pre-Exascale architectures. Improvements in this phase are expected to involve ease of use enhancements and hardening of the framework for use on a wide range of application software used in Government research and industry.

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3. JENKINShttps://www.jenkins.io/;
4. Singularityhttps://sylabs.io/docs/#singularity;
5. Singularity fake roothttps://sylabs.io/guides/3.5/user-guide/fakeroot.html;
6. DoD HPCMPhttps://centers.hpc.mil/;
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KEYWORDS: High Performance Computing; HPC; HPCMP; SHAMRC; Singularity; Container; FORTRAN; SecDevOps; High Fidelity;

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DTRA212-005 TITLE: Advanced Optics Based Magnetic Field Diagnostic for NWE Testing

RT&L FOCUS AREA(S): 5G, General Warfighting Requirements (GWR); Nuclear

TECHNOLOGY AREA(S): Nuclear; Sensors; 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 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: The objective of this effort is to develop an advanced optics based magnetic field sensor for Nuclear Weapon Effects (NWE) testing. The sensor should be low-cost and able to operate with high accuracy in a wide range of X-ray and gamma environments.

DESCRIPTION: Military system components are tested in X-ray and gamma radiation simulators, for time-varying Nuclear Weapon Effects (NWE), such as System Generated Electromagnetic Pulse (SGEMP), Internal EMP (IEMP), and Open Cavity SGEMP. These effects are caused by electrons emission from conducting surfaces which generate surface currents (with associated electric and magnetic fields). These magnetic fields can have strengths of order 1 to 1000 Amps/meter with rise times of order of nanoseconds (ns). It is important to measure the magnetic fields produced by pulsed X-ray exposures to validate models of a system's response. Traditionally, the magnetic fields of these NWE effects are measured with small B-Dot probes (simple induction coils), placed close to the external or internal surfaces of the test object. These sensors face challenges related to their miniaturization, Electromagnetic Interference (EMI) susceptibility and fielding considerations within a test object [1, 2]. Optical fiber based magnetic field sensors, offer several advantages which includes having a smaller size, reduced susceptibility to EMI noise and increased dynamic range [1]. These sensors are seldom fielded for NWE testing due to the requirement to be high speed, minimally intrusive and able to operate in a harsh environment [3]. The objective of this effort is to develop an advanced optics based magnetic field sensor appropriate for NWE testing.

DTRA seeks innovative ideas for the development of an advanced optics based magnetic field sensor suitable for NWE testing. The proposed magnetic field sensor should include the sensor probe as well as the measurement and recording instrumentation capable of nanosecond time resolution. The system must maintain the integrity of the magnetic field information sensed at the probe and transmitted to the recording instrumentation. The sensor probe should be low-cost, easily replaceable, small and able to operate with high accuracy in a wide range of X-ray and gamma environments. Phase 1 development should result in a conceptual design of the proposed sensor and demonstrates its feasibility for NWE related testing. Phase II development will further

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optimize the design of the sensor, fabricate and demonstrate that the design meets or exceeds the following threshold {objectives}:

1. B-Field Measurement Range: 0.01 to >1000 A/m
2. Accuracy: better than 5%
3. Bandwidth: >100 MHz
4. Rise Time: <3.5 ns
5. Be low cost and have a replaceable sensing element.
6. Be compact: the sensing element to be no larger than 1cm3.

PHASE I: Investigation will develop a conceptual design of the optics based magnetic field sensor that, at a minimum, addresses the stated objectives presented in the Description. Demonstrate the feasibility of the sensor design with performance predictions based on peer-reviewed literature, physics-based modeling and simulation, and/or data obtained from laboratory testing of sensor components. Develop a Phase development II plan.

PHASE II: Based on the results of Phase I, develop and deliver a prototype that demonstrates the performance of the chosen technology for this application and meets all stated minimum requirements stated in the Phase II development plan and objectives stated in the Description. Collaborate with Government personnel to test the prototype over its full dynamic range to ensure the capability meets the performance goals.

PHASE III DUAL USE APPLICATIONS: Optimize sensor design and demonstrate performance in an operational environment. Develop manufacturing and commercialization plans for implementing the research in production and dissemination of the sensors, respectively. This technology would benefit any organization seeking a low cost, small, robust magnetic field sensor.

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KEYWORDS: Electromagnetic Sensor, Magnetic Sensor, Optical Fiber Magnetic Field Sensor, NWE, NWE Testing, SGEMP, IEMP

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TRA212-006 TITLE: Algorithm that can locally link radiation detectors (of different resolutions) to enhance identification/ localization capability

RT&L FOCUS AREA(S): Nuclear; Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Nuclear; Sensors

OBJECTIVE: Development of network hosted algorithms to link multiple and varied battlefield RN detectors to enable the fusing and processing of raw detector outputs into usable information.

DESCRIPTION: This topic seeks to develop radiation detection algorithms that would reside within a network and support the fusion of multiple and varied raw detector outputs and the processing of this data into useable information. Often, multiple detectors, and multiple detector variants are deployed to characterize a complex scene (i.e. stationary detectors, handheld radioisotope devices, vehicle-mounted detectors, and backpack detectors) within 1 square km. Currently, algorithms for identification and characterization reside on each individual detector and each detector provides its unique result. This topic aims to better utilize those data from multiple detector types and analyze data in a way as to enhance the overall mission's ability to identify and localize a radiation source in a complex scene. The intent is to change the level of analysis and potentially fuse data (gross gamma/neutron counts, gamma spectral data, and/or GPS data) to identify and characterize anomalies in radiological signatures quicker than current local algorithms on singular devices.

PHASE I: Identification of multi-radiation detector algorithms and demonstrate their potential to improve the identification, characterization, and/or localization of a radioactive source in a complex scene as compared to the singular detector algorithm. Multiple candidate algorithms shall be down selected for further development in Phase II. Demonstrate pathways for meeting the Phase II performance goals through feasibility studies at the end of Phase I.

PHASE II: Demonstrate enhanced identification, characterization and/or localization of radioactive sources with the multi-detector algorithm that fuses data (gamma and neutron radiation outputs, and GPS location/time) from disparate ground based and mobile detector types. Demonstrate improved performance of the multi-detector algorithm over single-system algorithms. The algorithm should support the integration of additional new detector types.

PHASE III DUAL USE APPLICATIONS: Field demonstration in radiation environment with users deploying multiple and varied radiation detectors linked via communications to a network node in which the algorithm receives detector outputs. The algorithm must conduct scene characterization in real-time as operators move through a complex environment with disparate detector modalities. The multi-system algorithm will be directly compared to legacy single-system algorithms to assess impact on mission. Develop commercialization and transition plan to DoD end users.

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DETECTION OF RADIATION SOURCES. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Volume 784, 1 June 2015, Pages 326-331. Accessed from https://www.sciencedirect.com/science/article/abs/pii/S0168900215000686;

2. Joint Pub 3-11;

KEYWORDS: RN Detection, algorithm

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DTRA212-007 TITLE: Augmented Reality and Virtual Reality

RT&L FOCUS AREA(S): Nuclear

TECHNOLOGY AREA(S): Human Systems; Information Systems; Nuclear; Sensors; Battlespace; Electronics

OBJECTIVE: AR/VR evaluation tool that allows operators to walk through challenging life scenariosnuclear response scenarios (includes anomalies like shadowing, spotlighting, and attenuation effects) with radiation detectors.

DESCRIPTION: Develop software to support testing and evaluation of radiation detectors and their use in challenging life-like nuclear response scenarios without the use of radiological sources. Solutions to the problem set will focus on ensuring the technologies can effectively mimic real-world anomalies such as spotlighting and attenuation effects. Possible solutions may inject data in into sensors directly. The intent is to customize commercially available augmented reality and virtual reality solutions and applythem to the recreation of complex nuclear response scenarios. The solution should be flexible and agile enough to be quickly applicable to multiple mission locations, source configurations, and radiation detection systems.

PHASE I: Working Prototype-Technology Readiness Level 4

PHASE II: Robust Prototype TRL 6

PHASE III DUAL USE APPLICATIONS:

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KEYWORDS: Augmented and Virtual Reality

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DTRA212-008 TITLE: Modernized Low Visibility RF Radio Capability

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning; 5G, General Warfighting Requirements (GWR); Cybersecurity; Network Command, Control and Communications

TECHNOLOGY AREA(S): Information Systems; Sensors; Electronics

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OBJECTIVE: To develop a low visibility, jamming resistant, RF radio that is compatible with NE-CO sensors and operates on the Tactical Assault Kit (TAK) ecosystem. It will facilitate low-visibility CBRN Search Operations by the Technical Support Groups.

DESCRIPTION: TSG's are tasked with providing the Geographic Combatant Commanders (GCC) with a tactical, low-visibility CBRN search capability. The TSG's currently use Slingshot RF radios, and GSM/cellular to provide commanders the ability to command and control teams during search operations.

Presently, the RF radios used by TSGs do not have the ability to pass spectral data and is limited to a 900MHz ISM band, which is restricted in certain COCOMs, thus limiting tactical commanders in their communication PACE plans. Large area CBRN search operations require the deployment of a multitude of sensors, both statically and dynamically, throughout the defined mission space. This requires the simultaneous transmission of dozens of data streams in environments that are RF congested. The utilization of novel AI/ML algorithms to optimize RF waveforms in real time will improve the TSG's ability to locate and detect material of concern during search operations. This novel approach to waveform generation will allow TSGs to operate in all publically available ISM bands at 1 watt power levels which require little or no spectrum coordination with the host country, minimize the RF footprint, and are resistant to detection and countermeasure by technologically advanced adversaries.

To solve this challenge, TSGs require a new RF radio system which is interoperable with current and future NE-CO sensors and CBRN TAK plugins, providing TSG's with a flexible communications pathway, capable of relaying 300 kbps or higher for spectral analysis. Additionally, the new RF radio option should have 3 ISM band options, use minimal power, maintain a similar size or smaller than the current RF radio systems, incorporate waveforms purpose built to avoid detection, and are resistant to jamming. This would allow TSG's to adjust

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their communications PACE plan with minimal effort or host nation clearances, while maintaining operational effectiveness in a low visibility environment.

If successful, this RF radio system would provide TSG's and their supported forces with greater communications interoperability, allowing for better C3, faster identification and spectral analysis, and better allocation of operational resources.

PHASE I: Identify possible RF radio solutions. Requirements will include biweekly project updates, a final technical report, and successful live CONOP demonstration to include TAK functionality, sensor integration, and communications capabilities. Should include user interface for TAK a radio and network configuration as well as ML/AI capabilities to prevent jamming.

PHASE II: After identifying possible solutions, developer will be required to continue biweekly project updates and compile a final technical report. Additionally, developer will provide 1 prototype low visibility system for internal testing and demonstration as well as a live CONOP demonstration. Developer will demonstrate inclusion of AI capabilities and bandwidth for spectral analysis, as well as for jamming resistance during preliminary testing.

PHASE III DUAL USE APPLICATIONS:

REFERENCES:

1. ATAK CBRNE Central Staff, Tactical Assault Kit Plugins for Decision Support in CBRNE Environments.https://cbrnecentral.com/tactical-assault-kit-plugins-for-decision-support-in-cbrne-environments/19499/;
2. Department of Defense. (2004). Chemical, Biological, Radiological, and Nuclear Defense Program: Report to Congress. Washington, D. C.: DoD.;
3. Department of Defense. (2008). DoD CBRN Defense: Doctrine, Training, Leadership, and Education Strategic Plan. Washington, D. C.: CBDP.;
4. Department of Defense. (2018). Joint Electronic Library. Washington, D.C.: DoD. Accessed at: http://www.jcs.mil/Doctrine/;
5. Joint Acquisition CBRNE Knowledge System (2018). JACKS: News and Application Console. Retrieved from JACKS: https://pki.jacks.jpeocbd.army.mil;
6. Joint Publication 3-41, CBRNE Response Joint publication 3-11, Operations in CBRNE Environments Low, Cherlynn. What do made for AI processors really do? (2017) Accessed at: https://www.engadget.com/2017/12/15/ai-processor-cpu-explainer-bionic-neural-npu/;
7. National Academy of Sciences. (1999). Philosophy, Doctrine, and Training for Chemical and Biological Warfare. Retrieved from Strategies to Protect the Health of Deployed U.S. Forces: Force Protection and Decontamination: https://www.ncbi.nlm.nih.gov/books/NBK225131/;
8. US Army (2018). "CBRN Force Modernization Strategy.";

KEYWORDS: Nuclear Search, AI/ML, Signal Processing, TAK, Communications, Bandwidth

VERSION 2

DTRA - 7

Missile Defense Agency (MDA)
21.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

I. INTRODUCTION

The Missile Defense Agency's (MDA) mission is to develop and deploy a layered Missile Defense System (MDS) to defend the United States, its deployed forces, allies, and friends from missile attacks in all phases of flight.

The MDA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the MDA SBIR/STTR Program Management Office (PMO), located within the Innovation, Science, & Technology (DV) directorate. Specific questions pertaining to the administration of the MDA SBIR Program and these proposal preparation instructions should be submitted to:

Missile Defense Agency
SBIR/STTR Program Office
MDA/DVR
Bldg. 5224, Martin Road
Redstone Arsenal, AL 35898

Email: sbirsttr@mda.mil
Phone: 256-955-2020

Proposals not conforming to the terms of this Announcement will not be considered. MDA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by MDA will be funded. MDA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD Announcement and MDA instructions carefully prior to submitting your proposal. Please go to https://www.sbir.gov/about/about-sbir#sbir-policy-directive to read the SBIR/STTR Policy Directive issued by the Small Business Administration.

Federally Funded Research and Development Centers (FFRDCs) and Support Contractors

Only Government personnel with active non-disclosure agreements will evaluate proposals. Non-Government technical consultants (consultants) to the Government may review and provide support in proposal evaluations during source selection. Consultants may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. Consultants will not establish final assessments of risk and will not rate or rank offerors' proposals. They are also expressly prohibited from competing for MDA SBIR awards in the SBIR topics they review and/or on which they provide comments to the Government.

All consultants are required to comply with procurement integrity laws. Consultants will not have access to proposals or pages of proposals that are properly labeled by the offerors as "Government Only." Pursuant to FAR 9.505-4, the MDA contracts with these organizations include a clause which requires them to (1) protect the offerors' information from unauthorized use or disclosure for as long as it remains proprietary and (2) refrain from using the information for any purpose other than that for which it was furnished. In addition, MDA requires the employees of those support contractors that provide technical analysis to the SBIR/STTR Program to execute non-disclosure agreements. These agreements will remain on file with the MDA SBIR/STTR PMO.

Non-Government consultants will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. In accomplishing their duties related to the source selection process, employees of the aforementioned organizations may require access to proprietary information contained in the offerors' proposals.

II. OFFEROR SMALL BUSINESS ELIGIBILITY REQUIREMENTS

Each offeror must qualify as a small business at time of award per the Small Business Administration's (SBA) regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Small businesses that are selected for award will also be required to submit a Funding Agreement Certification document and be register with Supplier Performance Risk System https://www.sprs.csd.disa.mil/ prior to award.

SBA Company Registry

Per the SBIR/STTR Policy Directive, all applicants are required to register their firm at SBA's Company Registry prior to submitting a proposal. Upon registering, each firm will receive a unique control ID to be used for submissions at any of the eleven (11) participating agencies in the SBIR or STTR program. For more information, please visit the SBA's Firm Registration Page: http://www.sbir.gov/registration.

Performance Benchmark Requirements for Phase I Eligibility

MDA does not accept proposals from firms that are currently ineligible for Phase I awards as a result of failing to meet the benchmark rates at the last assessment. Additional information on Benchmark Requirements can be found in the DoD Instructions of this Announcement.

III. ORGANIZATIONAL CONFLICTS OF INTEREST (OCI)

The basic OCI rules for Contractors which support development and oversight of SBIR topics are covered in FAR 9.5 as follows (the Offeror is responsible for compliance):

(1) the Contractor's objectivity and judgment are not biased because of its present or planned interests which relate to work under this contract;

(2) the Contractor does not obtain unfair competitive advantage by virtue of its access to non-public information regarding the Government's program plans and actual or anticipated resources; and

(3) the Contractor does not obtain unfair competitive advantage by virtue of its access to proprietary information belonging to others.

All applicable rules under the FAR Section 9.5 apply.

If you, or another employee in your company, developed or assisted in the development of any SBIR requirement or topic, please be advised that your company may have an OCI. Your company could be precluded from an award under this BAA if your proposal contains anything directly relating to the development of the requirement or topic. Before submitting your proposal, please examine any potential

OCI issues that may exist with your company to include subcontractors and understand that if any exist, your company may be required to submit an acceptable OCI mitigation plan prior to award.

IV. USE OF FOREIGN NATIONALS (also known as Foreign Persons), GREEN CARD HOLDERS AND DUAL CITIZENS

See the "Foreign Nationals" section of the DoD SBIR Program Announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Identify any foreign nationals 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. 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)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens, or green card holders listed will be subject to security review during the contract negotiation process (if selected for award). MDA reserves the right to vet all uncleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed person and/or firm is found ineligible by the government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but is not required to disclose the underlying rationale.

V. EXPORT CONTROL RESTRICTIONS

The technology within most MDA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export controlled items based on user, country, and purpose. The offeror must ensure that their firm complies with all applicable export control regulations. Please refer to the following URLs for additional information: https://www.pmddtc.state.gov/ and https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear.

Most MDA SBIR topics are subject to ITAR and/or EAR. If the topic write-up indicates that the topic is subject to International Traffic in Arms Regulation (ITAR) and/or Export Administration Regulation (EAR), your company may be required to submit a Technology Control Plan (TCP) during the contracting negotiation process.

VI. CLAUSE H-08 PUBLIC RELEASE OF INFORMATION (Publication Approval)

Clause H-08 pertaining to the public release of information is incorporated into all MDA SBIR contracts and subcontracts without exception. Any information relative to the work performed by the contractor under MDA SBIR contracts must be submitted to MDA for review and approval prior to its release to the public. This mandatory clause also includes the subcontractor who shall provide their submission through the prime contractor for MDA's review for approval.

VII. FLOW-DOWN OF CLAUSES TO SUBCONTRACTORS

The clauses to which the prime contractor and subcontractors are required to comply include, but are not limited to the following clauses: MDA clause H-08 (Public Release of Information), DFARS 252.204-7000 (Disclosure of Information), DFARS clause 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting), and DFARS clause 252.204-7020 (NIST SP 800-171 DoD Assessment Requirements). Your proposal submission confirms that any proposed subcontract is in accordance to the clauses cited above and any other clauses identified by MDA in any resulting contract.

VIII. OWNERSHIP ELIGIBILITY

Prior to award, MDA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR Program Eligibility. These documents include, but may not be limited to, the Business License; Articles of Incorporation or Organization; By-Laws/Operating Agreement; Stock Certificates (Voting Stock); Board Meeting Minutes for the previous year; and a list of all board members and officers. If requested by MDA, the contractor shall provide all necessary documentation for evaluation prior to SBIR award. Failure to submit the requested documentation in a timely manner as indicated by MDA may result in the offeror's ineligibility for further consideration for award.

IX. FRAUD, WASTE, AND ABUSE

All offerors must complete the fraud, waste, and abuse training (Volume 6) that is located on the Defense SBIR/STTR Innovation Portal (DSIP) (https://www.dodsbirsttr.mil). Please follow guidance provided on DSIP to complete the required training.

To Report Fraud, Waste, or Abuse, Please Contact:

MDA Fraud, Waste & Abuse
Hotline: (256) 313-9699
MDAHotline@mda.mil

DoD Inspector General (IG) Fraud, Waste & Abuse
Hotline: (800) 424-9098
hotline@dodig.mil

Additional information on Fraud, Waste and Abuse may be found in the DoD Instructions of this Announcement.

X. PROPOSAL FUNDAMENTALS

Proposal Submission

All proposals MUST be submitted online using DSIP (https://www.dodsbirsttr.mil). Any questions pertaining to the DoD SBIR/STTR submission system should be directed to the DoD SBIR/STTR Help Desk at DoDSBIRSupport@reisystems.com.

It is recommended that potential offerors email topic authors to schedule a time for topic discussion during the pre-release period list in the DoD SBIR Program BAA.

Classified Proposals

Classified proposals **ARE NOT** accepted under the MDA SBIR Program. The inclusion of classified data in an unclassified proposal MAY BE grounds for the Agency to determine the proposal as non-responsive and the proposal not to be evaluated. Contractors currently working under a classified MDA SBIR contract must use the security classification guidance provided under that contract to verify new SBIR proposals are unclassified prior to submission. Phase I contracts are not typically awarded for classified work. However, in some instances, work being performed on Phase II contracts will require security clearances. If a Phase II contract will require classified work, the offeror must have a facility clearance and appropriate personnel clearances in order to perform the classified work. For more information on facility and personnel clearance procedures and requirements, please visit the Defense Counterintelligence and Security Agency Web site at: https://www.dcsa.mil.

Use of Acronyms

Acronyms should be spelled out the first time they are used within the technical volume (Volume 2), the technical abstract, and the anticipated benefits/potential commercial applications of the research or development sections. This will help avoid confusion when proposals are evaluated by technical reviewers.

Communication

All communication from the MDA SBIR/STTR PMO will originate from the sbirsttr@mda.mil email address. Please white-list this address in your company's spam filters to ensure timely receipt of communications from our office.

Proposal Status

The MDA Contracting Office will distribute selection and non-selection email notices to all firms who submit an MDA SBIR proposal. The email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet. MDA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission. MDA anticipates that selection and non-selection notifications will be distributed to all offerors in the September 2021 timeframe.

Proposal Feedback

MDA will provide written feedback to unsuccessful offerors regarding their proposals upon request. Requests for feedback must be submitted in writing to the MDA SBIR/STTR PMO within 30 calendar days of non-selection notification. Non-selection notifications will provide instructions for requesting proposal feedback. Only firms that receive a non-selection notification are eligible for written feedback.

Technical and Business Assistance (TABA)

The SBIR/STTR Policy Directive allows agencies to enter into agreements with suppliers to provide technical assistance to STTR awardees, which may include access to a network of scientists and engineers engaged in a wide range of technologies or access to technical and business literature available through on-line data bases.

All requests for TABA must be completed using the MDA SBIR/STTR Phase I TABA Form (https://www.mda.mil/global/documents/pdf/SBIR_STTR_PHI_TABA_Form.pdf) and included as a part of Volume 5 of the proposal package. MDA will not accept requests for TABA that do not utilize the MDA SBIR/STTR Phase I TABA Form or are not provided as part of Volume 5 of the Phase I proposal package.

An SBIR firm may acquire the technical assistance services described above on its own. Firms must request this authority from MDA and demonstrate in its SBIR proposal that the individual or entity selected can provide the specific technical services needed. In addition, costs must be included in the cost volume of the offeror's proposal. 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).

If the awardee supports the need for this requirement sufficiently as determined by the Government, MDA will permit the awardee to acquire such technical assistance, in an amount up to $5,000 per year. This will be an allowable cost on the SBIR award. The per year amount will be in addition to the award and is not subject to any burden, profit or fee by the offeror. The per-year amount is based on the original contract period of performance and does not apply to period of performance extensions. Requests for TABA funding outside of the base period of performance (6 months) for Phase I proposal submission will not be considered.

The purpose of this technical assistance is to assist SBIR awardees in:
1. Making better technical decisions on SBIR projects;
2. Solving technical problems that arise during SBIR projects;
3. Minimizing technical risks associated with SBIR projects; and
4. Developing and commercializing new commercial products and processes resulting from such projects including intellectual property protections.

The MDA Phase I TABA form can be accessed here: (https://www.mda.mil/global/documents/pdf/SBIR_STTR_PHI_TABA_Form.pdf) and must be included as part of Volume 5 using the "Other" category.

Protests Procedures
Refer to the DoD Program Announcement for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to:
Tina Barnhill | 256-450-2817 | sbristtr@mda.mil

XI. PHASE I PROPOSAL GUIDELINES

DSIP (available at https://www.dodsbirsttr.mil) will lead you through the preparation and submission of your proposal. Read the front section of the DoD Announcement for detailed instructions on proposal format and program requirements. Proposals not conforming to the terms of this Announcement will not be considered. To be considered for evaluation the proposal package must be formally submitted on DSIP.

MAXIMUM PHASE I PAGE LIMIT FOR MDA IS 15 PAGES FOR VOLUME 2, TECHNICAL VOLUME

Any pages submitted beyond the 15-page limit within the Technical Volume (Volume 2) will not be evaluated. If including a letter(s) of support and/or TABA request, it must be included as part of Volume 5 and will not count towards the 15-page Technical Volume (Volume 2) limit. Any technical data/information that should be in the Technical Volume (Volume 2) but is contained in other Volumes will not be considered.

MDA's objective for the Phase I effort is to determine the merit and technical feasibility of the concept. The contract period of performance for Phase I shall be six (6) months and the award shall not exceed $150,000. A list of topics currently eligible for proposal submission is included in these instructions, followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time.

Phase I Proposal

A complete Phase I proposal consists of six volumes:

- Volume 1 (required): Proposal Cover Sheet *(does not count towards 15-page limit)*
- Volume 2 (required): Technical Volume (maximum of 15 pages)
- Volume 3 (required): Cost Volume *(does not count towards 15-page limit)*
- Volume 4 (required): Company Commercialization Report *(does not count towards 15-page limit)*
- Volume 5:
  - Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment (required),
  - Foreign Ownership or Control Disclosure (Proposers must review Attachment 2 in the DoD SBIR 21.2 BAA: Foreign Ownership or Control Disclosure to determine applicability),
  - Letters of Support (optional),
  - TABA (optional).
- Volume 6 (required): Fraud, Waste, and Abuse Training Certification

Volume 5 – Supporting Documents

MDA will only accept the following four documents as part of Volume 5:

1. Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment (Required).
2. Foreign Ownership or Control Disclosure (Proposers must review Attachment 2 in the DoD SBIR 21.2 BAA: Foreign Ownership or Control Disclosure to determine applicability.
3. Request for TABA using the MDA Phase I TABA form (optional).
4. Letters of support (optional).

If including a request for TABA, the MDA Phase I TABA Form MUST be completed and uploaded using the "Other" category within Volume 5 of DSIP.

If including letters of support, they MUST be uploaded using the "Letters of Support" category within Volume 5 of DSIP. A qualified letter of support is from a relevant commercial or Government Agency procuring organization(s) working with MDA, articulating their pull for the technology (i.e., what MDS need(s) the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program. Letters of support shall not be contingent upon award of a subcontract.

Any documentation other than the prohibited Video Surveillance and Telecommunications Services and Equipment form, Foreign Ownership or Control Disclosure, letter(s) of support, or requests for TABA included as part of Volume 5 WILL NOT be considered.

References to Hardware, Computer Software, or Technical Data

In accordance with the SBIR/STTR Policy Directive, SBIR/STTR contracts are to conduct feasibility-related experimental or theoretical R/R&D related to described agency requirements. The purpose for Phase I is to determine the scientific and technical merit and feasibility of the proposed effort.

It is not intended for any formal end-item contract delivery and ownership by the Government of your hardware, computer software, or technical data. As a result, your technical proposal should not contain any reference to the term "Deliverables" when referring to your hardware, computer software, or technical data. Instead use the term: "Products for Government Testing, Evaluation, Demonstration, and/or possible destructive testing."

The standard formal deliverables for a Phase I are the:
A001: Report of Invention(s), Contractor, and/or Subcontractor(s) // Patent Application for Invention
A002: Status Report // Phase I Bi-monthly Status Report
A003: Contract Summary Report // Phase I Final Report
A004: Certification of Compliance // SBIR Funding Agreement Certification - Life Cycle Certification
A005: Computer Software Product // Product Description
A006: Technical Report - Study Services // Prototype Design and Operation Document

FAR 52.203-5 Covenant Against Contingent Fees

As prescribed in FAR 3.404, the following FAR 52.203-5 clause shall be included in all contracts awarded under this Broad Agency Announcement (BAA):

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) Bona fide agency, as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

XII. PHASE I PROPOSAL SUBMISSION CHECKLIST

____1. The following have been submitted electronically through DSIP by the date and time listed on the first page of the DoD Program BAA.

- ✓ Volume 1: DoD Proposal Cover Sheet

- ✓ Volume 2: Technical Volume (DOES NOT EXCEED 15 PAGES)**: Any pages submitted beyond this will not be evaluated. Your Proposal Cover Sheet, Cost Volume, and Company Commercialization Report DO NOT count toward your maximum page limit.**

  If proposing to use foreign nationals (also known as foreign persons), green card holders, and/or dual citizens; identify the personnel you expect to be involved on this project, the type of visa or work permit under which they are performing, country of origin and level of involvement.

- ✓ Volume 3: Cost Volume. **(Online Cost Volume form is REQUIRED by MDA)**

- ✓ Volume 4: Company Commercialization Report. (required even if your firm has no prior SBIR/STTR awards).

- ✓ Volume 5: Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment (required), Foreign Ownership or Control Disclosure, Letters of Supports (optional), and/or TABA (optional).

- ✓ Volume 6 (required): Fraud, Waste, and Abuse Training Certification.

____2. Phase I proposal is not to exceed $150,000. (or not to exceed $155,000 if TABA is included)

____3. The proposal must be formally submitted on DSIP. Proposals that are not submitted will not be evaluated.

XIII. MDA SECURITY REVIEW OF ABSTRACTS, BENEFITS, AND KEYWORDS

Proposal titles, abstracts, anticipated benefits, and keywords of proposals that are selected for contract award will undergo an MDA Policy and Security Review. Proposal titles, abstracts, anticipated benefits, and keywords are subject to revision and/or redaction by MDA. Final approved versions of proposal titles, abstracts, anticipated benefits, and keywords may appear on DSIP and/or the SBA's SBIR/STTR award site (https://www.sbir.gov/sbirsearch/award/all).

XIV. MDA PHASE I PROPOSAL EVALUATIONS

MDA will evaluate and select Phase I and Phase II proposals using scientific review criteria based upon technical merit and other criteria as discussed in this Announcement document. MDA reserves the right to award none, one, or more than one contract under any topic. MDA is not responsible for any money expended by the offeror before award of any contract. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality as determined by MDA will be funded.

Phase I proposals will be evaluated based on the criteria outlined below, including potential benefit to the MDS. 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 its commercialization.

Please note that potential benefit to the MDS will be considered throughout all the evaluation criteria and in the best value trade-off analysis. When combined, the stated evaluation criteria are significantly more important than cost or price.

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

Phase II Proposal Submission

Per DoD SBIR Phase II Proposal guidance, all Phase I awardees from the 21.2 Phase I announcement will be permitted to submit a Phase II proposal for evaluation and potential award selection. Details on the due date, format, content, and submission requirements of the Phase II proposal will be provided by the MDA SBIR/STTR PMO on/around the fourth month of the Phase I period of performance. Only firms who receive a Phase I award resulting from the 21.2 announcement may submit a Phase II proposal.

MDA will evaluate and select Phase II proposals using the Phase II evaluation criteria listed in the DoD Program Announcement. While funding must be based upon the results of work performed under a Phase I award and the scientific and technical merit, feasibility and commercial potential of the Phase II proposal, Phase I final reports will not be reviewed as part of the Phase II evaluation process. The Phase II proposal should include a concise summary of the Phase I effort including the specific technical problem or opportunity addressed and its importance, the objective of the Phase I effort, the type of research conducted, findings or results of this research, and technical feasibility of the proposed technology. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

All Phase II awardees must have a Defense Contract Audit Agency (DCAA) approved accounting system. It is strongly urged that an approved accounting system be in place prior to the MDA Phase II award timeframe. If you do not have a DCAA approved accounting system, this will delay/prevent Phase II contract award. Please visit https://www.dcaa.mil/Customers/Small-Business for more information on obtaining a DCAA approved accounting system.

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MDA 21.2 SBIR Phase I Topic Index

MDA212-001	Advanced Telescope Optics
MDA212-002	Automated MAP Compliance Assessment Tool
MDA212-003	Automated System Architecture Tool
MDA212-004	Dynamic Ballistic Missile Defense Three Dimensional (3-D) Combat Information Center Playback
MDA212-005	Methodologies for Development of Radiation-Hardened Large-Format Infrared Emitter Arrays
MDA212-006	Innovative Automated Support of Data Analysis for Emerging Missile Defense System (MDS) Capabilities
MDA212-007	Innovative Uses of Artificial Intelligence and Machine Learning in Scenario Planning and Design
MDA212-008	Operational Defense Effectiveness Assessments for Missile Raid Scenarios
~~MDA212-009~~	~~Next Generation Overhead Persistent Infrared Communications Modeling~~
MDA212-010	Innovative Digital Data Engineering Techniques to Develop Authoritative Sources of Truth and Knowledge across Missile Defense System Systems of Systems
MDA212-011	High Temperature Dynamic Seals for Solid Propulsion
MDA212-012	External Queuing Navigation Correction
MDA212-013	Design Innovative Equipment to Produce Large Single-Crystal CdZnTe for Long-wave Infrared Detector Arrays
MDA212-014	Optimized Waveforms for X-Band Missile-Defense Radars
MDA212-015	Predict Signatures of Hypersonic Cruise Missiles
MDA212-016	Kill Enhancing Devices
MDA212-017	Pursuit Evasion Strategies for Missile Defense
MDA212-018	Next-Gen Infrared Scene Projector for Hypersonic Hardware-in-the-loop Test and Evaluation
MDA212-019	Contextual Reasoning for Threat Classification Refinement
MDA212-020	Federated Learning for Accurate Object Classification

VERSION 3

MDA212-021	Salvo Management Using Artificial Intelligence
MDA212-022	Radiation Hardening of Non-Hardened Commercial Microelectronics

MDA21-001 TITLE: Advanced Telescope Optics

RT&L FOCUS AREA(S): Hypersonics; Space

TECHNOLOGY AREA(S): Materials; Sensors; Space Platform; 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 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 small form factor infrared (IR) reflective telescopic optics for use in interceptors that demonstrate strong performance and resilience to environmental conditions at high endo to exo-atmospheric conditions

DESCRIPTION: The government has interest in developing optical systems for interceptors that show increased performance in high altitude endo and exo-atmospheric environments and in a manmade, hostile radiation environment. Prior art shows polished substrate optics, such as Silicon Carbide (SiC), offer impressive thermal stability, strength, cost savings, and optical performance while reducing overall system weight.

PHASE I: Phase I should include a feasibility study investigating design and manufacturing concepts of innovative telescope optics that trade cost, weight, optical performance, and stability in the high altitude, in endo and exo-atmospheric environments, and in a manmade, hostile radiation environments. Study should focus on technology readiness of integrating optics into a fully functional IR telescope assembly no larger than 18” in diameter. Down selection of candidate materials driven by engineering judgement and testing is desired. Identify major technology gaps and limitations to overcome for future Phase II work.

PHASE II: With materials from Phase I, further investigate optimizations of technology regarding mounting and installation into a multi-mirror IR telescope. Develop a multi-mirror system that matches government provided optical and packaging requirements. Develop and execute an incremental test plan that includes environmental requirements (i.e. shock, vibration, temperature, humidity, etc.) and characterization of the mirror system at simulated altitudes, and at manmade radiation levels.

PHASE III DUAL USE APPLICATIONS: Based on Phase II lessons learned, revise the systems model to proof out the new design. Develop and execute a Phase III incremental test & integration plan that will produce a final prototype. Demonstrate interface capability with a government furnished telescope mount. Perform acceptance-like testing in accredited optics range.

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1. Silicon Carbide Technologies for Lightweighted Aerospace Mirrors. Lawrence E. Maston, Ming Y Chen, Brett deBlonk, Iwona A. Palusinski, Air Force Research Lab Wright-Patterson AFB, OH. September 2008. ;
2. CVD Silicon Carbide Characterization. G. A. Graves Jr., D. Iden. Dayton University Oh Research Institute. August 1994. https://apps.dtic.mil/dtic/tr/fulltext/u2/a285667.pdf

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KEYWORDS: Silicon Carbide Optics, Thermally Insensitive Optics, IR Telescope

MDA21-002 TITLE: Automated MAP Compliance Assessment Tool

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Information Systems; Ground Sea; Weapons

OBJECTIVE: Design, develop, and integrate a software audit tool that can be run in parallel with a software development environment and be able to identify when a software developer is or is not developing their software in accordance with MDA Assurance Provisions (MAP) requirements.

DESCRIPTION: The MAP, MDA-QS-001-MAP-Rev B and Rev C, define the software code/implementation requirements that contractors must follow and which are tailored using a Requirements Applicability Matrix (RAM). Currently, these software code/implementation requirements are checked and verified via manual processes or using tools after software has been coded/developed. This software audit tool should be programmed according to the MDA software code/implementation requirements identified within the MAP, Section 3.3.2.3, and be able to identify when a software developer is or is not developing their software in accordance with these requirements.

PHASE I: Phase I should include a feasibility study to identify one or more innovative methods of developing a software audit tool that can be run in parallel with a software development environment. The tool should have the ability for the automated tool to read software compliance to MAP.

PHASE II: Phase II should develop and execute an incremental test and integration plan that will address the technology challenges and produce a prototype for evaluation.

PHASE III DUAL USE APPLICATIONS: Based on Phase II lessons learned, revise the systems model to proof out the new design. Develop and execute a Phase III incremental test & integration plan that will produce a final prototype. Demonstrate interface capability with a government furnished software and MAP sample.

REFERENCES:
1. IEEE/ISO/IEC 14764 Standard for Software Engineering - Software Life Cycle Processes – Maintenance. ;
2. IEEE 1012 Standard for Software Verification and Validation. ;
3. ISO/IEC/IEEE 90003 Software engineering - Guidelines for the application of ISO 9001:2015 to Computer Software

KEYWORDS: Software Coding Standards, Software Audit, MAP

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MDA21-003 TITLE: Automated System Architecture Tool

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Ground Sea; Weapons

OBJECTIVE: Develop an automated tool that can import specifications and interface requirements from the specifications, DOORS modules, or spreadsheets and create a system architecture in Systems Modeling Language (SysML) or Unified Modeling Language (UML).

DESCRIPTION: Some legacy missile defense baselines have their system architecture defined within only their specifications. An automated tool that can create a system architecture based on those specifications would be beneficial to the government and more efficient and cost-effective than manually building system architectures.

PHASE I: Phase I should include a feasibility study to identify one or more innovative methods of developing an automated tool that can import specifications and interface requirements from the specifications, IBM® Engineering Requirements Management DOORS® (DOORS) modules, or spreadsheets and create a system architecture in SysML or UML. The tool should integrate new and existing system architectures.

PHASE II: Phase II should develop and execute an incremental test and integration plan that will address the technology challenges and produce a prototype for evaluation.

PHASE III DUAL USE APPLICATIONS: Based on Phase II lessons learned, revise the systems model to proof out the new design. Develop and execute a Phase III incremental test & integration plan that will produce a final prototype. Demonstrate interface capability and automated architecture SysML or UML with a government furnished sample specification stack.

REFERENCES:

1. https://www.omg.org/spec/UML/2.5/About-UML ;
2. https://sysml.org/sysml-specs ;
3. DES-N Syle Guide and Standards for SysML Architecture Development in IBM Rhapsody, Version 1.2

KEYWORDS: Software Architecture, SysML, UML, DOORS

MDA21-004 TITLE: Dynamic Ballistic Missile Defense Three Dimensional (3-D) Combat Information Center Playback

RT&L FOCUS AREA(S): Network Command, Control and Communications

TECHNOLOGY AREA(S): Information Systems; Ground Sea; Space Platform; Weapons

OBJECTIVE: Design, develop, and integrate a dynamic Missile Defense three-dimensional (3D) mission playback tool that can be used in the ship's Combat Information Center (CIC).

DESCRIPTION: The ability to process and visually display mission data within CIC would be extremely useful for flight test missions, mission planning, and other situations.

PHASE I: Phase I should include a feasibility study to identify one or more innovative methods of developing a dynamic Missile Defense 3D mission playback tool that can be used in the CIC. The tool should be able to have a timely ability to replay test and or combat data.

PHASE II: Phase II should develop and execute an incremental test and integration plan that will address the technology challenges and produce a prototype for evaluation.

PHASE III DUAL USE APPLICATIONS: Based on Phase II lessons learned, revise the systems model to proof out the new design. Develop and execute a Phase III incremental test & integration plan that will produce a final prototype. Demonstrate interface capability to process and visually display mission data within CIC.

REFERENCES:
1. https://www.lockheedmartin.com/en-us/products/aegis-combat-system.html ;
2. https://www.mda.mil/video/FTM44PostMissionVideo2.mp4

KEYWORDS: 3-D Visualization, Combat Information Center, Mission Analysis

VERSION 3

MDA21-005 TITLE: Methodologies for Development of Radiation-Hardened Large-Format Infrared Emitter Arrays

RT&L FOCUS AREA(S): Microelectronics; Space

TECHNOLOGY AREA(S): Sensors

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 infrared (IR) scene projector technology that is inherently radiation-hardened (rad-hard) for testing focal plane arrays in a test chamber that includes a radiation environment.

DESCRIPTION: This topic seeks the development of emitter arrays able to survive and operate through space and man-made radiation environments including total ionizing dose (TID) > 300 krads (Si), with single event upsets (SEU) < 10^(-10) errors per bit-day, and immunity to single event latch-up (SEL) at linear energy transfer (LET) levels > 100 MeV cm^2 / mg. The desired scene projector technology should have sufficiently high performance in format, dynamic range, and frame-rate to exercise next generation focal plane arrays, while at the same time being survivable in a test environment that includes radiation.

Sensor technologies are outpacing the ability to test them using current state-of-the-art IR scene projectors. In addition, relevant test environments include radiation effects, so an IR scene projector in a test chamber would need to be able to operate in a radiation environment, and at cryogenic temperatures. Development of a rad-hard emitter array should allow for testing of state-of-the-art focal plane arrays. In order to advance the state-of-the-art for projector technology, projector arrays in formats of 1024x1024 or greater, operating at frame rates of 500 Hz or higher, and with dynamic range of 21 bits or greater are desired. Consider whether resolution should be specified in apparent temperature, e.g. 50 mK at 300 K, rather than in bits of dynamic range.

PHASE I: Demonstrate the feasibility of a scene projector that can meet the high resolution needs of today’s state-of-the-art sensor formats. Consider producibility as well as performance. Also, demonstrate the feasibility of the scene projector operating in natural space and man-made radiation environments and at cryogenic temperatures. Develop a plan to mature the selected technique(s) in Phase II.

PHASE II: Implement the plan developed in Phase I and demonstrate the performance and survivability of the scene projector. Characterize performance of the hardware in the radiation and cryogenic environments and assess the accuracy of the projected scenes.

PHASE III DUAL USE APPLICATIONS: Refine methodology and tool developed and transition to interested platforms. Pursue commercialization for various technologies developed in the Phase II for potential commercial uses such as diverse fields including training in the use of FLIR sensor technology, computer graphics, and Microelectromechanical Systems fabrication.

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2. Tom Danielson, Greg Franks, Nicholas Holmes, Joe LaVeigne, Greg Matis, Steve McHugh, Dennis Norton, Tony Vengel, John Lannon, Scott Goodwin, “Achieving ultra-high temperatures with a resistive emitter array,” Proc. SPIE 9820, Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XXVII, 98200Z (3 May 2019); doi 10.1117/12.2225856. ;
3. Dennis T. Norton Jr., Joe Laveigne, Greg Franks, Steve McHugh, Tony Vengel, Jim Oleson, Michael MacDougal, David Westerfeld, “Development of a high-definition IR LED scene projector,” Proc. SPIE 9280, Infrared Imaging Systems: Design, Analysis, Modeling and Testing XXVII, 98200X (3 May 2016); doi: 10.1117/12.2225852. ;
4. “Recipes to build-up a rad-hard CMOS memory,” Cristiano Calligaro and Umberto Gatti, 2019 IEEE 25th International Symposium on On-Line Testing and Robust System Design (IOLTS). ;
5. Ken Label, Robert Gigliuto, Carl Szabo, Martin Carts, Matthew Kay, Timothy Sinclair, Matthew Gadlage, Adam Duncan and Dave Ingalls, “Hardness Assurance for Total Dose and Dose Rate Testing of a State-of-the-Art Off-Shore 32 nm CMOS Processor,” Proceedings of the 2013 IEEE Nuclear and Space Radiation Effects Conference (NSREC), also published on nepp.nasa.gov: https://nepp.nasa.gov/files/24951/NSREC2013_LaBel_W40L.pdf

KEYWORDS: Large IR scene projector, rad-hard electronics, hybridization, read-in integrated circuit.

MDA21-006 TITLE: Innovative Automated Support of Data Analysis for Emerging Missile Defense System (MDS) Capabilities

RT&L FOCUS AREA(S): Autonomy; Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop innovative data science technologies to advance data analysis within a missile defense digital architecture.

DESCRIPTION: This topic seeks innovative complex data science methods that go beyond traditional data analysis. The focus should be on the creation of efficient and cost-effective technologies to analyze large data sets derived from missile defense modeling and simulation (M&S) results. As the MDS evolves from primarily terrestrial Radio Frequency (RF) sensor architectures to incorporating many overhead Electro-Optical/Infrared (EO/IR) sensors to support the hypersonic missile defense mission, as well as new sensors and data taps to assure that missile defense systems are cyber secure, our ability to correlate and analyze the data from these sensors must evolve both at a system and system of systems level. Current analysis methods have difficulties with this predicted volume, variety, veracity, and velocity of data, especially when applied to data science, digital engineering and engineering simulations. Additionally, performance assessment studies using all-digital simulations generate nearly two petabytes of data annually. Data science technology areas of interest include, but are not limited to: algorithms, software tools, and turnkey solutions for complex analysis techniques (i.e. transformative, predictive and learning) that employ learning models (i.e. supervised, unsupervised and reinforcement styles) with different employment approaches (scheduling and sequencing).

PHASE I: Design and develop innovative solutions, methods, and concepts to advance data science methods as it pertains to the analysis and results of data science, digital engineering, and engineering simulations in a cloud-like environment. The solutions should capture the key areas for new development, suggest appropriate methods and technologies to minimize the time intensive processes, and incorporate new technologies researched during the design and development.

PHASE II: Complete a detailed prototype design incorporating government performance requirements. Coordinate with the government during prototype design and development to ensure that the delivered products will be relevant to an ongoing missile defense architecture and data types and structures.

PHASE III DUAL USE APPLICATIONS: Scale-up the capability from the prototype utilizing the new technologies developed in Phase II into a mature, full scale, field-able capability. Work with missile defense integrators to integrate the technology into a missile defense system level test-bed and test in a relevant environment.

REFERENCES:
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2. C. Wang, L. Ma, R. Li, T. S. Durrani and H. Zhang, "Exploring Trajectory Prediction Through Machine Learning Methods," in IEEE Access, vol. 7, pp. 101441-101452, 2019, doi: 10.1109/ACCESS.2019.2929430. https://ieeexplore.ieee.org/document/8766820 ;
3. R. M. M. Vallim, A. C. P. L. F. de Carvalho and J. Gama, "Data Stream Mining Algorithms for Building Decision Models in a Computer Role-Playing Game Simulation," 2010 Brazilian

Symposium on Games and Digital Entertainment, Florianopolis, 2010, pp. 108-116, doi: 10.1109/SBGAMES.2010.14. https://ieeexplore.ieee.org/document/5772278 ;
4. Y. T. Demey and M. Wolff, "SIMISS: A Model-Based Searching Strategy for Inventory Management Systems," in IEEE Internet of Things Journal, vol. 4, no. 1, pp. 172-182, Feb. 2017, doi: 10.1109/JIOT.2016.2638023. https://ieeexplore.ieee.org/document/7778999

KEYWORDS: Data Science, data analytics, algorithms, Machine Learning, System of Systems, data strategy, Digital Engineering, Data Strategy, MBSE, statistical, hypersonic, cyber, complex analysis techniques, learning models, autonomy, API

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MDA21-007 TITLE: Innovative Uses of Artificial Intelligence and Machine Learning in Scenario Planning and Design

RT&L FOCUS AREA(S): Autonomy; Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop innovative scenario planning technologies utilizing novel Artificial Intelligence (AI) and Machine Learning (ML) methods to augment and assist Subject Matter Experts (SMEs) developing test cases within a missile defense Modeling and Simulation (M&S) architecture.

DESCRIPTION: This topic seeks innovative AI/ML techniques that can provide SMEs with the information they need to quickly identify text-matrix gaps and build new and novel test cases to exercise the missile defense architecture. Current missile defense scenario planning involves scenario designers manually producing test cases to be executed. These scenarios are based on various factors including system requirements, test objectives, venue capabilities, and past data analysis and can take upwards of two years to develop and run. Scenarios include a physical representation of the threat (Red Force), Blue Force, and environments. This is a time-intensive manual process where an integrated product team coordinates assessment requirements that are fed into a Rapid Scenario Prototype (RaSP) team that creates scenario requirements to meet engagement and test objective goals with the least number of test cases and scenarios possible. The scenario requirements are then incorporated into a test case description document that is used by the community to create the scenarios to be ran. This scenario generation process is a cumbersome, sequential, resource and time intensive effort requiring work by every component of the integrated simulation team plus supporting organizations, which impacts the responsiveness of the M&S to government needs. With the amount of data exponentially increasing, faster and smarter scenario generation methods based on requirements and past data sets are desired. These technologies should enhance the credibility of the integrated M&S; shorten integration time enabling the government to gain efficiencies, reduce event schedules, and produce greater quantities of credible decision quality data.

PHASE I: Design and develop improved solutions, methods, and concepts for applying ML and AI in scenario generation. The solutions should capture the key areas where new development is needed, suggest appropriate methods and technologies to minimize time intensive processes, and incorporate new technologies researched during design development. Define the architecture and data structures required to support the missile defense M&S enterprise.

PHASE II: Complete a detailed prototype design incorporating government performance requirements. The contractor will coordinate with the government during prototype design and development to ensure that the delivered products will be relevant to ongoing and planned missile defense projects. This prototype design will be used to form the development and implementation of a mature, full-scale capability in Phase III.

PHASE III DUAL USE APPLICATIONS: Scale-up the capability from the prototype utilizing the new hardware and/or software technologies developed in Phase II into a mature, fieldable capability. Work with missile defense integrators to integrate the technology for a missile defense system level test-bed and test in a relevant environment.

REFERENCES:

1. G. Deshpande, C. Arora and G. Ruhe, "Data-Driven Elicitation and Optimization of Dependencies between Requirements," 2019 IEEE 27th International Requirements Engineering Conference (RE),

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KEYWORDS: Data Science, data analytics, algorithms, Machine Learning, artificial intelligence, System of Systems, data strategy, Digital Engineering, Data Strategy, MBSE, statistical, hypersonic, cyber, complex analysis techniques, learning models, autonomy, scenario test case, API

VERSION 3

MDA21-008 TITLE: Operational Defense Effectiveness Assessments for Missile Raid Scenarios

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop a methodology and computer system that allows analysts to create and display operational defense effectiveness assessments for missile raid scenarios.

DESCRIPTION: This topic seeks development of efficient solution techniques to perform operational defense effectiveness assessments for missile raid scenarios. Current operational effectiveness assessments (such as geographic heatmaps) that calculate and display the probability of engagement success across a geographic region (P[ES]), where P[ES] is the probability that a missile threat is successfully intercepted, are often confined to single-threat scenarios. For a single threat, multiple target locations can be evaluated and the P[ES] can be calculated via simulation for each one. By combining these probabilities, a heatmap picture can be constructed showing the relative protection available in different parts of a defended area. Missile raids of multiple simultaneous threats directed at multiple targets can be modeled and simulated, but the simple metrics and clear interpretation of the results for the single threat case are not easily extrapolated to raid scenarios where all threats could target the same location or may target different locations. Evaluating these raid scenarios entails significant mathematical and computational complexity because the combinations of possible threat aimpoints grows exponentially with the number of threats in a raid.

This topic desires solutions that provide meaningful metrics, create accompanying efficient solution techniques and support suitable information dispay to perform operational effectiveness assessments for missile raid scenarios. Without loss of generality, assume that the probability of primary interest in a raid evaluation is the probability of a leaker across multiple threats. The concept of simple operational effectiveness assessments, like a geographic heatmap, must be extended to consider how to display the missile defense system effectiveness and performance when defending against raid scenarios.

PHASE I: Define meaningful metrics for raid scenarios. Design and develop methods and algorithms for a proof of concept computer system that allows analysts to predict and display the operational effectiveness and performance of the missile defense system against a given missile raid based on a limited number of simulation runs and replications. Demonstrate that the predictions are sufficiently accurate across a geographic region.

PHASE II: Expand the methodology and computer system to minimize the computational resources needed to create and display a complete missile raid operational effectiveness assessment. Demonstrate this operational effectiveness assessment for multiple missile raids of varying complexity. Coordinate with the government sponsor during prototype design and development to ensure that the delivered products will be relevant to ongoing and planned missile defense projects.

PHASE III DUAL USE APPLICATIONS: Scale-up the capability from the prototype utilizing the new hardware and/or software technologies developed in Phase II into a mature, full-scale, field-able capability. Work with missile defense integrators to integrate the technology for a missile defense system level test-bed and test in a relevant environment.

REFERENCES:
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KEYWORDS: Missile Defense, Operations Research, Analysis, Metrics, Raids, Parameters, Mathematical Complexity

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TOPIC REMOVED

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MDA21-010 TITLE: Innovative Digital Data Engineering Techniques to Develop Authoritative Sources of Truth and Knowledge across Missile Defense System Systems of Systems

RT&L FOCUS AREA(S): Autonomy; Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Develop innovative digital data engineering based techniques and technologies that leverage Model Based Systems Engineering (MBSE), Artificial Intelligence/Machine Learning (AI/ML), and Development and Operations (DevOps) practices to create and manage authoritative sources of truth and knowledge across the Missile Defense System (MDS) Systems of Systems (SoS).

DESCRIPTION: This topic seeks innovative technologies for applying AI/ML, MBSE and DevOps in MDS throughout the Systems Engineering (SE) V-model process. Currently, MDS SE is predominantly a manual, analog, time intensive, effort at both the element system level and the MDS SoS level. Often, products and data are developed at each level of the V-model, then passed on to the next level in a stove piped fashion and are not treated as a strategic asset that exists across the entire lifecycle. Thus, these products are usually not reusable or extensible for other aspects of engineering. Challenges also arise with configuration management and data management of these products. In addition, current tools are not easy to use and are not easily integrated into Microsoft Office. Treating data as a strategic asset and applying these techniques and technologies across the V-model should provide engineers and developers with the information they need to more quickly engineer and manage the complexity of the MDS.

With the complexity of the MDS increasing and the amount of data exponentially increasing, faster and smarter engineering techniques and tools that pipeline the work in automatic ways while enabling an efficient configuration and data managed environment are desired. In addition, technologies that allow one to query across all the collected and metadata tagged engineering data sets (e.g., flight test, ground test, digital simulation, requirements, architecture, Random Access Memory (RAM), Computer-Aided Design (CAD), test plans, data analysis, etc.) are also desired. Lastly, technologies that enhance the quality and effectiveness of the MDS; shorten integration time enabling the government to gain efficiencies reducing schedules, and produce more lethal weapon systems are also of interest.

PHASE I: Design and develop improved solutions, methods, and concepts for applying AI/ML, and MBSE in systems engineering to create and manage authoritative sources of truth and knowledge across the MDS SoS. The solutions should capture the key areas where new development is needed, suggest appropriate methods and technologies to minimize the time intensive processes, and incorporate new technologies researched during design development. Define the architecture and data structures for the MDS M&S enterprise.

PHASE II: Complete a detailed prototype design incorporating government performance requirements. The contractor will coordinate with the government during prototype design and development to ensure that the delivered products will be relevant to ongoing and planned missile defense projects. This prototype design will be used to form the development and implementation of a mature, full-scale capability in Phase III.

PHASE III DUAL USE APPLICATIONS: Scale-up the capability from the prototype utilizing the new hardware and/or software technologies developed in Phase II into a mature, field-able capability. Work with missile defense integrators to integrate the technology for a missile defense system level engineering environment.

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KEYWORDS: Digital Engineering, MBSE, Data Science, Machine Learning, System of Systems, data strategy, configuration management, data management, authoritative truth

VERSION 3

MDA21-011 TITLE: High Temperature Dynamic Seals for Solid Propulsion

RT&L FOCUS AREA(S): Hypersonics

TECHNOLOGY AREA(S): Materials; 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 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 dynamic seals capable of withstanding temperatures over 800 degrees F and pressures over 3,000 lbf/in^2 (psi) in a solid rocket motor environment.

DESCRIPTION: The government desires solid propulsion systems with greater impulse and thrust for future systems. Increasing solid propellant burn temperatures may help achieve this goal but also creates thermal challenges for materials. This topic seeks to improve thermal capability of dynamic seal materials for use in solid propulsion systems. Materials should be capable of operating at temperatures over 800 degrees F and pressures over 3,000 lbf/in^2 (psi). Additionally, low friction, long shelf life, and chemical compatibility in a solid rocket motor environment is desired.
One application of dynamic seals is in pintle valves for controllable solid propulsion systems. Traditional elastomeric materials used in these dynamic seals include Polytetrafluoroethylene (PTFE) and other fluorocarbons. Proposed solutions could be elastomeric materials with higher temperature capabilities or other innovative concepts for dynamic seals.

PHASE I: Evaluate feasibility of proposed material concept by modeling and simulation and/or proof of concept testing. Material formulation and/or coupon fabrication is recommended to provide evaluation of critical properties. Work with solid propulsion system developers to understand environments.

PHASE II: Continue material and process development through design, analysis, and experimentation. Optimize processing parameters for yield and quality. Material testing should be conducted to validate material models and generate property databases. Demonstration in a representative environment is desired. Phase II should identify an insertion opportunity and conclude with a mature manufacturing process.

PHASE III DUAL USE APPLICATIONS: Work with a solid propulsion system manufacturer to iteratively design and fabricate prototype components for high-fidelity testing in a relevant solid rocket motor environment for current or future missile defense applications. A successful Phase III would provide the necessary technical data to transition the technology into a missile defense application.

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KEYWORDS: Dynamic Seals, Solid Rocket Motor, Elastomeric Materials, Thermal Management, Controllable Solid Propulsion

VERSION 3

MDA21-012 TITLE: External Queuing Navigation Correction

RT&L FOCUS AREA(S): Hypersonics; Space

TECHNOLOGY AREA(S): Air Platform; Sensors; Space Platform

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: Analyze best method and implementation for external inputs to navigation systems for course correction in global positioning system (GPS) denied environments.

DESCRIPTION: Currently, most navigation systems must either have inputs from GPS to correct course, or have very accurate Inertial Measurement Units (IMUs) to ensure angular random walk (ARW) error is low. The former are susceptible to GPS jamming and the latter are expensive, large and can be very sensitive to environmental factors. The government desires non-jammable external queueing systems for constant error correction to allow less expensive IMUs to be used in GPS contested environments on multiple platforms. Application to hypersonic platforms is desired. Current external queuing systems such as star trackers are used for initial position, but not used for constant error correction. Also, star trackers historically have poor performance in direct sunlight.

PHASE I: Design and develop innovative solutions, methods, and concepts to introduce external inputs into a navigation system. The solutions should capture the key areas for new development, suggest appropriate methods and technologies to minimize the time intensive processes, and incorporate new technologies researched during the design and development.

PHASE II: Complete a detailed prototype design incorporating government performance goals. Coordinate with the government during prototype design and development to ensure that the delivered products will be relevant to an ongoing missile defense architecture and data types and structures.

PHASE III DUAL USE APPLICATIONS: Scale-up the capability from the prototype utilizing the new technologies developed in Phase II into a mature, full scale, field-able capability. Work with missile defense integrators to integrate the technology into a missile defense system level test-bed and test in a relevant environment.

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VERSION 3

KEYWORDS: IMU, inertial, navigation, GPS denied, Guidance Navigation and Control

MDA21-013 TITLE: Design Innovative Equipment to Produce Large Single-Crystal CdZnTe for Long-wave Infrared Detector Arrays

RT&L FOCUS AREA(S): Space; Microelectronics

TECHNOLOGY AREA(S): Materials; Sensors; Electronics; Space Platform; 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 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 innovative equipment to produce large, nearly perfect, high quality, single-crystal cadmium zinc telluride (CdZnTe) material suitable for the production of the highest-performing long-wave infrared (LWIR) detector arrays.

DESCRIPTION: Mercury cadmium telluride (HgCdTe) infrared detector array technology has improved significantly over the last decade. Single element millimeter-sized detectors made from bulk HgCdTe crystals in the 1960’s have evolved today through research into arrays having more than one million elements with each element measuring less than 20 micrometers. This has resulted in Department of Defense infrared systems having much greater sensitivity and a much larger field of view.
Infrared detectors made with HgCdTe provide the government with the highest sensitivity for many missile-defense applications. Furthermore, HgCdTe detectors made by epitaxially growing HgCdTe films with differing Hg/Cd ratios onto infrared transparent CdZnTe substrates allow these detectors to operate at the highest cryogenic temperatures possible for a given sensitivity. This greatly increases the platforms and devices these detectors can be used on. As detector arrays get larger, the CdZnTe substrate size needs to increase to both accommodate the larger detectors as well as reduce cost.

One major drawback toward producing such large arrays, however, is the relative immaturity of large, nearly perfect, and fully single-crystal CdZnTe substrates. Recent research has demonstrated that some of the very largest HgCdTe infrared detectors arrays have defects that arise from an imperfect CdZnTe substrate. Even for smaller size detector arrays, the lack of large CdZnTe substrates is still driving down the yield and making smaller arrays cost rise to prohibitive levels for some applications. The development of a capability to produce large CdZnTe substrates is recommended.

Currently, the government believes that the most promising approach towards achieving this goal would be to extract large (e.g. 8x8 cm) substrates from boules grown in a thermally-stable Vertical Gradient Freeze (VGF) furnace. The boule would have a large diameter (e.g. 150 mm) and be nearly single-crystal. It is anticipated that such a growth furnace would need to have very tight control of the stability and uniformity of the high temperatures within its growth region. This VGF would also include an isotherm zone that is significantly cooler than the growth region in order to support overpressure control. One acceptable approach for responding to this topic would be to propose the development of an innovative VGF design that incorporates new technologies in order to meet or exceed the capabilities described above. Other approaches for producing CdZnTe material will be considered if they show a clear potential to meet the topic objectives and are suitable for the intended application. For example, one approach might be to propose improvements to either a Traveling Heater Method, Vertical Bridgeman, or other innovative furnace designs in order to meet topic objectives. However, the proposal should ompare these alternative methods to the VGF benchmark described above. A more speculative approach would be to epitaxially grow CdZnTe on a different substrate (e.g. CdTe). However, perceived challenges with defects, infrared absorption, CTE-mismatches (from cryogenic to bake-out), and throughput make these approaches seem higher risk compared to furnace-based approaches. These are a few examples and other techniques and approaches will be considered. In all cases, the primary focus of this topic is on the development of the equipment needed to implement a particular growth technique in a production setting, rather than further development of the underlying technique itself.

Note that this topic is focused on improving the capability to produce bulk single-crystal CdZnTe material and not on the subsequent steps needed to further process this bulk material into substrates. Solutions related to pre-growth preparation (e.g. precursor purification, mixing, cleaning) are important but are outside the scope of this topic. Likewise, solutions related to further processing bulk-material into substrates (e.g. dicing, polishing) are also outside of the scope of this topic. Proposed solutions should, to the extent possible, leverage existing standards and processes for these steps and shouldn't add any new steps or complicate existing ones.

Proposals should present complete solutions that incorporate a number of innovations, which, as a whole, would significantly push the state-of-the-art. Proposals should not focus primarily on a single aspect of the growth process (e.g. crucible design, control software, modeling) which, by itself, would only provide a marginal, incremental improvement.

Proposed solutions should increase equipment life expectancy >2 times and increase CdZnTe substrate yields by >25% compared to existing approaches. Proposed solutions should also be compatible with all the material specifications and safety requirements of a state-of-the-art commercial CdZnTe foundry. The government currently believes that the most viable commercialization plan is for a small business to design, fabricate, and supply production equipment to a domestic CdZnTe foundry rather than trying to produce the material in-house or attempting to produce substrates from this material. Other arrangements will be considered if adequate justification is provided. Proposers are strongly encouraged to partner with a domestic CdZnTe foundry as early as possible.

PHASE I: Study the scientific and technical feasibility of the proposed approach. Collaborate with government agencies, CdZnTe foundries, and LWIR detector manufacturers to develop requirements. Conduct research, analyses, and experimentation as needed to demonstrate feasibility and/or validate models. Develop preliminary designs for the new production equipment. Complete cost and performance assessments and compare to existing state-of-the-art approaches. Identify risk areas and mitigation plans that would be implemented in Phase II. Complete a plan for Phase II and collaborate with suppliers to verify that the plan is executable. No travel to government facilities would be necessary during Phase I.

PHASE II: Finalize equipment designs and fabricate a prototype. Demonstrate the ability to produce CdZnTe material that approaches (to the extent possible) all of the topic objectives. Provide samples of this material to the government and industry partners for independent assessment. Sample sizes, quantities, and configuration for testing will be coordinated with the government. Update models with experimental data and refine the design based on lessons-learned. Finalize cost and performance estimates based on these initial results. Collaborate with industry partners to put together a Phase III plan that includes quotes and letters of commitment.

PHASE III DUAL USE APPLICATIONS: Transition operation of the production equipment to a domestic CdZnTe foundry. Provide comprehensive supporting documentation and training for their operation and maintenance. Produce a large quantity (to be contractually specified) of material for verification testing to demonstrate quality, consistency and reproducibility. Continue to improve the equipment design in order to meet or exceed the topic objectives. Adapt the equipment to also support CdZnTe growth for other defense applications (e.g. medium-wave infrared and/or x-ray detection).

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KEYWORDS: Infrared, Detector, CdZnTe, CZT, HgCdTe, MCT, HCT, Substrate, Epitaxy, VGF, THM, Boule, Crystal

VERSION 3

MDA21-014 TITLE: Optimized Waveforms for X-Band Missile-Defense Radars

RT&L FOCUS AREA(S): Microelectronics

TECHNOLOGY AREA(S): Sensors; Electronics

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OBJECTIVE: Research and develop X-band waveforms that are both producible by commercially-available radar electronics and that are optimal for missile-defense applications.

DESCRIPTION: Long-range missile-defense radars are capable of producing a wide variety of waveforms in order to maximize sensitivity and/or resolution. The choice of waveform could depend on the task (e.g. acquisition, tracking, discrimination, etc.), target type (e.g. boosting missile, reentry vehicle, etc.), and environmental conditions (e.g. atmosphere, clutter, interference, weather, etc.). The waveform options are, in part, limited by the capabilities of the radar electronics needed to produce them. New, and potentially better performing, waveforms become feasible as electronics continue to improve and are incorporated into new or upgraded missile-defense radars. This topic seeks to research and develop the best X-band waveforms possible for missile-defense applications by leveraging the current state-of-the-art in commercially-available radar electronics.

The notional radar application may be assumed to be a large ground- or sea-based X-band (8-12 GHz) active electronically scanned array capable of searching for, tracking, and discriminating missile threats at ranges greater than 1,000 kilometers. Radio Frequency (RF) waveforms may be assumed to be centrally produced and then distributed to the elements. Several transmit and receive channels may be assumed. Targets of interest include ballistic and non-ballistic (e.g. boosting, hypersonic, etc.) missiles as well as their related items (e.g. staging debris, countermeasures, etc.).

It is anticipated that modeling and simulation will play an important role in the success of this research and development (R&D) effort. Medium- to high-fidelity models would likely be needed in order to accurately simulate the salient changes to the waveform as it propagates through the atmospheric transmit channel, to/from the target, and then back through the receive channel. Of particular interest is accurately modeling the receiver/exciter subsystem, which could incorporate the latest in commercially-available field-programmable gate arrays, digital-analog converters, timing generators, and data-links (among other components) in order to generate, filter, up-/down-convert, and convert software-defined waveforms between the analog and digital domains. Proposers might need to develop their own receiver/exciter model or improve upon an existing model. The government should have rights to this model and it should integrate well with other subsystem models provided by other vendors. It should be noted that the goal of this effort is not to produce models but rather to use them, as needed, to study and assess optimized waveforms. These waveforms, not models, are the desired end-product of this R&D effort.

PHASE I: Identify candidate waveforms based on a literature review and in-house analysis. Consult product specifications to determine which waveforms could be generated using commercially-available hardware. Analyze how these waveforms might be distorted/corrupted given the real behavior of radar hardware, long-range propagation through atmosphere, and target interaction. Propose innovative modifications to the waveform in order to compensate for this distortion. Down-select to the most promising waveforms. Put together a plan for further investigating these waveforms in Phase II using modeling and simulation. Identify any government-provided models and/or information that would help the execution of this plan. Identify which electronics are major contributors to waveform distortion and demonstrate the ability to model at least one contributor's effect on the waveform. No travel to government facilities would be necessary during Phase I.

PHASE II: Obtain, develop, and/or integrate the models necessary to investigate the performance of the waveforms under realistic conditions. If possible, validate these models using measured data. Incorporate government-provided information into these models and refine waveform selections based on this information. Assess these candidate waveforms under a wide variety of objectives, targets, and environmental conditions. Assess innovative modifications to the waveform in order to compensate for distortion. Begin developing a logic tree for when to select a particular waveform and how to optimize its parameters on a pulse-by-pulse basis for a given scenario. Proposers are highly encouraged to begin collaborating with missile-defense radar developers. Portions of Phase II would likely be classified.

PHASE III DUAL USE APPLICATIONS: Refine the waveforms in a fully classified environment. Assist with implementing these waveforms in a government-provided test radar and analyzing its performance. Transition the products of this research (waveforms and, if applicable, models) to the government and its contractor(s) and continue to provide support.

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KEYWORDS: Waveform, X-band, Radar, Receiver, Exciter

VERSION 3

MDA21-015 TITLE: Predict Signatures of Hypersonic Cruise Missiles

RT&L FOCUS AREA(S): Hypersonics

TECHNOLOGY AREA(S): Air Platform; 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 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 tools to predict signatures (Electro-Optical/Infrared (EO/IR), Radio Frequency (RF), and/or Acoustic) of hypersonic cruise missiles, based on Computational Fluid Dynamics (CFD) and accounting for turbulence, chemically reactive flow, propellant exhaust chemistry, radiative heat transfer, RF propagation, and acoustics.

DESCRIPTION: To address the evolving hypersonic threat, the government desires software tools to predict signatures (EO/IR, RF, and/or Acoustic) of hypersonic cruise missiles, accounting for aerothermal heating, wake flow, propulsion plumes, and ablation. The government envisions the use of CFD software to predict the flight environment of a maneuvering cruise missile system, along with gas-flow chemistry and vehicle material-response computations, plus radiation transport (EO/IR) and RF propagation capabilities. Tools should handle realistic missile geometries and propulsion systems for sustained powered flight (tens of minutes) in the Mach 5 to 10 range at mid-stratospheric altitudes. The government envisions non-real time, high-fidelity solutions.

Ultimately, the government desires tools that will support, acquisition, track, and trajectory prediction for hypersonic cruise missiles (modeling and simulation, as well as operational).

PHASE I: Develop concepts for new and/or enhanced-existing computational tools to predict aero-thermal effects and signatures for hypersonic cruise missile systems. The contractor should identify strengths/weaknesses associated with alternative solutions, methods, and concepts. Demonstrate credibility of proposed computational and validation approaches. Computational experimentation using simple nominal, unclassified shapes is suitable in this phase.

PHASE II: Develop and validate computational tools to support hypersonic cruise missile signature predictions. Tools should account for features and aerodynamic wakes from complex geometries and control surfaces. Provide a performance analysis of the planned computational capability (i.e., computer resource requirements). Complete executable code for the developed signature-prediction toolset, and an operator manual. Develop and implement verification and validation of the toolset. The contractor is expected to become familiar with hypersonic cruise missile test flights and realistic trajectories. Coordinate development efforts with the government, and/or potential prime-contractor partners, to ensure product relevance and compatibility with missile defense projects and government modeling and simulation systems. Portions of the Phase II effort are likely to be classified.

PHASE III DUAL USE APPLICATIONS: Collaborate with simulation model developer(s) and/or user(s) on integration of product(s) into a missile defense application. Optimize toolset to accommodate new advances in the technology of tracking and prediction of cruise missile flight. Transition the technology to an appropriate government or defense contractor for integration and testing. Integrate and validate the functional signature tools into a real-world missile defense application.

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KEYWORDS: Hypersonic, Cruise missile, Signatures, Electro-Optical/Infrared (EO/IR), Radio Frequency (RF), Acoustic, Computational Fluid Dynamics (CFD), Aero-thermal Effects, Modeling and Simulation, Flight, Track, Predict, Wake Analysis

VERSION 3

MDA21-016 TITLE: Kill Enhancing Devices

RT&L FOCUS AREA(S): Hypersonics

TECHNOLOGY AREA(S): Battlespace; 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 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 technology to improve kill effectiveness of interceptors.

DESCRIPTION: Highly maneuverable threats challenge the performance abilities of hit to kill interceptors. Increasing the effective kill volume of a hit to kill interceptor may relax overall system requirements and improve affordability of defense systems. This topic will explore kill enhancing devices, to include warheads, which improve the probability of kill for highly maneuverable advanced threats. Relevant technology and investments could fall under numerous categories, such as: modeling and simulation, fuzing, warhead, sensors, etc. Improvements in hardware should minimize size and mass while increasing the effective kill volume.

The kill enhancing device should improve the kill volume, warhead compactness, and/or lethality given the following technical parameters. The maximum missile fairing size should not exceed a 21-inch diameter. The maximum warhead mass should not exceed 50 kilograms. Improvements in fuzing technology should optimize end-game distance and timing to interception. Improvements in sensor technology should consider a minimum closing velocity at 1.5 km/s. Kill enhancing devices can be, but are not limited to: blast/fragmentation/shaped charge warhead, fragmentation material, fuzing technology, sensor technology, etc.

PHASE I: In the Phase I effort, the contractor will perform a trade study to identify kill enhancing devices in relation to the advancing missile defense environment. The optimal kill enhancing device will be down-selected for initial conceptual design from the performed trade study. An analytical study should demonstrate the kill enhancing technology improves the kill volume, lethality and/or compactness of the warhead.

PHASE II: In the Phase II effort, the contractor will design and develop sub-scale warhead component technology demonstrated through bread board/brass board testing. The sub-scale testing should validate the analytical predictive modelling.
Portions of the Phase II effort are likely to be classified.

PHASE III DUAL USE APPLICATIONS: In the Phase III effort, the contractor will produce a full scale prototype demonstration and evaluation of the technology. Contractor will provide manufacturing, quality, and safety documentation to be transferred to a program of record.

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VERSION 3

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KEYWORDS: Warheads, Lethality, Fragmentation, Explosives, Kill Enhancement, Blast Wave, Fuzing

VERSION 3

MDA21-017 TITLE: Pursuit Evasion Strategies for Missile Defense

RT&L FOCUS AREA(S): Hypersonics

TECHNOLOGY AREA(S): Air Platform; Information Systems; Battlespace; 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 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: Support hypersonic threat interception by developing battle management and advanced guidance and control algorithms based on differential game theory, continuous pursuit/evasion concepts, control theory, and optimization methods.

DESCRIPTION: The subsequent trajectory and aim point of a detected and tracked hypersonic threat is indeterminate, although subject to constraints, due to either pre-programmed maneuvers (unknown in advance to the defense) or real-time evasion by the threat from a threat-detected interceptor. Application of state-of-the-art pursuit-evasion strategies to battle management and to guidance and control processes could increase the likelihood of successful defense.

Key output of the objective computational capabilities is optimal interceptor launch scheduling and dynamic behavior in flight (i.e., the interceptor flight plan to be updated in useful real time during the engagement). Expected collateral outputs include optimal (from the offense point of view) threat behavior and a collapsing map of possible threat impact points. The computational framework should be capable of real-time solution, and be suitable for execution at the battle management node and, optimally, onboard the interceptor(s).

The objective of this topic can be further described by considering the scenario-imposed constraints on both the defense/pursuer/interceptor and on the offense/evader/threat:
The underlying assumption is that the evader (the offensive threat), has two objectives: (i) maneuver to evade interception by the defense, and (ii) conserve sufficient momentum and energy to reach the target (or alternatively, another high-value target). Model constraints for the offense may include threat missile performance capabilities, target/target-set selection, degree of offense knowledge/assumptions about defense-asset capabilities, and capacity for sensing of defensive interceptor maneuvers. One special case is where the offense pre-programs the threat target with a pre-determined evasive trajectory, but does not update that trajectory based on real time tracking of the interceptor.

A parallel underlying assumption is that the pursuer (defense) has the objective of denying either one of the two offense objectives, i.e. to either achieve intercept or to force the threat to exhaust its energy capability to reach target range due to evasive maneuvers. Model constraints for the defense may include interceptor performance, interceptor inventory, threat acquisition and tracking accuracy, knowledge/assumptions about the threat capability and intention, and defended asset relative values. Primary near-term application is in defense against boost/glide-type offensive hypersonic weapons, and for interception during the threat mid-trajectory glide phase.

VERSION 3

PHASE I: Develop computational algorithms for the differential game with limited constraints using nominal trajectories. This phase should focus on 1-on-1 simulation (one pursuer and one evader). The scenario could utilize a single interceptor at a certain location and a single threat with one target. Algorithm outputs could be battle management, optimal launch scheduling, and optimal guidance onboard the interceptor. Evaluate feasibility compared to traditional guidance, navigation and control (GNC) with nominal data.

PHASE II: Enhance computational capability with increased functionality. This could also include the possibility of government supplied information. A missile defense system insertion opportunity should be identified. Work with a potential system integrator. Evaluate effectiveness compared to traditional GNC.

PHASE III DUAL USE APPLICATIONS: Develop fire control and guidance algorithms based on Phase II results, suitable for insertion into an operational battle manager and/or interceptor GNC (guidance, navigation and control). Work with system integrator to develop roadmap for actual insertion into an operational system. Productize the tool to expand capabilities to other military applications.

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KEYWORDS: Differential Game Theory, Pursuit Evasion Strategies, Hypersonic Defense, Optimal Guidance, Navigation, and Control

MDA21-018 TITLE: Next-Gen Infrared Scene Projector for Hypersonic Hardware-in-the-loop Test and Evaluation

RT&L FOCUS AREA(S): Hypersonics; Space

TECHNOLOGY AREA(S): Sensors

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: This topic seeks to advance the state-of-the-art in infrared scene projector (IRSP) technology in order to increase hardware-in-the-loop (HWIL) test and evaluation capability to address requirements related to Electro-Optical/Infrared (EO/IR) sensors for hypersonic target signature detection.

DESCRIPTION: Hypersonic and counter-hypersonic system development is a national defense priority. Next-generation EO/IR sensor systems associated with these platforms challenge existing HWIL test and evaluation capabilities. This topic seeks technology developments that would enhance HWIL capability to test multi-spectral (MS), hyper-spectral (HS), and wide field-of-view (WFoV) sensor systems to assess sensor/seeker performance under simulated hypersonic aerothermal and aerodynamic conditions to accommodate space tracking applications for hypersonic and ballistic threats. Enhanced capability requires integration of multiple technologies (hybrid solution) for scene projectors to meet next generation sensor performance testing. Current generation sensors are at the limits of testability in existing test chambers. Current HWIL capabilities are as follows:

−Spatial Resolution/Format: Existing facilities which have 512x512 projection capability cannot meet WFOV needs. Currently, WFOV and large format sensors are tested piecewise. That is, test a part of the sensor, stop test, rearrange the setup and test the next part. This is both inefficient in test time and does not test the entire sensor over its field of view, or full format. This practice prevents system level effects from being tested. Projector arrays require 2-1 spatial sampling ratio.
−Temporal Response: Current Infrared Scene Generators (IRSG) are ~ 200Hz with 8 – 14 bits of radiance quantization.
−Spectral Range: Current IRSGs are single band (long-wave infrared, middle-wave infrared, or short-wave infrared).
−Spectral Resolution: Currently most projectors span across a band.
−Dynamic Range: Maximum apparent temperatures are < 1000 degrees K.

Future Multi-spectral, Hyperspectral, and WFoV sensor requirements greatly exceed current capability for Hardware-in the loop sensors testing. This project would push capability towards the following:

−Spatial Resolution/Format: An ability to test wide field of view sensors with apertures up to 10”; an ability to test sensor arrays approaching 8k x 8k (64M pixel).
−Temporal Response: 1 kHz (objective); > 200 Hz (threshold); Radiance quantization: 14 bits (threshold) 16 bits (objective).
−Spectral Range: Accommodates Dual-Band operation.

−Spectral Resolution: Accommodates wavelength selectively with spectral resolution < 0.15 micrometers for each pixel.
−Dynamic Range: Necessary maximum apparent temperatures need to be > 1000 degrees K (threshold); > 1300 K (objective).

PHASE I: Complete optical, mechanical, electrical design layout using existing commercial components that target the cost-Size, Weight and Power (c-SWAP) and system requirements prescribed with predicted system performance results based upon Modeling & Simulation (M&S). Identification of tech gaps/shortfalls for specific components/devices performance desired.

PHASE II: Down-select among performers to build and demonstrate a prototype for a specific representative test scene.

PHASE III DUAL USE APPLICATIONS: Integrate the developed technology into a (HWIL) application to evaluate the performance of the technology in real world test environment.

REFERENCES:
1. Igor Anisimov and Yakov Soskind, "Infrared Dynamic Scene Projector: Technical Challenges and System Requirements", 2016 GOMAC Tech Conference. For access to reference, please email: igor.anisimov.1@us.af.mil ;
2. Daniel A. Saylor, D. Brett Beasley, Bill Braselton, and James A. Buford Jr. "Current status of IR scene projection at the U.S. Army Aviation and Missile Command", Proc. SPIE 4366, Technologies for Synthetic Environments: Hardware-in-the-Loop Testing VI, (31 August 2001); https://doi.org/10.1117/12.438066 ;
3. Jim Oleson, John Cordell, Derek Greer, Tom Joyner, and Brian Woode "Large format resistive array scene simulation validation testing and readiness", Proc. SPIE 7663, Technologies for Synthetic Environments: Hardware-in-the-Loop Testing XV, 76630A (23 April 2010); https://doi.org/10.1117/12.852648

KEYWORDS: Hardware-in-the-Loop (HWIL), EO/IR, Sensors, Hypersonic, Infrared Scene Projection, multi-spectral (MS), hyper-spectral (HS), Wide Field-of-View (WFoV)

VERSION 3

MDA21-019 TITLE: Contextual Reasoning for Threat Classification Refinement

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Air Platform; Information Systems; 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 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: Evolve beyond classification based on a predetermined set of features for a given threat type and reason on a larger set of information to include scene based reasoning and contextual evidence.

DESCRIPTION: Advances in technology have allowed adversaries to employ numerous types of reentry vehicles and decoys in an attempt to thwart counter techniques. Understanding and classifying inbound objects quickly provides critical information necessary to perform optimal midcourse defense through precision assignment and targeting of the highest priority objects. To enhance the accuracy of this classification, we pursue advances in contextual reasoning. Recognizing that the threat may not appear as was predicted, that which can be discerned from the context about the engagement and threat presentation could be key.

DARPA has expanded the 'wave' concept of Artificial Intelligence (AI) to a third wave of AI including contextual adaptation, and we aspire to incorporate this paradigm for threat identification. The first wave of AI was expert systems with handcrafted reasoning – rules that were defined by subject matter experts. The second wave brought in the new developments in machine learning, primarily supervised deep learning in the classification domain. Although this was a remarkable advancement, it generally dealt with individual classification and obscured the reasons for the classification call. For complex scenes, hierarchical reasoning, scene based reasoning, or evidence based reasoning for an expanded concept and exploitation of evidence, may enable us to achieve additional accuracy for threat identification, as well as gain confidence knowing why the determination was made.

The goal is to develop a better classifier, with disparate sensor data. that assesses classification of objects, including over time (as opposed to single shot classifiers) so that salvo firing control can be better informed to target high priority objects. The classifier must be mission assured by informing the operator of an unknown classification of an object rather than best guess by way of some metric in order to prevent misclassifications on zero-day events.

PHASE I: Demonstrate proof of principle with technology prototype. From self-generated representative data from two different sensor types, design a classifying technology utilizing additional scene, or context, information. Deliver Algorithm Description Document (ADD) to accompany final report with test results and analysis.

PHASE II: Using realistic, relevant data, produce matured technology prototype. Define preferred data and message content for optimal technology performance. Validate concept with flight and/or ground test data. Assess performance across a range of government supplied scenarios and data compositions. Deliver ADD with test results. This phase will likely be classified due to the nature of the data.

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PHASE III DUAL USE APPLICATIONS: The topic has numerous unclassified applications, as well as alternate classified applications. For example, disease detection, mental illness diagnosis, terrorist identification, disaster management, and natural language processing.

REFERENCES:

1. Looking for a synergy between human and artificial cognition: Brézillon, P., Blackburn, P., Dapoigny, R. (eds.) CONTEXT 2013. LNCS (LNAI), vol. 8175, pp. 45–58. Springer, Heidelberg (2013). ;
2. Representation of procedures and practices in contextual graphs. Brézillon, P. Knowl. Eng. Rev. 18, 147–174 (2003). ;
3. Reasoning with Contextual Knowledge and Influence Diagrams. Erman Acar, Rafael Peñaloza, arXiv:2007.00571v1. ;
4. Relational inductive biases, deep learning, and graph networks, P.W. Battaglia et al, arXiv:1806.01261v3, October 2018 ;

KEYWORDS: Classification, Contextual reasoning, Threat identification, Artificial Intelligence

MDA21-020 TITLE: Federated Learning for Accurate Object Classification

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning

TECHNOLOGY AREA(S): Space Platform; 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 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 an Artificial Intelligence/Machine Learning (AI/ML) system that distributes across multiple sensors and systems terminating at the interceptor.

DESCRIPTION: Federated Neural Nets (FNNs) train an algorithm across multiple, heterogeneous decentralized edge devices, such as sensors, or cell phones, where the assumption of independent, identically distributed data may not be valid. Google has explored this concept of keeping all the training data on the device, decoupling the ability to do machine learning from the need to store the data in the cloud, or a centralized server. FNNs have been utilized to learn a shared prediction model while components provide more secure transmission of information. For missile defense, the interceptor seeks determination of object class, as well as threat attributes to support handover applications that could benefit from artificial intelligence. However, the interceptor is separated from raw sensor data which could inform neural nets by layers of information processing. In a distributed system, generally, raw data is refined repeatedly through the system, and the terminal node then has very limited information available to resolve complex, dynamic situations. If the system is designed and trained, however, as one coherent network, the information transmitted for interceptor exploitation is maximized. In this case, layers may reside in a distributed manner and parameters are transmitted across the communications network, adding an extra layer of security. For a classical supervised machine learning system class labels are associated with input data, and this is the goal here, but the NN itself is distributed across multiple nodes. The proposed solution is not required to be a NN, or an FNN in particular, but needs to utilize elemental data in a manner that allows maximum flexibility for the terminal element.

PHASE I: Design a system that distributes a machine learning application across multiple, disparate sensors. Analyze message size, processing loads at each node, and utility for terminal node. Explore factors that may inform feasibility, suitability, and utility in the missile defense system. Deliver a prototype system with test data and results.

PHASE II: Expand and mature the prototype to the actual missile defense system with realistic data, transmission rates, and potential bandwidth limitations. Demonstrate performance for terminal node threat identification. Explore robustness across system uncertainties.

PHASE III DUAL USE APPLICATIONS: Many data fusion applications where raw data can be fused at a remote node to predict a classification would benefit from this technology. This could include illness prediction from pharmacy ordering patterns and/or traffic prediction from cell phones.

REFERENCES:
1. Communication-Efficient Learning of Deep Networks from Decentralized Data, H. Brendan McMahan, et al, Feb. 2017, arXiv: 1602.05629v3. ;

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2. Federated Machine Learning: Concept and Applications, Qiang Yang et al, Feb. 2019, arXiv:1902.04885v1. ;
3. Performance Analysis of Distributed and Federated Learning Models on Private Data; International Conference on Recent Trends in Advanced Computing 2019. ;
4. Agnostic Federated Learning, Mehryar Mohri, et al, Proceedings of the 36th International Conference on Machine Learning, 2019.

KEYWORDS: Artificial Intelligence, Machine Learning, Federated Learning, Classification

VERSION 3

MDA21-021 TITLE: Salvo Management Using Artificial Intelligence

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning

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 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 a technology to serve as a battle management aid, in particular inform salvo management.

DESCRIPTION: Although system-wide battle management handles tasking and assignments to sensors and weapon systems, each weapon system then must assign weapons from its inventory and request tasking. As new versions of weapons come online, mixed field inventory assignment and management can become difficult to optimize in light of fundamental uncertainties. Not only may the salvo composition need to be constructed from more than one weapon system, but modest but significant differences in ability and reliability should also be considered. Additionally, salvo timing and management after launch in light of potential battlespace updates should inform the battle management. Input will consist of threat state from the centralized battle manager, but considerations need to be made concerning the type of threat system being engaged in terms of fundamental capabilities – matching interceptor capabilities to threat capabilities. With fixed inventory sizes, and uncertain threat inventories, the goal is to define how highly capable and reliable weapons should be partitioned to address the threat. Salvo composition, timing and management, before as well as after launch should be optimized with respect to available, and dynamic, threat information.

PHASE I: Define a test set of two major interceptor versions, with modest but significant variations in capability and reliability among the sets. Define a small set of threats that represent variety in maneuverability, countermeasure configuration, and warhead number. Define an artificial intelligence system, e.g. reinforcement learning, that produces a small set of battle plans from which the warfighter can select. Demonstrate how battlespace updates effect the plan. Develop prototype code with an algorithm description document with test results. Include particular input information that would benefit the operation.

PHASE II: Using high fidelity weapon and threat information, including throughout the timeline, upgrade the fidelity of the system to handle realistic data. Ensure the developed plan is consistent with commander intent as well as defined tactics, techniques and procedures. Define how the system would respond to data updates, and define requests for more information (sensor tasking.) Submit a list of preferred system information to support optimal engagement. Develop and deliver code with an algorithm description document with test results and analysis of government delivered scenario data as well as own data. Demonstrate through analysis robustness of the system.

PHASE III DUAL USE APPLICATIONS: This task involves system automation and could learn from, as well as inform, automated systems such as vehicle driving, plant operation, and inventory management for emergency response.

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REFERENCES:

1. Alpha C2-An Intelligent Air Defense Commander Independent of Human Decision-Making, Qiang Fu et al, IEEE Access, May, 2020, DOI 10.1109/Access.2020.2993459. ;
2. An Introduction to Deep Reinforcement Learning, Vincent Francois-Lavet et al, December 2018, ArXiv:1811.12560v2. ;
3. AI-enabled wargaming in the military decision making process, Peter Schwartz et al, Proc. SPIE 11413, Artificial Intelligence and Machine Learning for Multi-Domain Operations Applications II, 11413H (April 2020) doi 1117/12.2560494. ;
4. PEORL: Integrating Symbolic Planning and Hierarchical Reinforcement Learning for Robust Decision-Making, Fangkai Yang et al, Proceedings of the twenty-Seventh International Joint Conference on Artificial Intelligence (IJCAI – 18).

KEYWORDS: Salvo management, inventory management, artificial intelligence, reinforcement learning, battlefield management

VERSION 3

MDA21-022 TITLE: Radiation Hardening of Non-Hardened Commercial Microelectronics

RT&L FOCUS AREA(S): Artificial Intelligence/ Machine Learning; 5G; Microelectronics; Space

TECHNOLOGY AREA(S): Sensors; Electronics; Space Platform; Nuclear; 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 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: To develop a process to radiation harden commercial microelectronics that were not originally designed to operate in a radiation environment.

DESCRIPTION: The market for microelectronics that meet government radiation requirements is small. Commercial microelectronics can meet the government's performance requirements but they are not designed to meet military radiation requirements.

The underlying concept of this topic is that today's state-of-the-art microelectronics have inherent radiation hardness that meet certain levels of performance in the space and man-made environments. For example, Fully-Depleted Silicon-on-Insulator (FD-SOI) technologies and Fin Field-Effect Transistor (FinFET) technologies have an inherent hardness to single-event effects because of their reduced sensitive area at the transistor level. Additionally, cube sat vendors have developed single board computers that use an architecture built on the use of commercial radiation tolerant electronics to meet their radiation requirements.

This topic seeks innovative solutions that modify already fabricated parts to enhance their radiation performance for single-event effects and dose-rate. Parts should be able to survive and operate through space radiation environments with recommended total ionizing dose (TID) >100 krads (Si), single event upsets (SEU) < 10-10 errors/bit-day, and immunity to single event latch-up (SEL) at linear energy transfer (LET) levels > 75 MeV cm2/mg. For dose-rate, the modification must improve the part's performance 10x or demonstrate the part can already meet significant dose-rate levels.

Potential solutions may involve modifying the SOI substrate of FDSOI to improve their hardness or changing the dopant concentration of the semiconductor. Other solutions may use a concept of heterogeneous packaging that pairs a state-of-the-art Field Programmable Gate Array (FPGA) or general purpose processor with a radiation tolerant or hardened watchdog part. This would be similar to the concept of taking a single board computer and redesigning it with advanced heterogeneous packaging techniques.

Solutions that will not be accepted are ones that rely on shielding the part or requiring access at the state of the art foundry to add or change masks. All solutions should start with already fabricated parts either in bare die form or packaged parts.

PHASE I: Develop the proposed approach to a sufficient level to demonstrate its viability and identify requirements for full development. The following are anticipated at the conclusion of Phase I: a) A demonstration/proof-of-concept of the viability of the proposed approach. b) A plan for the development of an initial working prototype capability.

PHASE II: Optimize design(s) to improve baseline performance, increase survivability and level of operability in realistic radiation environments. Fabricate and test optimized parts in realistic radiation environments and against standard military temperature cycling specification. Work with a vendor/trusted foundry/fabrication house and/or military prime contractor on part(s) manufacturability/producibility. Incorporate hardened parts in a representative space avionic subsystem/system application and test in realistic space radiation environments.

PHASE III DUAL USE APPLICATIONS: Team with a vendor/trusted foundry/fabrication house and/or military prime contractor to develop and space qualify radiation-hardened parts. Work with the transition partner to establish a pathway to insert technology into an existing or planned missile defense application.

REFERENCES:

1. Srour, J.R., and J.M. McGarrity. “Radiation Effects on Microelectronics in Space.” Proc. IEEE; (United States) 76:11 (1988). ;
2. A. H. Johnston, "Radiation effects in advanced microelectronics technologies," in IEEE Transactions on Nuclear Science, vol. 45, no. 3, pp. 1339-1354, Jun 1998. ;
3. P. Nsengiyumva et al., "Analysis of Bulk FinFET Structural Effects on Single-Event Cross Sections," in IEEE Transactions on Nuclear Science, vol. 64, no. 1, pp. 441-448, Jan. 2017, doi: 10.1109/TNS.2016.2620940. ;
4. R. Liu et al., "Single Event Transient and TID Study in 28 nm UTBB FDSOI Technology," in IEEE Transactions on Nuclear Science, vol. 64, no. 1, pp. 113-118, Jan. 2017, doi: 10.1109/TNS.2016.2627015.

KEYWORDS: Radiation, RHDB, microelectronics, state-of-the-art, defense, sensors, heterogeneous packaging, advanced packaging, chiplets

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY
21.2 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. 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 and these proposal preparation instructions 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 questions regarding the DoD SBIR/STTR electronic submission system, contact the DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com.

PHASE I PROPOSAL INFORMATION

Follow the instructions in the DoD SBIR Program BAA for program requirements and proposal submission instructions at https://www.dodsbirsttr.mil/submissions/.

NGA has developed topics to which small businesses may respond to in this fiscal year 2021 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), Technical and Business Assistance (TABA) 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. **Notable differences from the OSD guidance on the volumes are listed below and override the OSD guidance:**

- **Technical Volume (Volume 2)**: The length of the technical volume is limited to 20 pages. The Government will not consider pages in excess of the page count limitations. Number all pages of your proposal consecutively.
- **Company Commercialization Report (Volume 4):** See DoD SBIR Instructions on Company Commercialization Report. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.
- **Supporting Documents (Volume 5):** 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. Items that may go into, not all inclusive, are additional cost proposal information, Completed Form SF326, advocacy letters, etc.
- **Fraud, Waste and Abuse Training (Volume 6):** See DoD SBIR Instructions on Fraud, Waste and Abuse. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.

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). As part of subfactor c in the evaluation criteria, the vendor will be evaluated on how it addresses the following five questions on the overall commercialization strategy:

(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?

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.

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.

Proposing firms will be notified of selection or non- selection status for a Phase I award within 90 days of the closing date of the BAA. The individual named as the Corporate Official on the Proposal Cover Sheet will receive an email for each proposal submitted from the Government Contracting Officer/Specialist with their official notification of proposal selection or non-selection. The notices will be binned into 3 categories: (1) proposals selected for award, (2) proposals selected for award, if additional funding becomes available, and (3) proposals not selected for award. Proposals with the award designation of 'Award if Additional Funding Becomes Available' will receive consideration for award 12 months from the BAA close date. 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 monthly status reports, a more detailed interim report not later than 7 months after award, a final report no later than 9 months after award and any software/algorithms/documentation from items developed in Phase I. 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.
- A summary of any risks or issues

The interim report (draft final report) 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.

PHASE II GUIDELINES (Not Direct to Phase II)

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 a timely review.

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 DoDSBIRSupport@reisystems.com.

NGA SBIR Phase II Proposals have four UNCLASSIFIED 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.

- **Proposal Cover Sheet (Volume 1):** 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.
- **Format of Technical Volume (Volume 2)**: 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. The length of each part of the technical volume is limited to 40 pages. The Government will not consider pages in excess of the page count limitations. Number all pages of your proposal consecutively. Font size should not be smaller than 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½" by 11" paper. The header on each page of the Technical Volume should contain your company name, topic number, and proposal number assigned by DSIP when the Cover Sheet was created. The header may be included in the one-inch margin.

- (1) Significance of the Problem. Define the specific technical problem or opportunity addressed and its importance.
- (2) Phase II Technical Objectives. Enumerate the specific objectives of the Phase II work, and describe the technical approach and methods to be used in meeting these objectives.
- (3) Phase II Statement of Work. The statement of work should provide an explicit, detailed description of the Phase II approach, indicate what is planned, how and where the work will be carried out, a schedule of major events and the final product to be delivered. 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 total proposal. Include how and where the work will be carried out, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail.
- (4) Section 508 Compliance: The contractor shall ensure that all systems, hardware, software, software engineering, and information technology associated with this effort is made in a manner that is accessible for people with the standards for people with disabilities as directed in the NGA Instruction 8400.4 and Section 508 of the Rehabilitation Act of 1973 as amended in 1998 (Section 508). Specifically, all Information and Communications Technology (ICT) associated with this contract, may use the Web Content Accessibility Guidelines (WCAG) 2.1 to comply with the Section 508 or use alternative designs or technologies which result in substantially equivalent or greater access to and use of the product for people with disabilities. Furthermore, the contractor shall pursue human centered design and usability guidelines in order to ensure that all services associated with this Topic Area are accessible by as many users as possible and as a means to drive modernization, innovation, and enhance mission support. **As part of the vendor's proposal, the vendor should include an outline specifically how Section 508 compliance will be achieved in the design of the ICT product. The proposal for Phase 2 should provide an explicit, detailed description of the approach, indicate what is planned, how and where the work will be carried out, a schedule of major events, how the solution will be Section 508 Compliant, and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. If a determination is made that a Section 508 exception request is justified, the rationale for the exception request must be made and submitted as a part of the proposal.**
- (5) Related Work. Describe significant activities directly related to the proposed effort, including any conducted by the PI, the proposer, consultants or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal 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.

- (6) Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. ii. Discuss the significance of the Phase II effort in providing a foundation for Phase III research and development or commercialization effort.
- (7) Key Personnel. Identify key personnel who will be involved in the Phase II effort including information on directly related education and experience. A concise resume of the PI, including a list of relevant publications (if any), must be included. All resumes count toward the page limitation.
- (8) Foreign Citizens. Identify any foreign nationals you expect to be involved on this project.
- (9) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in the cost proposal) shall be justified under this section. If proposing to perform classified activities during the period of performance you need to provide the following: 1) Will the information include controlled unclassified information (CUI) and; 2) What unclassified IT systems will be required.
- (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. Please refer to section 4.2 of this BAA for detailed eligibility requirements as it pertains to the use of subcontractors/consultants.
- (11) Prior, Current or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this 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 the PI 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 proposal submitted or award received. Note: If this does not apply, state in the proposal "No prior, current, or pending support for proposed work."
- (12) Commercialization Strategy. NGA is equally interested in dual use commercialization of SBIR/STTR projects that result in products sold to the U.S. military, the private sector market, or both. NGA expects explicit discussion of key activities to achieve this result in the commercialization strategy part of the proposal. The Technical Volume of each Direct to Phase I proposal must include a commercialization strategy section. The Phase I commercialization strategy shall not exceed 5 pages. The commercialization strategy should include the following elements:
    - a) Problem or Need Statement. Briefly describe what you know of the problem, need, or requirement, and its significance relevant to a Department of Defense application and/or a private sector application that the SBIR/STTR project results would address.
    - b) Description of Product(s) and/or System Application(s). Identify the commercial product(s) and/or DoD system(s), or system(s) under development, or potential new system(s). Identify the potential DoD endusers, Federal customers, and/or private sector customers who would likely use the technology.
    - c) Business Model(s)/Procurement Mechanism(s). Discuss your current business model hypothesis for bringing the technology to market. Describe plans to

license, partner, or self-produce your product. How do you plan to generate revenue? Understanding NGA's goal of creating and sustaining a U.S. military advantage, describe how you intend to develop your product and supply chains to enable this differentiation.

- d) Target Market. Describe the market and customer sets you propose to target, their size, their growth rate, and their key reasons they would consider procuring the technology. Describe competing technologies existent today on the market as well as those being developed in the lab.
- e) Funding Requirements. Describe your company's funding history. How much external financing have you raised? Describe your plans for future funding sources (internal, loan, angel, venture capital, etc.).
- f) Commercialization Risks. Describe the major technology, market and team risks associated with achieving successful transition of the NGA funded technology. NGA is not afraid to take risks but we want to ensure that our awardees clearly understand the risks in front of them.
- g) Expertise/Qualifications of Team/Company Readiness. Describe the expertise and qualifications of your management, marketing/business development and technical team that will support the transition of the technology from the prototype to the commercial market and into government operational environments. Has this team previously taken similar products/services to market? If the present team does not have this needed expertise, how do you intend to obtain it? What is the financial history and health of your company (e.g., availability of cash, profitability, revenue growth, etc.)?

- **Format of Cost Volume (Volume 3):** The Cost Volume (and supporting documentation) DOES NOT count toward the page limit of the Technical Volume. Some items in the Cost Breakdown Guidance below may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. ALL proposed costs should be accompanied by documentation to substantiate how the cost was derived. For example, if you proposed travel cost to attend a project-related meeting or conference, and used a travel website to compare flight costs, include a screen shot of the comparison. Similarly, if you proposed to purchase materials or equipment, and used the internet to search for the best source, include your market research for those items. You do not necessarily have to propose the cheapest item or supplier, but you should explain your decision to choose one item or supplier over another. It's important to provide enough information to allow contracting personnel to understand how the proposer plans to use the requested funds. If selected for award, failure to include the documentation with your proposal will delay contract negotiation, and the proposer will be asked to submit the necessary documentation to the Contracting Officer to substantiate costs (e.g., cost estimates for equipment, materials, and consultants or subcontractors). It is important to respond as quickly as possible to the Contracting Officer's request for documentation. Cost Breakdown Guidance:
    - List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
    - Special tooling and test equipment and material cost may be included. 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 Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These 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 NGA; unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by NGA.

- Cost for travel funds must be justified and related to the needs of the project.
- Cost sharing is permitted for proposals under this announcement; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.
- 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. The Supporting Documents Volume (Volume 5) may be used if additional space is needed. For more information about cost proposals and accounting standards, see the DCAA publication titled "Audit Process Overview – Information for Contractors" available at: http://www.dcaa.mil.

- **Company Commercialization Report (Volume 4):** See DoD SBIR Instructions on Company Commercialization Report. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.
- **Supporting Documents (Volume 5):** 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. Items that may go into, not all inclusive, are additional cost proposal information, Completed Form SF326, advocacy letters, etc.

Fraud, Waste and Abuse Training (Volume 6): See DoD SBIR Instructions onFraud, Waste and Abuse Training. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.

Selection of Phase II proposals will be in accordance with the evaluation procedures and criteria discussed in this BAA (refer to Section 6.0 of the BAA). As part of subfactor c in the evaluation criteria, the vendor will be evaluated on how it addresses the following five questions on the overall commercialization strategy:

(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?

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.

Initial 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 a monthly status and financial reports, an interim report not later than 12 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.
- A summary of any risks or issues

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

Due to the nature of our business, only US Nationals are permitted to work on NGA topics, unless the vendor proposes the work as Fundamental Research and indicates it as such in the proposal. The use of non-US National on a NGA contract is PROHIBITTED, unless the work is scoped as Fundamental Research. If the effort is Fundamental Research, the PI must be a US National. ALL offerors proposing to use non-US Nationals (which has not been determined as Fundamental Research) on the effort will be ineligible for award. This includes the use at universities or any other subcontractor. In the event it is determined to be Fundamental Research, non-US Nationals will be ineligible to receive controlled unclassified information as described below.

CONTROLLED UNCLASSIFIED INFORMATION (CUI)
Controlled Unclassified Information (CUI) is information that requires safeguarding or dissemination controls pursuant to and consistent with applicable law, regulations, and government-wide policies but is not classified under Executive Order 13526 or the Atomic Energy Act, as amended.

Executive Order 13556 "Controlled Unclassified Information" (the Order), establishes a program for managing CUI across the Executive branch and designates the National Archives and Records Administration (NARA) as Executive Agent to implement the Order and oversee agency actions to ensure compliance. The Archivist of the United States delegated these responsibilities to the Information Security Oversight Office (ISOO).

32 CFR Part 2002 "Controlled Unclassified Information" was issued by ISOO to establish policy for agencies on designating, safeguarding, disseminating, marking, decontrolling, and disposing of CUI, self-inspection and oversight requirements, and other facets of the Program. The rule affects Federal executive branch agencies that handle CUI and all organizations (sources) that handle, possess, use, share, or receive CUI—or which operate, use, or have access to Federal information and information systems on behalf of an agency.

During performance of this contract, if the government provides the vendor a dataset that is not publically released, the vendor must be CUI Compliant to receive it. For more information on this compliance please see DFARS Clause 252.204-7012, NIST Special Publication SP 800-171 and the National Archives and Records Administration (NARA) website (https://www.archives.gov/cui/about).

CERTICATE PERTAINING TO FOREIGN INTERESTS
Offers must submit a SF-328 in Volume 5 in order to be considered for award. If after review of the form, the offeror may be found ineligible for award if the offerors foreign interest are found to be unacceptable. The form can be found at https://www.gsa.gov/forms-library/certificate-pertaining-foreign-interests.

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;
(2) The information is otherwise in the public domain before the date of release; or
(3) The information results from or arises during the performance of a project that involves no covered defense information (as defined in the clause at DFARS 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting) and **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* (which by definition cannot involve any covered defense information)**, 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 Under Secretary of Defense (Acquisition, Technology, and Logistics) 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.

(c) The Contractor agrees to include a similar requirement, including this paragraph (c), in each subcontract under this contract. Subcontractors shall submit requests for authorization to release through the prime contractor to the Contracting Officer.

***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.**

5X252.204-7000-90 PUBLIC RELEASE OF INFORMATION

(a) Except as provided in paragraph (b) of this clause, information pertaining to this contract shall not be released to the public unless 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.

(b) The contractor may provide past performance information regarding this contract, without Contracting Officer approval, to the Office of the Director of National Intelligence (ODNI), the Central Intelligence Agency (CIA), the National Reconnaissance Office (NRO), the National Security Agency (NSA), the Defense Intelligence Agency (DIA), and NGA to support source selections at those agencies. The contractor is responsible for the proper classification and handling of such information and shall provide a copy of the information provided to the Contracting Officer.

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.

NGA 21.2 SBIR Phase I Topic Index

NGA212-001 TITLE: Optical Shutter for Dynamic Active Electro-Optical Range Gating Systems

RT&L FOCUS AREA(S): Sensors, Electronics, and Electronic Warfare

TECHNOLOGY AREA(S): Microelectronics, Space, GWR

OBJECTIVE: Develop a compact, free-space electro-optical (EO) shutter to regulate photons arriving at a laser-based remote sensing receiver and to detect weak returns from targets largely obscured by strong returns from overhead tree canopies or camouflage.

DESCRIPTION: The government seeks to develop a compact, low-cost, dynamic optical shutter/isolation capability for integration with existing and/or future active remote sensing platforms. The system shall be capable of operating with a high repetition rate (Objective: 100 kHz) pulsed, polarized output, free-space pulsed lasers (1064 nm), and deployable in-line with narrow field of view imaging lidar systems. The device shall have an acceptance angle of 1 degree or more, maintain and select polarization, and be bi-directional. It shall facilitate on-demand pico- and nanosecond gating between 200 pm to 100 ns, ideally, of both a pulsed laser source and the time-delayed return of reflected pulses off a far-field target.

The capability can build on Pockels Cell/Q-Switch technology and represents a new functional implementation and developmental evolution of this technology because it leverages recent advances in crystal growth, electrode design, and voltage control electronics. It promises to dramatically improve the three-dimensional (3D) imaging performance of long-standoff active EO systems.

The proposed range gating technology will be demonstrated as a breadboard prototype. By providing exquisite temporal power control over in-situ scene illumination (transmitter) and received backscatter, it should improve the performance of traditional Geiger-mode lidar systems by improving the probably of detection of targets under canopy, while conferring improved system-level optical damage tolerance to both inadvertent and adversarial sources of high-intensity illumination.

Such a capability will allow for improvements in the ability of single-photon and conventional linear-mode lidar systems to image past highly reflective objects (such as canopy) by selectively and effectively attenuating these returns, while simultaneously improving sensor sensitivity with respect to far-field target objects in the human activity layer. Because of the notional design of such a system, this capability, as developed, also lends itself for use in dynamic in-sensor attenuation of highly reflective objects in scene and undesired sources of active illumination within the field of regard. It affords the entire system an additional degree of protection against optical damage and provides additional capabilities in the areas of pulse picking and/or pulse slicing. In addition, it confers the potential to pick pulses out of a multi-pulse train (e.g., MHz pulse repetition frequency), reduce the pulse width of nanosecond pulses into the picosecond range, and selectively gate far-field returns based on the mission profile.

PHASE I: Develop one or more proof-of-concept component designs and modeling analysis that meet the technical performance requirements outlined above.

PHASE II: Build a monolithic optical assembly that is fixture mountable to a standard imperial optical breadboard, and associated electrical equipment, suitable for bench testing. Identify paths to a production-ready device that can be integrated into a long-standoff 3D imaging system.

PHASE III DUAL USE APPLICATIONS: The desired Pockels cell will improve both passive and active imaging systems that require nonmechanical high-speed optical shutters and signal attenuators, specifically those already using optical components based on the Pockels effect.

REFERENCES:
None

KEYWORDS: Lidar, Laser, Pockels Cell, Optics

NGA212-002 TITLE: Dynamic Parameter Selection for Community Detection Algorithms (Graph Networks)

RT&L FOCUS AREA(S): INFORMATION SYSTEMS

TECHNOLOGY AREA(S): AUTONOMY

OBJECTIVE: Establish a general approach for dynamically setting the tuning parameter for a given community detection (CD) algorithm and graph. Validate the approach on four algorithms with novel data provided by the National Geospatial Intelligence Agency (NGA) .

DESCRIPTION: NGA produces timely, accurate, and actionable geospatial intelligence to support U.S. national security. NGA works with a variety of data types including graph networks, which can be used to analyze computer, biological, and social networks. One of the fundamental problems in graph networks is CD. About half of all CD algorithms require a tuning parameter. For example, the Walktrap [1] algorithm finds communities by taking random walks on the graph, but the user must define the length of the walks. For the purposes of this solicitation, we are investigating the four CD algorithms in Table 1.

Table 1 CD algorithms and their parameters. Time complexity is provided in terms of n (number of nodes) and m (number of edges). All four algorithms are available in the igraph library [5].

CD algorithm Tuning parameter Time complexity
Walktrap [1] num_steps O(mn2)
Spinglass [2] gamma O(n3.2)
Leiden [3] gamma O(nlog(n))
FluidC [4] num_communities O(m)

In real-world scenarios (where ground truth is not available) parameter selection is performed by maximizing a heuristic like modularity [6]. However, this approach has several limitations. First, modularity is unable to resolve small communities in large networks, even when they are well-defined [7]. Second, the brute-force approach to parameter tuning is computationally inefficient because it requires running the algorithm multiple times.

The purpose of this solicitation is to develop a method for dynamically setting the parameter value for a given CD algorithm based only on observable features of the graph (e.g., number of nodes, degree distribution, average diameter, centrality measures, or clustering coefficient [8]). This approach reduces the overall time required to process large graphs by avoiding a brute-force search, facilitates automation of the CD algorithms, and advances research in parameter selection for graph network algorithms.

Please note that NGA prefers proposals whose dynamic parameter selection solutions generalize beyond CD algorithms and even beyond the graph network domain. CD algorithms that are parameter-free (e.g., Fastgreedy, Infomap, Label propagation, or Edge betweenness see [9]) or based on deep learning [10] are out of scope for Phase I.

Communities are defined as subgroups of nodes that are more densely connected internally than with the rest of the network, suggesting that the network has certain natural divisions within it.

PHASE I: Design and develop a method for dynamically setting the parameter value for a given CD algorithm and graph. Test the proposed approach on the four CD algorithms listed in Table 1. NGA will evaluate funded proposals using test graphs for which NGA knows the ground truth. For each test graph, performers must choose one tuning parameter for each of the four CD algorithms. The performers' scores and an analysis of the time complexity of their approaches will determine who is funded in Phase II.

PHASE II: Validate the generalizability of the proposed approach by dynamically setting the parameter value for at least two other graph algorithms (i.e., not CD algorithms). Performers will be responsible for selecting the target algorithms and performing experiments that validate their approach.

PHASE III DUAL USE APPLICATIONS: The ability to automate algorithms that otherwise require human input is of significant commercial value. This technology could be used to create new features for existing software products or automate human-driven processes.

REFERENCES:
[1] P. Pons and M. Latapy, "Computing communities in large networks using random walks (long version)," arXiv:physics/0512106, Dec. 2005 [Online]. Available: http://arxiv.org/abs/physics/0512106.
[2] J. Reichardt and S. Bornholdt, "Statistical Mechanics of Community Detection," Phys. Rev. E, vol. 74, no. 1, p. 016110, Jul. 2006, doi: 10.1103/PhysRevE.74.016110.
[3] V. A. Traag, L. Waltman, and N. J. van Eck, "From Louvain to Leiden: guaranteeing well-connected communities," Scientific Reports, vol. 9, no. 1, p. 5233, Mar. 2019, doi: 10.1038/s41598-019-41695-z.
[4] F. Parés et al., "Fluid Communities: A Competitive, Scalable and Diverse Community Detection Algorithm," in Complex Networks & Their Applications VI, Cham, 2018, pp. 229–240, doi: 10.1007/978-3-319-72150-7_19.
[5] G. Csardi, "The igraph software package for complex network research," Int J Complex Syst, vol. 1695, 2006 [Online]. Available: https://igraph.org/.
[6] M. E. J. Newman, "Modularity and community structure in networks," Proc Natl Acad Sci U S A, vol. 103, no. 23, pp. 8577–8582, Jun. 2006, doi: 10.1073/pnas.0601602103.
[7] A. Lancichinetti and S. Fortunato, "Limits of modularity maximization in community detection," Phys. Rev. E, vol. 84, no. 6, p. 066122, Dec. 2011, doi: 10.1103/PhysRevE.84.066122.
[8] L. Peel, "Estimating network parameters for selecting community detection algorithms," in 2010 13th International Conference on Information Fusion, 2010, pp. 1–8, doi: 10.1109/ICIF.2010.5712065.
[9] Z. Yang, R. Algesheimer, and C. J. Tessone, "A Comparative Analysis of Community Detection Algorithms on Artificial Networks," Scientific Reports, vol. 6, no. 1, p. 30750, Aug. 2016, doi: 10.1038/srep30750.

[10] F. Liu et al., “Deep Learning for Community Detection: Progress, Challenges and Opportunities,” Proceedings of the Twenty-Ninth International Joint Conference on Artificial Intelligence, pp. 4981–4987, Jul. 2020, doi: 10.24963/ijcai.2020/693.

KEYWORDS: intelligent systems, parameter selection, graph networks, community detection

VERSION 4

UNITED STATES SPECIAL OPERATIONS COMMAND
21.2 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 21.2 Program Broad Agency Announcement (BAA). A thorough reading of the "Department of Defense Small Business Innovation Research (SBIR) Program, SBIR 21.2 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	Contract Type
Phase I SOCOM212-001	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 6 months	NTE $150,000.00	Firm-Fixed-Price
Phase I SOCOM212-002	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 6 months	NTE $150,000.00	Firm-Fixed-Price

Contract Awards:

SBIR awards for topic SOCOM212-001 may be made under the authority of National Defense Authorization Act for Fiscal Year 2020, Section 851, PILOT PROGRAM FOR DEVELOPMENT OF TECHNOLOGY-ENHANCED CAPABILITIES WITH PARTNERSHIP INTERMEDIARIES. USSOCOM may use a partnership intermediary to award SBIR contracts and agreements to small business concerns. SOCOM212-001 SBIR contract awards may be done through SOFWERX and result in a commercial contract between the firm and DEFENSEWERX. The Government will evaluate and select for award all SOCOM212-001 proposals. The Government will award all SBIR contracts for SOCOM212-002.

Proposal Submission:

Firms must upload their proposals to the Defense SBIR/STTR Innovation Portal Proposal Submissions at https://www.dodsbirsttr.mil/submissions/login . Additional USSOCOM specific submission requirements for each volume are detailed below.

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Technical Inquiries:

During the Pre-release Period of the DoD SBIR 21.2 Program BAA, all questions must be submitted in writing either by e-mail to sbir@socom.mil or to the online DSIP Topic Q&A. All questions and answers submitted to DSIP Topic Q&A 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 4.13.c. of the DoD SBIR 21.2 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 4.13.d of the DoD SBIR 21.2 Program BAA Instructions.

Site visits will not be permitted during the Pre-release and Open Periods of the DoD SBIR 21.2 Program BAA.

Proposal Volumes:

Volume 1: Cover Page is created as part of the DOD Proposal Submissions process.

Volume 2: Technical Volume
The Technical Volume page count will include all the required items under section 5.4.c of the DoD SBIR 21.2 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 are 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 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 3.7 entitled “Foreign Nationals” of the DoD SBIR 21.2 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 USSOCOM Phase I Cost excel spreadsheet, with a base not to exceed $150,000.00.

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
CCR is required to be submitted with proposals in response to USSOCOM 21.2 SBIR topics. Please refer to the DoD 21.2 SBIR BAA for full details.

Volume 5: Supporting Documents
Potential Offerors shall submit a slide deck not to exceed 15 PowerPoint slides, and Section K in this volume.

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Volume 6: Fraud, Waste and Abuse Training
Fraud, Waste and Abuse (FWA) training is required for Phase I and Direct to Phase II proposals. Please refer to the DoD 21.2 SBIR BAA for full details.

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.
7) Discretionary Technical and Business Assistance

Phase I Evaluations:

USSOCOM evaluates Phase I proposals using the evaluation criteria specified in section 6.0 of the DoD 21.2 SBIR Announcement with the following exceptions:

1. Proposals missing technical volume, 2/3 rule, cost volume, or slide deck will not be evaluated or those that exceed the maximum price allowed as per Table 1 of this instructions. Those proposals will be considered non-responsive.

2. The technical evaluation will utilize the Evaluation Criteria provided in Section 6.0 of the DoD SBIR 21.2 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 6.0 of the DoD SBIR 21.2 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) to the USOCOM technical evaluation team, using a virtual teleconference. This will be a technical presentation of the proposed solution and the key personnel listed in the proposal should be conducting the presentation and responding to the questions of the evaluation team. This presentation is NOT intended for business development personnel, it is purely technical. Selected Offerors shall restrict their presentations to only the 15 page PowerPoint presentation that were submitted with their proposals. There will be no changes or updates to the presentations from what was proposed. All selected firms will be required to provide a teleconference information for the presentation. This presentation will complete the evaluation of the proposal the panel did against the criteria listed under Section 6.0 of the DoD SBIR 21.2 BAA. Notifications of selection/non-selection for Phase I award will be completed within a timely manner.

3. The Cost Volume (Volume 3) evaluation:
   For this Phase I, the award amount is set at a not to exceed (NTE), a technical evaluation of the proposal cost will be completed to assess price fair and reasonableness. Proposals above the set NTE for the effort will not be considered for award. The team will assess the technical approach

presented for the effort based on the number of labor hours by labor categories, the key personnel level of involvement, materials, subcontractors and consultants (scope of work, expertise, participation and proposed effort), and other direct cost as proposed.

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:

For topic SOCOM212-001 the Defensewerx (also known as SOFWERX) will notify each Offeror whether they have been selected for award. The e-mail notification will be sent to the Corporate Official (Business) identified by the Offeror.

For topic SOCOM212-002, 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 to their respective Contracting Officer, within 30 calendar days of receipt of notification of non-selection, for informal feedback. The respective Contracting Officer will provide informal feedback in response to an Offeror's written request rather than a debriefing as specified in paragraph 4.10, entitled "Debriefing," of the DoD SBIR 21.2 Announcement.

USSOCOM SBIR Program Point of Contact:

Inquiries concerning the USSOCOM SBIR Program and these proposal preparation instructions should be addressed to sbir@socom.mil.

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SOCOM 21.2 SBIR PHASE I TOPIC INDEX

VERSION 4

SOCOM212-001 TITLE: Man-Portable Starlink System

RT&L FOCUS AREA(S): Microelectronics; Network Command, Control and Communications

TECHNOLOGY AREA(S): Electronics; Information Systems; Materials; Space Platform

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: The objective of this topic is to develop applied research toward an innovative capability to develop a small form factor system that enables reliable access to the Starlink commercial internet system.

DESCRIPTION: As a part of this feasibility study, the proposers shall address all viable overall system design options with respective specifications on the key system attributes. The current commercial Starlink system uses a 1m dish and requires significant amounts of power to operate. The key system attributes for the desired system are that it must be man portable and battery powered. The system should be designed to be as small as possible while providing enough link margin to achieve reliable internet connection over the Starlink constellation. The antenna and modem need to be miniaturized along with being integrated with a small commercial off the shelf Software Defined Radio (e.g. Epiq Z2) for the RF link.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled “Objective” and “Description.”

The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study (“Technology Readiness Level 3”) 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 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 on a man portable Starlink system.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where the need for a man portable Starlink system is required for operation of a communication or data exfiltration system.

REFERENCES:

1. Special Operations Tactical Communications, Defense Media Network, 27 May 2020, Andrew White; https://www.defensemedianetwork.com/stories/special-operations-tactical-communications/.

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KEYWORDS: antenna; UHF; small; tactical; commercial, space; starlink

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SOCOM212-002 TITLE: Small Form Factor UHF SATCOM Antenna

RT&L FOCUS AREA(S): Microelectronics; Network Command, Control and Communications

TECHNOLOGY AREA(S): Electronics; Information System; Materials; Space Platform

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: The objective of this topic is to develop applied research toward an innovative capability to develop a small form factor antenna that enables Ultra High Frequency (UHF) satellite communications for small handheld devices.

DESCRIPTION: As a part of this feasibility study, the proposers shall address all viable overall system design options with respective specifications on the key system attributes. The key system attributes for the antenna are that it must be tuned for transmitting and receiving a frequency range of 225 to 400 megahertz (Mhz). It also must be right-hand circularly polarized (RHCP). The antenna must be able to accept output power of a handheld transmitter of up to 37 decibel-milliwatts (dbm) (5 Watts). SubMiniature version A (SMA) type connectors are preferred for connecting the antenna to a handheld transceiver. A flexible patch type antenna is desired; however, the smallest size possible antenna is most desirable.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled "Objective" and "Description."

The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study ("Technology Readiness Level 3") 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 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 on a small form factor UHF SATCOM antenna.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where the need for a small form factor UHF antenna is required for operation of a communication or data exfiltration system.

REFERENCES:

1. Special Operations Tactical Communications, Defense Media Network, 27 May 2020, Andrew White; https://www.defensemedianetwork.com/stories/special-operations-tactical-communications/.

VERSION 4

KEYWORDS: antenna; UHF; small; tactical

VERSION 3

UNITED STATES SPECIAL OPERATIONS COMMAND
21.2 Small Business Innovation Research (SBIR)
Direct to Phase II Proposal Submission Instructions

Introduction:

The United States Special Operations Command (USSOCOM) 21.2 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. The Government will evaluate only responsive proposals.

A thorough reading of the "Department of Defense Small Business Innovation Research (SBIR) Program, SBIR 21.2 Program Broad Agency Announcement (BAA)", located at https://rt.cto.mil/rtl-small-business-resources/sbir-sttr/, 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 SOCOM212-D003	Not to exceed 10 pages not including Feasibility Appendix	15-page PowerPoint	Typically 18 months	Not to Exceed $2,775,917.00

Contract Awards:

SBIR awards for this Direct to Phase II topic will be awarded as a fixed price (level of effort type), Other Transactions Agreement (OTA). Successful completion of the prototype under an OTA may result in a follow-on production OTA or contract. Successful completion of the prototype is defined as meeting one or more threshold requirements. Firms may download the template at https://www.socom.mil/SOF-ATL/Pages/SBIR-21-2.aspx. The terms and conditions as well as the requirements are included in the OTA template provided in this solicitation. The terms and conditions of the Template OTA and the latest version of the OTA may be revised prior to execution. The document deliverables required for the effort are under attachment 2 of the OTA and the statement of objectives is under attachment 3 of the OTA template. Offerors must review these documents to develop their proposal.

The OTA template needs to be completed by only those Offerors selected for award and will be submitted directly to the Agreements Officer identified in the notification. Providing the completed OTA for those invited to present, is desirable but not required.

Those selected for award would be required to enter their company information, expected milestones (attachment 1), and provide a non-proprietary Statement of Work (SOW) following the format of the Statement of Objectives (SOO) (attachment 3).

Proposal Submission:
Firms must upload their proposals to the Defense SBIR/STTR Innovation Portal Proposal Submissions at https://www.dodsbirsttr.mil/submissions/login . Additional USSOCOM specific submission requirements for each volume are detailed below.

USSOCOM does not provide Discretionary Technical and Business Assistance for Direct to Phase II awards.

Technical Inquiries:
During the Pre-release Period of the DoD SBIR 21.2 Program BAA, all questions must be submitted in writing either by e-mail to sbir@socom.mil or to the online DSIP Topic Q&A. All questions and answers submitted to DSIP Topic Q&A will be released to the general public. USSOCOM does not allow inquirers to communicate directly in any manner to the topic authors (differs from Section 4.13.c. of the DoD SBIR 21.2 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 4.13.d of the DoD SBIR 21.2 Program BAA Instructions.

Site visits will not be permitted during the Pre-release and Open Periods of the DoD SBIR 21.2 Program BAA.

Proposal Volumes:
Volume 1: Cover Page is created as part of the DOD Proposal Submissions process.

Volume 2: Technical Volume
2.1 The Technical Volume shall not exceed 10 pages and will include all required items under section 5.4.c. of the DoD SBIR 21.2 instructions. Any additional pages will be deleted from the proposal prior to evaluation.

The technical proposal shall include a Statement of Work (SOW) with the planned tasks and descriptions to meet the Statement of Objectives (SOO) goals detailed in Attachments 3 of the OTA Template. Do not upload the whole SOO with your proposal. The SOO and CDRL are provided to help the Offerors consider the required goals, scope, and deliverables when developing the proposal, but it is an Offeror's responsibility to provide fully responsive, complete, and clear submissions. Exceptions to the requirements need to be identified/explained. The SOO, and CDRLs are provided in the OTA Template and can be downloaded from https://www.socom.mil/SOF-ATL/Pages/SBIR-21-2.aspx.

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 applicable sections of the SOO and it shall include no proprietary information, data, or marking. The provided SOW will become Attachment 3 of the resulting OTA, incorporating any agreed upon changes if necessary.

Note: The Phase I feasibility Appendix (Appendix A) is required for the Direct to Phase II proposal and is specified in **Volume 5**.

Volume 3: Cost Volume
Offerors must complete the cost volume using the Phase II OTA Cost Proposal template posted on the USSOCOM Portal at https://www.socom.mil/SOF-ATL/Pages/SBIR-21-2.aspx, and read instructions before completing it. 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.

VERSION 3

For the direct to Phase II topic in this announcement, the total price limit to provide a testable prototype is listed in table 1 titled "Consolidated SBIR Topic Information". **Any proposal submitted with a total price above the provided limit will not be considered for award.**

The final negotiated price of a USSOCOM Phase II SBIR contract will result from a determination of price fairness and reasonableness commensurate with the magnitude and complexity of the required research and development effort. The resulting agreement will be a firm priced agreement.

Proposal information should include the itemized listing (a-h) specified below. The proposal information must include a level of detail that would enable the Government personnel to determine the purpose, necessity, and reasonability of the proposal and show an understanding of the scope of the work. It is requested that a breakdown of labor hours per labor category and other associated costs be provided by task. The Agreements Officer may request additional information to support price analysis or understand the approach 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. The reason for the requirement and the intention of offeror on disposition of the special material / equipment shall be documented in the proposal as well as the reason on why said equipment is charge directly to the effort rather than in the indirect cost of the business.

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, and loaded rate to include all indirect costs. Identify key personnel by name if possible and labor category.

e. Travel: Travel costs must relate to the needs of the project. Proposed travel cost must be in accordance with the Federal Travel Regulation (FTR).

1. Per Diem Rates can be obtained at: http://www.gsa.gov/perdiem
2. The following information is documented –

   (i) Date (estimated), length and place (city, town, or other similar designation) of the trip;

   (ii) Purpose of the trip; and

   (iii) Number of personnel included in the estimate.

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/profit.

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 Agreements 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 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
CCR is required to be submitted with proposals in response to USSOCOM 21.2 SBIR topics. Please refer to the DoD 21.2 SBIR BAA for full details.

Volume 5: Supporting Documents
Include the Feasibility Study, section K and Slide deck in this volume.

Slide Deck: Potential Offerors shall submit a slide deck with the proposed technical solution not to exceed 15 PowerPoint slides. Must be separate and clearly marked. Any additional slides will not be evaluated, only slide 1-15 will be evaluated.

Feasibility Study: 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 this volume. 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 the feasibility assessment 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. There is no minimum or maximum page limitation for the Feasibility Appendix (Appendix A).

Section K: The proposal must also include a completed Section K which does not count toward the page limit and should be uploaded with this volume. The identification of foreign national involvement in a USSOCOM SBIR topic is required 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 3.7 entitled "Foreign Nationals" of the DoD SBIR 21.2 Announcement) to work on a USSOCOM ITAR topic must possess an export license to receive a SBIR Phase II contract.

Volume 6: Fraud, Waste and Abuse Training
Fraud, Waste and Abuse (FWA) training is required for Phase I and Direct to Phase II proposals. Please refer to the DoD 21.2 SBIR BAA for full details.

<u>Direct to Phase II Evaluations:</u>
The Government will evaluate only responsive proposals.

USSOCOM evaluates Direct to Phase II proposals using the evaluation criteria specified in section 7.4 of the DoD 21.2 SBIR Announcement with the following exceptions:

1. Proposals missing technical volume, feasibility appendix, cost volume, or slide deck will not be evaluated or those that exceed the maximum price allowed as per Table 1 of this instructions. Those proposals will be considered non-responsive.

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 of Phase I**. 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 7.4 of the DoD SBIR 21.2 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 7.4 of the DoD SBIR 21.2 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 technical evaluation team, using a virtual teleconference. This will be a **technical presentation** of the proposed solution and the key personnel listed in the proposal should be conducting the presentation and responding to the questions of the evaluation team. This presentation is NOT intended as for business development people but purely technical. The technical approach and key personnel knowledge involved in the project will be considered. All selected firms will be required to provide teleconference information for the presentation. This presentation will complete the panel's evaluation of the proposal against the criteria listed under Section 7.4 of the DoD SBIR 21.2 BAA. Notifications of selection/non-selection for Phase II award will be completed within a timely manner.

4. The Cost Volume (Volume 3) evaluation:

   For this direct to Phase II, the award amount is set at a not to exceed (NTE), a technical evaluation of the proposal cost will be completed to assess the probability of success to obtain a working prototype. Proposals above the set NTE for the effort will not be considered for award. The team will assess the technical approach presented for the effort based on the number of labor hours by labor categories, the key personnel level of involvement, materials, equipment, subcontractors and consultants (scope of work, expertise, participation and proposed effort), travel and other direct cost as proposed.

   The resulting award/s will be a fixed price OTA prototyping agreement and a successful prototype may lead to follow on production. Follow on production awards may be FAR based, Fixed Price or 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 USSOCOM 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. The Government will also notify the Offerors if their proposal is considered non-responsive (disqualified).

Informal Feedback:
A non-selected Offeror can make a written request to the Contracting Officer, within 30 calendar days of receipt of notification of non-selection, for informal feedback. The Contracting Officer will provide informal feedback after receipt of an Offeror's written request rather than a debriefing as specified in paragraph 4.10, entitled "Debriefing," of the DoD SBIR 21.2 Announcement.

USSOCOM SBIR Program Point of Contact:
Inquiries concerning the USSOCOM SBIR Program and these proposal preparation instructions should be addressed to sbir@socom.mil.

VERSION 3

USSOCOM 21.2 SBIR DIRECT TO PHASE II TOPIC INDEX

VERSION 3

SOCOM212-D003 TITLE: Stand-Off Precision Guided Weapon Program Cruise Missile

RT&L FOCUS AREA(S): Hypersonics; General Warfighting Requirements (GWR)

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 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: The objective of this topic is to develop an innovative long-range cruise missile that will fit in the Common Launch Tube (CLT) and have a threshold range of 200 NM and an objective range greater than 400NM.

DESCRIPTION: Design a long-range cruise missile incorporated into a Common Launch Tube (CLT) with a threshold range of 200 NM and an objective range greater than 400NM. This system will include, at threshold, an EO/IR seeker and as an objective incorporate a multi-mode seeker package able to acquire and/or reacquire targets in flight. At threshold it shall have a removable payload section that can accept 13lbs of warhead or other desired payload (objective of 37 lbs), compatibility with an X-Net radio, electric propulsion, and an INS/GPS (M-Code) capability.
Key attributes include the long range, data link connection to Situational Awareness Data Link (SADL) (threshold) and SADL/Link-16 (objective), resilient GPS/INS to work in a denied GPS environment, a sensor capable of identifying targets once over the target area, and a payload to effect the target.

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 (“Technology Readiness Level 3”) 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 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: This system could be used in a broad range of military applications where a long-range weapon must fit in small space.

REFERENCES:

1. SOCOM Replenishing Precision-Guided Weapon Stockpiles; https://www.nationaldefensemagazine.org/articles/2018/5/11/socom-replenishing-precision-guided-weapon-

stockpiles#:~:text=Dynetics%27%20standoff%20precision%2Dguided%20munition,systems%2C%20according%20to%20the%20company.&text=The%20kits%20will%20provide%20SOF,munitions%20and%20other%20weapon%20systems.

KEYWORDS: Extended Range; Weapons; Cruise Missile