AMENDMENT 2

DEPARTMENT OF DEFENSE
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SBIR 24.1 Program Broad Agency Announcement (BAA)

November 29, 2023: DoD BAA issued for pre-release
January 03, 2024: DoD begins accepting proposals
February 21, 2024: Deadline for receipt of proposals no later than **12:00 p.m. ET**

The purpose of Amendment 2 is to:

1. **Extend the deadline for proposal receipt to February 21, 2024 at 12:00 PM ET**

Participating DoD Components:

- Department of Navy (Navy)
- Department of Air Force (Air Force)
- Defense Health Agency (DHA)
- Defense Logistics Agency (DLA)
- Defense Microelectronics Activity (DMEA)
- Missile Defense Agency (MDA)

IMPORTANT

This BAA incorporates MANDATORY foreign disclosure requirements and other important programmatic changes as required by the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183). These updates can be found in sections 2.2, 2.5, 3.0, 4.2.e., 4.3, 6.0, 8.2, and Attachment 2. Proposals that do not include the fully completed and signed Attachment 2 of this BAA (labeled Version 2) in Volume 5 of the proposal submission will be deemed noncompliant and will not receive an evaluation. All small business concern/proposal identifying information and a response to every question on the form MUST be provided. Small business concerns are highly encouraged to review the full BAA to remain apprised of any additional recent programmatic changes.

Deadline for Receipt: Complete proposals must be certified and submitted in DSIP no later than **12:00 PM** ET on **February 21, 2024.** Proposals submitted after 12:00 p.m. ET 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. Proposing Small Business Concerns are required to register for a Login.gov account and link it to their DSIP account. See section 4.16 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 (BAA). The DoD SBIR/STTR Programs follow the policies and practices of the SBA SBIR/STTR Policy Directive, current version. 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 HERE.

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: Please refer to the DSIP Customer Support Document for general information regarding the DoD SBIR/STTR process in DSIP. For additional assistance with the DSIP application, please visit the Learning & Support section of the DSIP at https://www.dodsbirsttr.mil/submissions/learning-support/. Email DSIP Support at DoDSBIRSupport@reisystems.com only for further assistance with issues pertaining directly to the DSIP application. Questions submitted to DSIP Support 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 4.15 for further information on where to direct questions regarding instructions and topics in this BAA.**

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1.0 INTRODUCTION

Navy, Air Force, DHA, DLA, DMEA and MDA, hereafter referred to as DoD Components, invite proposing small business concerns to submit proposals under this BAA for the Small Business Innovation Research (SBIR) Program. Proposing Small Business Concerns 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 DLA are offering Direct to Phase II topics for this BAA – see the Component-specific instructions for more information.

A separate BAA will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All proposing small business concerns 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 proposing small business concern 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 proposing small business concern before the issuance of any award. Proposals must conform to the terms of this announcement.

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 Due Diligence Program to Assess Security Risks

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally funded award. The full text of the SBIR and STTR Extension Act of 2022 is available at https://www.congress.gov/117/plaws/publ183/PLAW-117publ183.pdf.

As previously stated, the DoD SBIR/STTR Programs follow the policies and practices of the Small Business Administration (SBA) SBIR/STTR Policy Directive. The Policy Directive was revised effective May 3, 2023, to incorporate requirements of the SBIR and STTR Extension Act of 2022. This revision is incorporated into this BAA, including the utilization of the Appendix III, Disclosure Questions, as Attachment 2 “Disclosures of Foreign Affiliations or Relationships to Foreign Countries”.

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Small business concerns must submit Attachment 2 "Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Version 2)" of this BAA in Volume 5 of the proposal submission. Previous versions of Attachment 2 or versions created by other Federal agencies will not be accepted. All small business concern identifying information requested in Attachment 2 must be provided and all questions must be answered. Attachment 2 must also be signed, certifying that information provided is accurate and complete. The Government may require the proposing small business concerns to provide additional information to assist the Government in evaluating the small business concerns' disclosures in Attachment 2.

Small business concerns who: 1) fail to submit Attachment 2 in Volume 5 of the proposal submission; 2) do not use Attachment 2, version 2, as provided in this BAA; 3) do not provide their complete identifying information or do not completely answer all questions in Attachment 2; 4) fail to provide the Government additional information regarding Attachment 2 when requested; or, 5) fail to sign Attachment 2, **will be deemed noncompliant and will not receive an evaluation of their proposal**.

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the Department of Defense will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The Department will use information provided by the small business concern in in response to the Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2) and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the financial ties and obligations (which shall include surety, equity, and debt obligations) of the small business concern and employees of the small business concern to a foreign country, foreign person, or foreign entity. The Department will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13).

DoD has partnered with Project Spectrum to provide an online course on Understanding Foreign Ownership, Control, or Influence (FOCI). This course defines FOCI, explains what it means to be under FOCI, and details FOCI's effect on a company seeking initial or continued eligibility for access to a federally funded award. Small business concerns can register and access this course by following the instructions below:

1. Go to projectspectrum.io
2. Click "Profile/Dashboard" in the top right and then click "Sign Up" from the dropdown menu.
3. Follow the instructions to sign up for an account. Descriptions of the account types are provided below each option.
4. Verify your email by entering the code sent to the email address you provided when signing up.
5. Log in to Project Spectrum by clicking "Profile/Dashboard > Login" in the top right.
6. Find the Training Course on "Understanding Foreign Ownership, Control, or Influence (FOCI)" by clicking "Courses > Training Courses"
7. Copy the provided password.
8. Click on the course and log in to Encite.io using your email address and the copied password.
9. Enroll in the course and click "Enter" to begin.

For assistance with registration or access to the Project Spectrum website, please contact support@projectspectrum.io.

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2.3 OUSD(R&E) Critical Technology Areas

Although each DoD Component develops SBIR and STTR topics that are mission-oriented to their programs, topics generally align with the OUSD(R&E) Critical Technology Areas. While many technologies may cross between these categories, these areas represent the broad and different approaches that are required to advance technologies crucial to the Department. By focusing efforts and investments into these critical technology areas, the Department will accelerate transitioning key capabilities to the Military Services and Combatant Commands.

OUSD(R&E) Critical Technology Areas:

- FutureG
- Trusted AI and Autonomy
- Biotechnology
- Advanced Computing and Software
- Integrated Sensing and Cyber
- Directed Energy (DE)
- Hypersonics
- Microelectronics
- Integrated Network Systems-of-Systems
- Quantum Science
- Space Technology
- Renewable Energy Generation and Storage
- Advanced Materials
- Human-Machine Interfaces

Below are additional technology areas supporting DoD Component-specific mission-critical areas:

- Advanced Infrastructure & Advanced Manufacturing
- Combat Casualty Care
- Emerging Threat Reduction
- Military Infectious Diseases
- Military Operational Medicine
- Mission Readiness & Disaster Preparedness
- Nuclear
- Sustainment & Logistics

Full descriptions of the above technology areas can be reviewed here: https://media.defense.gov/2023/Mar/21/2003183351/-1/-1/1/OUSDRE_SBIR_STTR_CRITICAL_TECH_AREAS.PDF.

2.4 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. Proposing small business concerns 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 proposing small business concerns based on 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.

2.5 Program on Innovation Open Topics

Section 7 of the SBIR and STTR Extension Act of 2022 requires the Department of Defense to establish innovation open topic activities in order to—

(A) increase the transition of commercial technology to the Department of Defense;
(B) expand the small business nontraditional industrial base;
(C) increase commercialization derived from investments of the Department of Defense; and

(D) expand the ability for qualifying small business concerns to propose technology solutions to meet the needs of the Department of Defense.

Unlike conventional topics, which specify the desired technical objective and output, open topics can use generalized mission requirements or specific technology areas to adapt commercial products or solutions to close capability gaps, improve performance, or provide technological advancements in existing capabilities.

A small business concern may only submit one (1) proposal to each open topic. If more than one proposal from a small business concern is received for a single open topic, only the most recent proposal to be certified and submitted prior to the submission deadline will receive an evaluation. All prior proposals submitted by the small business concern for the same open topic will be marked as nonresponsive and will not receive an evaluation.

Open topics released under this BAA will be clearly identified as such in the title and objective of the topic. Proposal preparation instructions for open topics may vary significantly across DoD Components. Proposing small business concerns are advised to carefully read and follow all instructions from the DoD Component for the open topic of interest. Unless specifically noted in the Component instructions, all requirements outlined in this BAA remain in effect for open topics.

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.

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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 small business concern.

Covered Individual

An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research and development (R&D) project proposed to be carried out with a Federally funded award from DoD. DoD has further designated covered individuals as including all proposed key personnel.

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.

Federally Funded Award

A Phase I, Phase II (including Direct to Phase II, sequential Phase II/subsequent Phase II and cross-agency Phase II), or Phase III SBIR or STTR award made using a funding agreement.

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Foreign Affiliation

As defined in 15 U.S.C. § 638(e)(16), foreign affiliation means a funded or unfunded academic, professional, or institutional appointment or position with a foreign government or government-owned entity, whether full-time, part-time, or voluntary (including adjunct, visiting, or honorary). This includes appointments or positions deemed adjunct, visiting, or honorary with research institutions located in a foreign country of concern.

Foreign Country of Concern

As defined in 15 U.S.C. § 638(e)(17), foreign country of concern means the People's Republic of China, the Democratic People's Republic of Korea, the Russian Federation, the Islamic Republic of Iran, or any other country determined to be a country of concern by the Secretary of State.

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 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 contracts and other transaction authority (OTA) agreements 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).

Malign Foreign Talent Recruitment Program

As defined in 42 U.S.C § 19237, the term "malign foreign talent recruitment program" means-

(A) any program, position, or activity that includes compensation in the form of cash, in-kind compensation, including research funding, promised future compensation, complimentary foreign travel, things of non de minimis value, honorific titles, career advancement opportunities, or other types of remuneration or consideration directly provided by a foreign country at any level (national, provincial, or local) or their designee, or an entity based in, funded by, or affiliated with a foreign country, whether or not directly sponsored by the foreign country, to the targeted individual, whether directly or indirectly stated in the arrangement, contract, or other documentation at issue, in exchange for the individual-

(i) engaging in the unauthorized transfer of intellectual property, materials, data products, or other nonpublic information owned by a United States entity or developed with a Federal research and development award to the government of a foreign country or an entity based in, funded by, or affiliated with a foreign country regardless of whether that government or entity provided support for the development of the intellectual property, materials, or data products;

(ii) being required to recruit trainees or researchers to enroll in such program, position, or activity;

(iii) establishing a laboratory or company, accepting a faculty position, or undertaking any other employment or appointment in a foreign country or with an entity based in, funded by, or affiliated with a foreign country if such activities are in violation of the standard terms and conditions of a Federal research and development award;

(iv) being unable to terminate the foreign talent recruitment program contract or agreement except in extraordinary circumstances;

(v) through funding or effort related to the foreign talent recruitment program, being limited in the capacity to carry out a research and development award or required to engage in work that would result in substantial overlap or duplication with a Federal research and development award;

(vi) being required to apply for and successfully receive funding from the sponsoring foreign government's funding agencies with the sponsoring foreign organization as the recipient;

(vii) being required to omit acknowledgment of the recipient institution with which the individual is affiliated, or the Federal research agency sponsoring the research and development award, contrary to the institutional policies or standard terms and conditions of the Federal research and development award;

(viii) being required to not disclose to the Federal research agency or employing institution the participation of such individual in such program, position, or activity; or

(ix) having a conflict of interest or conflict of commitment contrary to the standard terms and conditions of the Federal research and development award; and

(B) a program that is sponsored by-

(i) a foreign country of concern or an entity based in a foreign country of concern, whether or not directly sponsored by the foreign country of concern;

(ii) an academic institution on the list developed under section 1286(c)(8) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232) ; or

(iii) a foreign talent recruitment program on the list developed under section 1286(c)(9) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232).

Performance Benchmark Requirements

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.

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) amended the application of these benchmarks for more experienced firms. Detailed information on benchmark calculations and increased performance standards for more experienced firms can be found at https://www.sbir.gov/performance-benchmarks.

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Personal Conflict of Interest

A situation in which an individual has a financial interest, personal activity, or relationship that could impair the employee's ability to act impartially and in the best interest of the Government when performing under the contract. (A de minimis interest that would not "impair the employee's ability to act impartially and in the best interest of the Government" is not covered under this definition.)

Among the sources of personal conflicts of interest are-
(i) Financial interests of the covered employee, of close family members, or of other members of the covered employee's household;
(ii) Other employment or financial relationships (including seeking or negotiating for prospective employment or business); and
(iii) Gifts, including travel.

Financial interests referred to in paragraph (1) of this definition may arise from-
(i) Compensation, including wages, salaries, commissions, professional fees, or fees for business referrals;
(ii) Consulting relationships (including commercial and professional consulting and service arrangements, scientific and technical advisory board memberships, or serving as an expert witness in litigation);
(iii) Services provided in exchange for honorariums or travel expense reimbursements;
(iv) Research funding or other forms of research support;
(v) Investment in the form of stock or bond ownership or partnership interest (excluding diversified mutual fund investments);
(vi) Real estate investments;
(vii) Patents, copyrights, and other intellectual property interests; or
(viii) Business ownership and investment interests.

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 proposing small business concern 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 proposing small business concern 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 any information that a small business concern considers to be non-public information that is owned by the small business concern and is marked accordingly.

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. Proposing small business concerns 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 small business concern 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**.

a. 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 the SBIR program with respect to such project. DoD does not guarantee Direct to Phase II opportunities will be offered in future BAAs.

Each eligible topic requires that proposing small business concerns provide documentation to demonstrate feasibility described in the Phase I section of the topic has been met. **Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.** Work submitted within the feasibility documentation must have been substantially performed by the proposing small business concern and/or the PI. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposing small business concern must either own the IP or must have obtained license rights to such technology prior to proposal submission, to enable it and its subcontractors to legally carry out the proposed work.

If the proposing small business concern fails to demonstrate technical merit and feasibility equivalent to the Phase I level as described in the associated topic, the related Phase II proposal will not be accepted or evaluated, in accordance with the Component-specific Direct to Phase II instructions.

Please refer to the Component-specific Direct to Phase II instructions for full details regarding Component Direct to Phase II processes and proposal preparation requirements.

4.2 Proposing Small Business Concern Eligibility and Performance Requirements

a. Each proposing small business concern 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). Proposing small business concern must meet eligibility requirements for Small Business Ownership and Control (see 13 CFR § 121.702).
b. A minimum of two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing small business concern. For Phase II, a minimum of one-half (50%) of the research and/or analytical work must be performed by the proposing small business concern. The percentage of work is measured by both direct and indirect costs. Occasionally, deviations from these SBIR requirements may occur, and must be approved in writing by the Funding Agreement officer after consultation with the agency SBIR/STTR program manager/coordinator. For more information on the percentage of work calculation during proposal submission, refer to section 5.3.
c. For both Phase I and II, the primary employment of the principal investigator must be with the proposing small business concern 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**. Proposing small business concern with prior SBIR/STTR awards must meet two performance benchmark requirements as determined by the Small Business Administration (SBA) on June 1 each year.
   (1) Phase I to Phase II Transition Rate: For all proposing small business concerns 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 proposing small business concerns with greater than 15 Phase II awards over the last 10 fiscal years excluding the last two years, the proposing small business concern 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.

   The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) amended the application of these benchmarks for more experienced firms. Detailed information on benchmark calculations, increased performance standards for more experienced firms and consequence of failure to meet benchmarks can be found at https://www.sbir.gov/performance-benchmarks.

   As defined by the SBIR/STTR Policy Directive, Department of the Army, Department of the Navy, and Department of the Air Force each constitute its own Federal agency, and the remaining

DoD Components fall under the executive agency of the Department of Defense. Companies that fail to meet either of the benchmarks under the Increased Performance Standards for more Experienced Firms may not receive more than an overall total of 80 awards from DoD, as detailed in the breakdown below:

Army – 20 total Phase I and Direct to Phase II awards
Navy – 20 total Phase I and Direct to Phase II awards
Air Force – 20 total Phase I and Direct to Phase II awards
All other DoD Components - 20 Phase I and Direct to Phase II awards, combined

4.3 Disclosures Regarding Ties to People's Republic of China and Other Foreign Countries

Each proposing small business concern is required to submit Attachment 2 "Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Version 2)" of this BAA in Volume 5 of the proposal submission. Previous versions of Attachment 2 or versions created by other Federal agencies will not be accepted. All small business concern identifying information requested in Attachment 2 must be provided and all questions must be answered. Attachment 2 must also be signed, certifying that information provided is accurate and complete. The Government may require the proposing small business concerns to provide additional information to assist the Government in evaluating the small business concerns' disclosures in Attachment 2.

Small business concerns who: 1) fail to submit Attachment 2 in Volume 5 of the proposal submission; 2) do not use Attachment 2, version 2, as provided in this BAA; 3) do not provide their complete identifying information or do not completely answer all questions in Attachment 2; 4) fail to provide the Government additional information regarding Attachment 2 when requested; or, 5) fail to sign Attachment 2, **will be deemed noncompliant and will not receive an evaluation of their proposal**.

The disclosure requires the following information:

(A) the identity of all owners and covered individuals of the small business concern who are a party to any foreign talent recruitment program of any foreign country of concern, including the People's Republic of China;
(B) the existence of any joint venture or subsidiary of the small business concern that is based in, funded by, or has a foreign affiliation with any foreign country of concern, including the People's Republic of China;
(C) any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity;
(D) whether the small business concern is wholly owned in the People's Republic of China or another foreign country of concern;
(E) the percentage, if any, of venture capital or institutional investment by an entity that has a general partner or individual holding a leadership role in such entity who has a foreign affiliation with any foreign country of concern, including the People's Republic of China;
(F) any technology licensing or intellectual property sales to a foreign country of concern, including the People's Republic of China, during the five-year period preceding submission of the proposal; and
(G) any foreign entity, offshore entity, or entity outside the United States related to the small business concern.

After reviewing the above listed disclosures of the proposing small business concern, and if determined appropriate by the DoD, the Department may ask the small business concern may to provide true copies of any contractual or financial obligation or other agreement specific to a business arrangement or joint-venture like arrangement with an enterprise owned by a foreign state or any foreign entity in effect during the five-year period preceding submission of the proposal with respect to which the small business concern made the disclosures.

4.4 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. Proposing small business concern must disclose joint ventures with existing (or planned) relationships/partnerships with any foreign entity or any foreign government-controlled companies.

A small business joint venture entity must submit, with its proposal, the representation required in paragraph (c) of FAR solicitation provision 52.212-3, Offeror Representations and Certifications-Commercial Products and Commercial Services, and paragraph (c) of FAR solicitation provision 52.219-1, Small Business Program Representations, in accordance with 52.204-8(d) and 52.212-3(b) for the following categories:

(A) Small business;
(B) Service-disabled veteran-owned small business;
(C) Women-owned small business (WOSB) under the WOSB Program;
(D) Economically disadvantaged women-owned small business under the WOSB Program; or
(E) Historically underutilized business zone small business.

These representations can be found as Attachment 3 to this BAA and must be uploaded to Volume 5, Supporting Documents of the proposal submission in DSIP, if applicable.

4.5 Majority Ownership in Part by Multiple Venture Capital, Hedge Fund, and Private Equity Firms

Unless otherwise noted in the participating Component instructions, proposing small business concerns 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 proposing small business concern 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 proposing small business concern, whether such equity stake is directly or indirectly held. The proposing small business concern 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.

4.6 Conflicts of Interest

Contract awards to proposing small business concern 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.

4.7 Organizational Conflicts of Interest (OCI)

FAR 9.5 Requirements
In accordance with FAR 9.5, proposing small business concerns are required to identify and disclose all facts relevant to potential OCIs involving the proposing small business concern's organization and any

proposed team member (sub-awardee, consultant). Under this Section, the proposing small business concern is responsible for providing this disclosure with each proposal submitted to the BAA. The disclosure must include the proposing small business concern's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposing small business concern has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposing small business concern's judgment and to prevent the proposing small business concern 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. As part of the FAR 9.5 disclosure requirement above, a proposing small business concern must affirm whether the proposing small business concern or any proposed team member (sub-awardee, consultant) is providing SETA, A&AS, or similar support to any DoD Component office(s) under: (a) a current award or sub-award; or (b) a past award or sub-award 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 (sub-awardee, 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 proposing small business concerns to provide additional information to assist the Government in evaluating the proposing small business concern'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.

4.8 Classified Proposals

Classified proposals will not be accepted under the DoD SBIR Program. If topics will require classified work during Phase II, the proposing small business concern 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 Counterintelligence and Security Agency (DCSA) website at: https://www.dcsa.mil/mc/ctp/fc/.

4.9 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. proposing small business concerns 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.**

4.10 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.

4.11 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.

4.12 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.

4.13 Pre-Award and Post Award BAA Protests

Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Protests exclusively related to the terms of this BAA must be served to:
osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil

For the purposes of a protest related to a particular topic selection, non-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 proposing small business concern may also be made to the Small Business Administration.

Size protests regarding the small business status of a selected proposing small business concern may be made to the Small Business Administration in accordance with the procedures in FAR § 19.302.

4.14 Phase I Award Information

All Phase I proposals will be evaluated and judged on a competitive basis in terms of technical capability and technical value. Proposals will be initially screened to determine responsiveness to the topic objective. Proposals passing this initial screening will be technically evaluated by engineers or scientists to determine the most promising technical and scientific approaches. As a common statement of work does not exist, each proposal will be assessed on the merit of the approach in achieving the technical objectives established in the topic. DoD is under no obligation to fund any proposal or any specific number of proposals in each 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 negotiation and possible 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 proposing small business concerns 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 important for proposing small business concerns to review Component-specific instructions regarding award size.

d. **Timing**. Proposing small business concerns 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. 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 information in this section is applicable to Phase I proposals only. If the Component is participating in the **Direct to Phase II Program**, refer to the Component-specific Direct to Phase II instructions for award information.

4.15 Questions about this BAA and BAA Topics

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

(1) **DSIP Support**:
Email DSIP Support at DoDSBIRSupport@reisystems.com only for assistance with using the DSIP application. Questions regarding DSIP can be emailed to DSIP Support 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). Please include information on your small business concern, a proposal number (if applicable), and screenshots of any pertinent errors or issues encountered.

DSIP Support 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. Proposing small business concerns 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://www.defensesbirsttr.mil/, which provides the following resources:

- Customer Support Information
- 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.** Questions pertaining to a particular DoD Component or the Component-specific BAA instructions should be submitted in accordance with the instructions given at the beginning of that Component's topics.

c. **Direct Contact with Topic Authors**. From **November 29, 2023 – January 03, 2024,** 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 small business concerns 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 small business concerns 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 **January 03, 2024,** no further direct contact between proposing small business concerns and topic authors is allowed unless the Topic Author is responding to a question submitted during the pre-release period. Proposing small business concerns 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 small business concerns 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 **November 29, 2023**, and closes to new questions on **January 24, 2023**, **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.

AMENDMENT 2

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

4.16 Registrations and Certifications

Individuals from proposing small business concerns must be registered in the Defense SBIR/STTR Innovation Portal (DSIP) in order to prepare and submit proposals. **The DSIP application is only accessible from within the United States, which is defined as 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.** All users are required to have an individual user account to access DSIP. As DSIP user accounts are authenticated by Login.gov, all users, who do not already have a Login.gov account, will be required to create one. 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, can be accessed here: https://www.dodsbirsttr.mil/submissions/learning-support/training-materials.

Be advised that the sharing of accounts and passwords is a violation of the Terms of Use for Login.gov and DoD policy.

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 UEI or 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 UEI or 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 UEI or 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.

Users should complete their account registrations as soon as possible to avoid any delays in proposal submissions.

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit www.sam.gov. A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its representations and certifications are up to date to avoid delay in award.

The Federal Government will use the Unique Entity ID (SAM) to identify organizations doing business with the Government. The DUNS number will no longer be a valid identifier. If the proposing small business concern has an entity registration in SAM.gov (even if the registration has expired), a UEI (SAM) has already been assigned. This can be found by signing into SAM.gov and selecting the Entity Management widget in the Workspace or by signing in and searching entity information. **For proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the small business concern profile with the UEI (SAM) as soon as possible.**

For new proposing small business concern registrations, follow instructions during SAM registration on how to obtain a Commercial and Government Entry (CAGE) code and be assigned the UEI (SAM). Once a CAGE code and UEI (SAM) are obtained, update the proposing small business concern's profile on the 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 proposing small business concerns at time of award and during the award life cycle. Each proposing small business concern must provide this additional information at the time of the Phase I and Phase II award, prior to final payment on the Phase I award, prior to receiving 50% of the total award amount for a Phase II award, and prior to final payment on the Phase II award.

4.17 Promotional Materials

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

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

IMPORTANT -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work (see Section 3) for consideration under numerous federal program BAAs or solicitations, it is unlawful to enter negotiation for 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 5.3.c(11).

4.19 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 https://www.dodig.mil/Components/Administrative-Investigations/DoD-Hotline/Hotline-Complaint/ to submit a complaint. Mailed correspondence should be addressed to the Defense Hotline, The Pentagon, Washington, DC 20301-1900, or e-mail addressed to hotline@dodig.mil.

4.20 State and Other Assistance Available

Many states have established programs to provide services to those proposing small business concerns 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 business concerns may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States.

4.21 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. The proposing small business concerns 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. Proposing small business concerns are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through this site for the first time will be asked to register. It is recommended that proposing small business concerns register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process.

This information in this section is applicable to Phase I proposals only. If 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. A completed proposal submission in DSIP does NOT indicate that each proposal volume has been completed in accordance with the Component-specific instructions. Accordingly, it is the proposing small business concern's responsibility to consult the Component-specific instructions for detailed guidance, including required proposal documentation and structure, 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
- Volume 5: Supporting Documents
    - a. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1) MANDATORY
    - b. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2) MANDATORY
    - c. Verification of Eligibility of Small Business Joint Ventures (Attachment 3), if applicable

d. Disclosure of Funding Sources (Attachment 4) MANDATORY
e. Other supporting documentation (Refer to Component-specific instructions for additional Volume 5 requirements)

A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.

Volume 6: Fraud, Waste and Abuse Training

All proposing small business concerns **must** complete the following:

- Volume 4: Company Commercialization Report (upload of CCR from SBIR.gov to DSIP is required for proposing small business concerns with prior Federal SBIR or STTR awards)
- Volume 5(a): Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
- Volume 5(b): Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
- Volume 5(c): Disclosure of Funding Sources (Attachment 4)
- Volume 6: Fraud, Waste and Abuse training.

DO NOT lock, password protect, or encrypt any files uploaded to DSIP.

Refer to Section 5.3 below for full details on these proposal requirements.

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 proposing small business concern 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 negotiation and possible award, the DoD Component program will contact the proposing small business concern for signatures prior to award.

5.2 Marking Proprietary Proposal Information

Proposing small business concerns 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 proposing small business concern 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 that describes the proposed R&D project and a discussion of anticipated benefits and potential commercial applications. Each section should be no more than 200 words. **Do not include proprietary or classified information in the Proposal Cover Sheet**. If your proposal is selected for negotiation and possible 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.

Effective January 2023, the amounts listed in the Percentage of Work (POW) certification question on the Proposal Cover Sheet are derived from information entered by the proposing small business concern in the Cost Volume (Volume 3). Details on the calculation can be viewed in DSIP during proposal submission.

If the POW calculations fall below eligibility requirements, a letter of explanation or approval by the Funding Agreement officer must be uploaded to the certification question to complete the submission. Some DoD Components will not accept any deviations from the POW minimum requirements. Please refer to the Component instructions regarding acceptance of deviations to the POW requirements.

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 small business concern'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 proposing small business concern 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 <u>in the order given below</u>:

(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. If 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 the proper approvals have been obtained (see Sections 4.9 - 4.11). **Small Business Concerns 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 small business concern, 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 proposing small business concern'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 proposing small business concern'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 proposing small business concern 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. Proposing small business concerns 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. The proposal may be deemed nonresponsive if the requested information is not provided. The proposing small business concerns should report 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 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 to the same level of detail as the prime contractor costs. 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 small business concern, 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, proposing small business concerns 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 may not apply to the proposed project. There is no need to provide information on each individual 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; 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 negotiation and possible 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 https://www.dcaa.mil/Guidance/Audit-Process-Overview/.

e. **Company Commercialization Report (Volume 4)**

The Company Commercialization Report (CCR) allows companies to report funding outcomes resulting from prior SBIR and STTR awards. SBIR and STTR awardees are required by SBA to update and maintain their organization's CCR on SBIR.gov. Commercialization information is required upon completion of the last deliverable under the funding agreement. Thereafter, SBIR and STTR awardees are requested to voluntarily update the information in the database annually for a minimum period of 5 years.

The proposing small business concern has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, regardless of whether the project has any commercialization to date, a PDF of the CCR must be downloaded from SBIR.gov and uploaded to the Firm Forms section of DSIP by the Firm Admin. Firm Forms are completed by the DSIP Firm Admin and are applied across all proposals the proposing small business concern submits. The DSIP CCR requirement is fulfilled by completing the following:

1. Log into the firm account at https://www.sbir.gov/.
2. Navigate to My Dashboard > My Documents to view or print the information currently contained in the Company Registry Commercialization Report.
3. Create or update the commercialization record, from the company dashboard, by scrolling to the "My Commercialization" section, and clicking 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. **Ensure the report is certified and submitted.**
4. Click the "Company Commercialization Report" PDF under the My Documents section of the dashboard to download a PDF of the CCR.
5. Upload the PDF of the CCR (downloaded from SBIR.gov in previous step) to the Company Commercialization Report in the Firm Forms section of DSIP. This upload action must be completed by the Firm Admin.

This version of the CCR, uploaded to DSIP from SBIR.gov, is inserted into all proposal submissions as Volume 4.

During proposal submission, the proposing small business concern will be prompted with the question: “Do you have a new or revised Company Commercialization Report to upload?”. There are three possible courses of action:

a. If the proposing small business concern has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards and **DOES have a new or revised CCR from SBIR.gov to upload to DSIP**, select YES.
    - If the user is the Firm Admin, they can upload the PDF of the CCR from SBIR.gov directly on this page. It will also be updated in the Firm Forms and be associated with all new or in-progress proposals submitted by the proposing small business concern. If the user is not the Firm Admin, they will receive a message that they do not have access and must contact the Firm Admin to complete this action.
    - **<u>WARNING:</u>** Uploading a new CCR under the Firm Forms 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 small business concern 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 small business concerns will have to recertify and resubmit such proposals. If a proposing small business concern does not recertify or resubmit such proposals, they will not be considered fully submitted and will not be evaluated.

b. If the proposing small business concern has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, and **DOES NOT have a new or revised CCR from SBIR.gov to upload to DSIP**, select NO.
    - If a prior CCR was uploaded to the Firm Forms, the proposing small business concern will see a file dialog box at the bottom of the page and can view the previously uploaded CCR. This read-only access allows the proposing small business concern to confirm that the CCR has been uploaded by the Firm Admin.
    - If no file dialog box is present at the bottom of the page that is an indication that **there is no previously uploaded CCR in the DSIP Firm Forms**. To fulfill the DSIP CCR requirement the Firm Admin must follow steps 1-5 listed above to download a PDF of the CCR from SBIR.gov and upload it to the DSIP Firm Forms to be included with all proposal submissions.

c. If the proposing small business concern has **NO** prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, the upload of the CCR from SBIR.gov is not required and small business concern will select NO. The CCR section of the proposal will be marked complete.

While all proposing small business concerns with prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards must report funding outcomes resulting from these awards through the CCR from SBIR.gov and upload a copy of this report to their Firm Forms in DSIP, **please refer to the Component-specific instructions for details on how this information will be considered during proposal evaluations.**

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

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

All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
3. Disclosure of Funding Sources (Attachment 4)

A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.

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. Verification of Eligibility of Small Business Joint Ventures (Attachment 3)
8. Other

g. **Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or 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 Defense Federal Acquisition Regulation Supplement (DFARS) provisions 252.204-7016, 252.204-7017, and clause 252.204-7018, executed by the proposing small business concern's authorized proposing small business concern representative. The DFARS provisions and clause may be found in BAA Attachment 1. **These certifications must be signed by the authorized proposing small business concern 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 the proposing small business concern and any contractors that may be proposed as a part of the submission including research partners and suppliers. The proposing small business concerns 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.

AMENDMENT 2

h. **Disclosures of Foreign Affiliations or Relationships to Foreign Countries**

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022 and the SBA SBIR/STTR Policy Directive, the Department of Defense will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award.

Small business concerns must submit Attachment 2 "Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Version 2)" of this BAA in Volume 5 of the proposal submission. Previous versions of Attachment 2 or versions created by other Federal agencies will not be accepted. All small business concern identifying information requested in Attachment 2 must be provided and all questions must be answered. Attachment 2 must also be signed, certifying that information provided is accurate and complete. The Government may require the proposing small business concerns to provide additional information to assist the Government in evaluating the small business concerns' disclosures in Attachment 2.

Small business concerns who: 1) fail to submit Attachment 2 in Volume 5 of the proposal submission; 2) do not use Attachment 2, version 2, as provided in this BAA; 3) do not provide their complete identifying information or do not completely answer all questions in Attachment 2; 4) fail to provide the Government additional information regarding Attachment 2 when requested; or, 5) fail to sign Attachment 2, **will be deemed noncompliant and will not receive an evaluation of their proposal**. DO NOT lock, password protect or encrypt the form when uploading to Volume 5 in DSIP.

For additional details, please refer to Section 2.2 and 4.3.

i. **Certification Regarding Disclosure of Funding Sources**

The proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, which requires that covered individuals:

(A) disclose the amount, type, and source of all current and pending research support received by, or expected to be received by, the individual as of the time of the disclosure;
(B) certify that the disclosure is current, accurate, and complete; and
(C) agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award

Small business concerns must also certify that each covered individual who is employed by the small business and listed on the proposal has been made aware of the requirements listed above. **The disclosure and certification must be made by completing Attachment 4 of this BAA and uploading to Volume 5, Supporting Documents of the proposal submission in DSIP.**

j. **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 small business concern. 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 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 proposing small business concern.

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 a determination of the overall technical value of each proposal and an evaluation of the cost volume, with the appropriate method of analysis given the contract type to be awarded, for selection of the proposal(s) most advantageous 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 proposing small business concern 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.

Denial of Awards
The DoD will not make an award under the SBIR program if it determines that—
(A) the small business concern submitting the proposal –
- (i) has an owner or covered individual that is party to a malign foreign talent recruitment program;
- (ii) has a business entity, parent company, or subsidiary located in the People's Republic of China or another foreign country of concern; or
- (iii) has an owner or covered individual that has a foreign affiliation with a foreign entity located in the People's Republic of China or another foreign country of concern; and

(B) the relationships and commitments described in clauses (i) through (iii) of subparagraph (A)—
- (i) interfere with the capacity for activities supported by the DoD to be carried out;
- (ii) create duplication with activities supported by the DoD;
- (iii) present concerns about conflicts of interest;
- (iv) were not appropriately disclosed to the DoD;
- (v) violate Federal law or terms and conditions of contracts or other agreements awarded by the DoD; or
- (vi) pose a risk to national security.

AMENDMENT 2

7.0 PHASE II PROPOSAL INFORMATION

7.1 Introduction

Unless the Component is participating in 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 negotiation for 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 proposing small business concern 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 proposing small business concern 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 proposing small business concern contain marketing expertise and, if not, how will that expertise be brought into the small business concern?
(5) Who are the proposing small business concern'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 proposing small business concern 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

To reduce risk to the small business and avoid potential contracting delays, 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 https://www.dcaa.mil/Guidance/Audit-Process-Overview/ and https://www.dcaa.mil/Checklists-Tools/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 proposing small business concern 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 DoD SBIR/STTR Program 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.

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

8.0 CONTRACTUAL REQUIREMENTS

8.1 Additional Contract Requirements

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of Government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulation that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. 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 (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 22.2803.

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. 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 small business concern receiving an SBIR/STTR award is required to provide adequate cybersecurity on all covered contractor information systems. Specific security requirements and cyber incident reporting requirements are listed in DFARS 252.204.7012. To learn about cybersecurity resources for your SBIR/STTR contract visit the Blue Cyber webpage: https://www.safcn.af.mil/CISO/Small-Business-Cybersecurity-Information/.

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. **Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.** In accordance with DFARS Subpart 204.21, DFARS provisions 252.204-7016, 252.204-7017, and clause 252.204-7018 are incorporated into this solicitation. This subpart implements section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) and section 889(a)(1)(A) of the National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232). Full text of the provisions and clause and required offeror representations can be found in Attachment 1 of this BAA.

8.2 Agency Recovery Authority and Ongoing Reporting

In accordance with Section 5 of the SBIR and STTR Extension Act of 2022, the DoD will –

1) require a small business concern receiving an award under its SBIR program to repay all amounts received from the Federal agency under the award if—
   (A) the small business concern makes a material misstatement that the Federal agency determines poses a risk to national security; or
   (B) there is a change in ownership, change to entity structure, or other substantial change in circumstances of the small business concern that the Federal agency determines poses a risk to national security; and
2) require a small business concern receiving an award under its SBIR program to regularly report to the Federal agency and the Administration throughout the duration of the award on—
   (A) any change to a disclosure required under subparagraphs (A) through (G) of section 4.3 above;
   (B) any material misstatement made under section 8.2 paragraph (A) above; and
   (C) any change described in section 8.2 paragraph (B) above.

8.3 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 (NOV 2021)

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

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

(2) *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 websites) or simple transactional information, such as necessary to process payments.

(3) *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).

(4) *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).

(5) *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 products or commercial services, 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.

(End of clause)

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

DFARS 252.225-7055, Representation Regarding Business Operations with the Maduro Regime, is incorporated into this solicitation. In accordance with section 890 of the National Defense Authorization Act for Fiscal Year 2020 (Pub. L. 116-92), DoD is prohibited from 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 the person has a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

8.5 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.

8.6 Patents

Small business concerns 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 U.S.C. § 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 Section 8.7, Invention Reporting.

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 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 Government Purpose 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 proposing small business concern 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, at the end of the technical volume. The contract cannot be awarded until assertions have been approved.

8.9 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 are available 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 proposing small business concern in its Phase II proposal to report Phase I progress may also be used in the final report.

   (2) For each unclassified report, the proposing small business concern 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 proposing small business concern'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.

AMENDMENT 2

ATTACHMENT 1

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

Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
(DFARS SUBPART 204.21)

Contractor's Name	
Small Business Concern 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.

DFARS PROVISIONS INCORPORATED IN FULL TEXT:

252.204-7016 Covered Defense Telecommunications Equipment or Services—Representation

COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES—REPRESENTATION (DEC 2019)

(a) *Definitions*. As used in this provision, "covered defense telecommunications equipment or services" has the meaning provided in the clause 252.204-7018 , Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services.

(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 defense telecommunications equipment or services".

(c) *Representation*. The Offeror represents that it ☐ does, ☐ does not provide covered defense 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.

252.204-7017 Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services—Representation

PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES—REPRESENTATION (MAY 2021)

*The Offeror is not required to complete the representation in this provision if the Offeror has represented in the provision at 252.204-7016 , Covered Defense Telecommunications Equipment or Services—Representation, that it "**does not** provide covered defense 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."*

(a) *Definitions*. "Covered defense telecommunications equipment or services," "covered mission," "critical technology," and "substantial or essential component," as used in this provision, have the meanings given in the 252.204-7018 clause, Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services, of this solicitation.

(b) *Prohibition*. Section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) prohibits agencies from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

(c) *Procedures*. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

Representation. If in its annual representations and certifications in SAM the Offeror has represented in paragraph (c) of the provision at 252.204-7016 , Covered Defense Telecommunications Equipment or Services—Representation, that it "does" provide covered defense 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, then the Offeror shall complete the following additional representation:

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The Offeror represents that it ☐will ☐will not provide covered defense telecommunications equipment or services as a part of its offered products or services to DoD in the performance of any award resulting from this solicitation.

(e) *Disclosures*. If the Offeror has represented in paragraph (d) of this provision that it “will provide covered defense telecommunications equipment or services,” the Offeror shall provide the following information as part of the offer:

(1) A description of all covered defense telecommunications equipment and services offered (include brand or manufacturer; product, such as model number, original equipment manufacturer (OEM) number, manufacturer part number, or wholesaler number; and item description, as applicable).

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

(3) For services, the entity providing the covered defense telecommunications services (include entity name, unique entity identifier, and Commercial and Government Entity (CAGE) code, if known).

(4) For equipment, the entity that produced or provided the covered defense telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the OEM or a distributor, if known).

(End of provision)

252.204-7018 Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services

PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES (JAN 2021)

Definitions. As used in this clause—

“Covered defense 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) Telecommunications services provided by such entities or using such equipment; or

(3) Telecommunications equipment or services produced or provided by an entity that the Secretary of Defense reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

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"Covered foreign country" means—

(1) The People's Republic of China; or

(2) The Russian Federation.

"Covered missions" means—

(1) The nuclear deterrence mission of DoD, including with respect to nuclear command, control, and communications, integrated tactical warning and attack assessment, and continuity of Government; or

(2) The homeland defense mission of DoD, including with respect to ballistic missile defense.

"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).

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

(b) *Prohibition*. In accordance with section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91), the contractor shall not provide to the Government any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless the covered defense telecommunication equipment or services are covered by a waiver described in Defense Federal Acquisition Regulation Supplement 204.2104 .

(c) *Procedures*. The Contractor shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service, to carry out covered missions, that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

(d) *Reporting*.

(1) In the event the Contractor identifies covered defense 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, the Contractor shall report at https://dibnet.dod.mil the information in paragraph (d)(2) of this clause.

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

(i) Within 3 business days from the date of such identification or notification: the contract number; the order number(s), if applicable; supplier name; 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 30 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 a covered defense 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)

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ATTACHMENT 2

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

Disclosures of Foreign Affiliations or Relationships to Foreign Countries
(Version 2)

In accordance with the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) and the Small Business Administration (SBA) SBIR/STTR Policy Directive, small business concerns are required to disclose the information requested below about the small business's investment and foreign ties. Small business concerns who: 1) fail to submit this form in Volume 5 of the Defense SBIR/STTR Innovation Portal (DSIP) proposal submission; 2) do not use this form, version 2, as provided herein; 3) do not provide their complete identifying information in the table below or do not completely answer all questions in this form; 4) fail to provide the Government additional information regarding this form when requested; or, 5) fail to sign this form, **will be deemed noncompliant and will not receive an evaluation of their proposal**. DO NOT lock, password protect or encrypt this form when uploading to Volume 5 in DSIP.

Relevant definitions can be found at the end of this document. An up-to-date list of countries determined to be countries of concern by the Secretary of State will be maintained and accessible on SBIR.gov.

Small Business Concern (SBC)	
SBC Unique Entity ID (UEI)	
Proposal # (assigned by DSIP when proposal is created)	
SBC Point of Contact (POC) Name	
SBC POC Phone #	
SBC POC Email	

Responses to disclosure questions may contain trade secrets or commercial or financial information that is privileged or confidential and is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with an award between the submitter and the Government.

The information provided in response to the Disclosure Questions listed below is certified to be accurate and complete. 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.

Name of person authorized to sign: ______________________________

Signature of person authorized: ______________________________

Date: ______________________________

AMENDMENT 2

Disclosure Questions

1. Is any owner or covered individual of the applicant or awardee party to any malign foreign talent recruitment program?
☐ Yes ☐ No

If yes, disclose the first and last name of each owner or covered individual, identify their role (i.e., owner or covered individual), and the malign foreign talent recruitment program.

2. Is there a parent company, joint venture, or subsidiary, of the applicant or awardee that is based in or receives funding from, any foreign country of concern?
☐ Yes ☐ No

If yes, disclose the name, full address, applicant or awardee relationships (i.e., parent company, joint venture, or subsidiary) of each entity based in, or funded by, any foreign country of concern.

3. Does the applicant or awardee have any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity?
☐ Yes ☐ No

If yes, disclose the name of each enterprise or foreign entity, type of obligation, agreement, or arrangement (*i.e.,* contractual, financial, or other), description of obligation, agreement, or arrangement, and the foreign state(s) and/or the country of the foreign entity (or entities).

4. Is the applicant or awardee wholly owned in a foreign country?
☐ Yes ☐ No

If yes, disclose the foreign country.

5. Does the applicant or awardee have any venture capital or institutional investment?
☐ Yes ☐ No

If yes, proceed to question 5a. If no, proceed to question 6.

5a. Does the investing entity have a general partner or any other individual holding a leadership role who has a foreign affiliation with any foreign country of concern?
☐ Yes ☐ No ☐Unable to determine

If yes or unable to determine, disclose the venture capital or institutional investing entity's name, the percentage of ownership obtained by the investing entity, and the type of investment (i.e., equity, debt, or combination of equity and debt).

6. During the previous 5-year period, did the applicant or awardee have any technology licensing or intellectual property sales or transfers, to a foreign country of concern?

☐ Yes ☐ No

If yes, disclose the name, address, and country, of the institution or entity that licensed, purchased, or received the technology or intellectual property.

7. Is there any foreign business entity, offshore entity, or entity outside the United States related to the applicant or awardee?

☐ Yes ☐ No

If yes, disclose the entity name, relationship type (i.e., foreign business entity, offshore entity, entity outside the United States), description of the relationship to the applicant or awardee, and entity address and country.

8. Does the applicant or awardee have an owner, officer, or covered individual that has a foreign affiliation with a research institution located in a foreign country of concern?

☐ Yes ☐ No

If yes, disclose the first and last name of each owner, officer, or covered individual that has a foreign affiliation with a foreign country of concern, identify their role (i.e., owner, officer, or covered individual), and the name of the foreign research institution and the foreign country of concern where it is located.

Relevant Definitions

Covered individual — An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research and development (R&D) project proposed to be carried out with a Federally funded award from DoD. DoD has further designated covered individuals as including all proposed key personnel.

Federally funded award — A Phase I, Phase II (including Direct to Phase II, sequential Phase II/subsequent Phase II and cross-agency Phase II), or Phase III SBIR or STTR award made using a funding agreement.

Foreign affiliation — As defined in 15 U.S.C. § 638(e)(16), foreign affiliation means a funded or unfunded academic, professional, or institutional appointment or position with a foreign government or government-owned entity, whether full-time, part-time, or voluntary (including adjunct, visiting, or honorary). This includes appointments or positions deemed adjunct, visiting, or honorary with research institutions located in a foreign country of concern.

Foreign country of concern — As defined in 15 U.S.C. § 638(e)(17), foreign country of concern means the People's Republic of China, the Democratic People's Republic of Korea, the Russian Federation, the Islamic Republic of Iran, or any other country determined to be a country of concern by the Secretary of State.

Malign foreign talent recruitment program — As defined in 42 U.S.C § 19237, the term "malign foreign talent recruitment program" means-

(A) any program, position, or activity that includes compensation in the form of cash, in-kind compensation, including research funding, promised future compensation, complimentary foreign travel, things of non de minimis value, honorific titles, career advancement opportunities, or other types of remuneration or consideration directly provided by a foreign country at any level (national, provincial, or local) or their designee, or an entity based in, funded by, or affiliated with a foreign country, whether or not directly sponsored by the foreign country, to the targeted individual, whether directly or indirectly stated in the arrangement, contract, or other documentation at issue, in exchange for the individual-

- (i) engaging in the unauthorized transfer of intellectual property, materials, data products, or other nonpublic information owned by a United States entity or developed with a Federal research and development award to the government of a foreign country or an entity based in, funded by, or affiliated with a foreign country regardless of whether that government or entity provided support for the development of the intellectual property, materials, or data products;
- (ii) being required to recruit trainees or researchers to enroll in such program, position, or activity;
- (iii) establishing a laboratory or company, accepting a faculty position, or undertaking any other employment or appointment in a foreign country or with an entity based in, funded by, or affiliated with a foreign country if such activities are in violation of the standard terms and conditions of a Federal research and development award;
- (iv) being unable to terminate the foreign talent recruitment program contract or agreement except in extraordinary circumstances;
- (v) through funding or effort related to the foreign talent recruitment program, being limited in the capacity to carry out a research and development award or required to engage in work that would result in substantial overlap or duplication with a Federal research and development award;
- (vi) being required to apply for and successfully receive funding from the sponsoring foreign government's funding agencies with the sponsoring foreign organization as the recipient;
- (vii) being required to omit acknowledgment of the recipient institution with which the individual is affiliated, or the Federal research agency sponsoring the research and development award, contrary to the institutional policies or standard terms and conditions of the Federal research and development award;
- (viii) being required to not disclose to the Federal research agency or employing institution the participation of such individual in such program, position, or activity; or
- (ix) having a conflict of interest or conflict of commitment contrary to the standard terms and conditions of the Federal research and development award; and

(B) a program that is sponsored by-

- (i) a foreign country of concern or an entity based in a foreign country of concern, whether or not directly sponsored by the foreign country of concern;

AMENDMENT 2

(ii) an academic institution on the list developed under section 1286(c)(8) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232) ; or

(iii) a foreign talent recruitment program on the list developed under section 1286(c)(9) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232).

AMENDMENT 2

ATTACHMENT 3

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

Verification of Eligibility of Small Business Joint Ventures

A small business joint venture offeror must submit, with its offer, the representation required in paragraph (c) of FAR solicitation provision 52.212-3, Offeror Representations and Certifications-Commercial Products and Commercial Services, and paragraph (c) of FAR solicitation provision 52.219-1, Small Business Program Representations, in accordance with 52.204-8(d) and 52.212-3(b) for the following categories:

(A) Small business;
(B) Service-disabled veteran-owned small business;
(C) Women-owned small business (WOSB) under the WOSB Program;
(D) Economically disadvantaged women-owned small business under the WOSB Program; or
(E) Historically underutilized business zone small business

Contractor's Name	
Small Business Concern Name	
Office Tel #	
Mobile #	
Email	

Name of person authorized to sign: ______________________________

Signature of person authorized: ______________________________

Date: ____________________

FAR Provision Incorporated in Full Text:

52.219-1 Small Business Program Representations (Oct 2022)

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

Economically disadvantaged women-owned small business (EDWOSB) concern means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States and who are economically disadvantaged in accordance with 13 CFR part 127, and the concern is certified by SBA or an approved third-party certifier in accordance with 13 CFR 127.300. It automatically qualifies as a women-owned small business concern eligible under the WOSB Program.

Service-disabled veteran-owned small business concern-

(1) Means a small business concern-

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) "Service-disabled veteran" means a veteran, as defined in 38 U.S.C.101(2), with a disability that is service-connected, as defined in 38 U.S.C.101(16).

Small business concern—

(1) Means a concern, including its affiliates, that is independently owned and operated, not dominant in its field of operation, and qualified as a small business under the criteria in 13 CFR part 121 and the size standard in paragraph (b) of this provision.

(2) *Affiliates*, as used in this definition, means business concerns, one of whom directly or indirectly controls or has the power to control the others, or a third party or parties control or have the power to control the others. In determining whether affiliation exists, consideration is given to all appropriate factors including common ownership, common management, and contractual relationships. SBA determines affiliation based on the factors set forth at 13 CFR 121.103.

Small disadvantaged business concern, consistent with 13 CFR 124.1002, means a small business concern under the size standard applicable to the acquisition, that-

(1) Is at least 51 percent unconditionally and directly owned (as defined at 13 CFR 124.105) by-

(i) One or more socially disadvantaged (as defined at 13 CFR 124.103) and economically disadvantaged (as defined at 13 CFR 124.104) individuals who are citizens of the United States, and

(ii) Each individual claiming economic disadvantage has a net worth not exceeding $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(2) The management and daily business operations of which are controlled (as defined at 13 CFR 124.106) by individuals who meet the criteria in paragraphs (1)(i) and (ii) of this definition.

Veteran-owned small business concern means a small business concern-

AMENDMENT 2

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C.101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

Women-owned small business concern means a small business concern-

(1) That is at least 51 percent owned by one or more women; or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

Women-owned small business (WOSB) concern eligible under the WOSB Program (in accordance with 13 CFR part 127) means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States, and the concern is certified by SBA or an approved third-party certifier in accordance with 13 CFR 127.300.

(b) (1) The North American Industry Classification System (NAICS) code for this acquisition is _________ *[insert NAICS code]*.

(2) The small business size standard is ________ *[insert size standard]*.

(3) The small business size standard for a concern that submits an offer, other than on a construction or service acquisition, but proposes to furnish an end item that it did not itself manufacture, process, or produce (*i.e.*, nonmanufacturer), is 500 employees if the acquisition—

(i) Is set aside for small business and has a value above the simplified acquisition threshold;

(ii) Uses the HUBZone price evaluation preference regardless of dollar value, unless the offeror waives the price evaluation preference; or

(iii) Is an 8(a), HUBZone, service-disabled veteran-owned, economically disadvantaged women-owned, or women-owned small business set-aside or sole-source award regardless of dollar value.

(c) *Representations.*

(1) The offeror represents as part of its offer that—

(i) it ☐is, ☐ is not a small business concern; or

(ii) It ☐is, ☐is not a small business joint venture that complies with the requirements of 13 CFR 121.103(h) and 13 CFR 125.8(a) and (b). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.]

(2) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.*] The offeror represents that it ☐is, ☐ is not, a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.]* The offeror represents as part of its offer that it ☐ is, ☐ is not a women-owned small business concern.

(4) *Women-owned small business (WOSB) joint venture eligible under the WOSB Program.* The offeror represents as part of its offer that it ☐ is, ☐ is not a joint venture that complies with the requirements of 13 CFR 127.506(a) through (c). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.]

(5) *Economically disadvantaged women-owned small business (EDWOSB) joint venture.* The offeror represents as part of its offer that it ☐ is, ☐ is not a joint venture that complies with the requirements of 13 CFR 127.506(a) through (c). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.]

(6) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.*] The offeror represents as part of its offer that it ☐ is, ☐ is not a veteran-owned small business concern.

(7) [*Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (c)(6) of this provision.*] The offeror represents as part of its offer that

(i) It ☐ is, ☐ is not a service-disabled veteran-owned small business concern; or

(ii) It ☐ is, ☐ is not a service-disabled veteran-owned joint venture that complies with the requirements of 13 CFR 125.18(b)(1) and (2). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.] Each service-disabled veteran-owned small business concern participating in the joint venture shall provide representation of its service-disabled veteran-owned small business concern status.

(8) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.*] The offeror represents, as part of its offer, that-

(i) It ☐ is, ☐ is not a HUBZone small business concern listed, on the date of this representation, as having been certified by SBA as a HUBZone small business concern in the Dynamic Small Business Search and SAM, and will attempt to maintain an employment rate of HUBZone residents of 35 percent of its employees during performance of a HUBZone contract (see 13 CFR 126.200(e)(1)); and

(ii) It ☐ is, ☐▫ is not a HUBZone joint venture that complies with the requirements of 13 CFR 126.616(a) through (c). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.] Each HUBZone small business concern participating in the HUBZone joint venture shall provide representation of its HUBZone status.

AMENDMENT 2

(d) *Notice.* Under 15 U.S.C.645(d), any person who misrepresents a firm's status as a business concern that is small, HUBZone small, small disadvantaged, service-disabled veteran-owned small, economically disadvantaged women-owned small, or women-owned small eligible under the WOSB Program in order to obtain a contract to be awarded under the preference programs established pursuant to section 8, 9, 15, 31, and 36 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall-

(1) Be punished by imposition of fine, imprisonment, or both;

(2) Be subject to administrative remedies, including suspension and debarment; and

(3) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

AMENDMENT 2

Attachment 4

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

Disclosure of Funding Sources

In accordance with Section 223 of the William M. (Mac) Thornberry National Defense Authorization Act (NDAA) for Fiscal Year 2021, DoD shall require, as part of any application for a research and development award—

- (1) that each covered individual listed on the application—
  - (A) disclose the amount, type, and source of all current and pending research support received by, or expected to be received by, the individual as of the time of the disclosure;
  - (B) certify that the disclosure is current, accurate, and complete; and
  - (C) agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award; and
- (2) that any entity applying for such award certify that each covered individual who is employed by the entity and listed on the application has been made aware of the requirements under paragraph (1).

Full text of Section 223 of the FY21 NDAA, including relevant definitions, can be found on pages 84-86: https://www.congress.gov/116/plaws/publ283/PLAW-116publ283.pdf.

Small Business Concern (SBC)	
SBC Unique Entity ID (UEI)	
Proposal # (assigned by DSIP when proposal is created)	
SBC Point of Contact (POC) Name	
SBC POC Phone #	
SBC POC Email	

The SBC has been made aware of the requirements outlined in Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 and certifies that the disclosures provided below are current, accurate, and complete. The SBC further agrees to update such disclosure at the request of DoD prior to the award of support and at any subsequent time DoD determines appropriate during the term of the award.

Name of person authorized to sign: ______________________________

Signature of person authorized: ______________________________

Date: ______________________________

AMENDMENT 2

☐ Covered individuals have no current or pending research support to disclose in accordance with Section 223 of the FY21 NDAA, as described above.

Disclosures

Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	

AMENDMENT 2

[Additional space as needed]

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

IMPORTANT

- **The following instructions apply to topics:**
  - **N241-001 through N241-069**

- Submitting small business concerns are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic changes.
  - The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Select the tab for the appropriate BAA cycle.
  - Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

- The information provided in the DON Proposal Submission Instructions 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.**

- Proposing small business concerns 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 proposing small business concerns are detailed in the section titled ADDITIONAL SUBMISSION CONSIDERATIONS.

- Phase I Technical Volume (Volume 2) and Supporting Documents (Volume 5) templates, specific to DON topics, are available at https://www.navysbir.com/links_forms.htm.

- The DON provides notice that Basic Ordering Agreements (BOAs) may be used for Phase I awards, and BOAs or Other Transaction Agreements (OTAs) may be used for Phase II awards.

- This BAA is issued under regulations set forth in Federal Acquisition Regulation (FAR) 35.016 and awards will be made under “other competitive procedures”. The policies and procedures of FAR Subpart 15.3 shall not apply to this BAA, except as specifically referenced in it. All procedures are at the sole discretion of the Government as set forth in this BAA. Submission of a proposal in response to this BAA constitutes the express acknowledgement to that effect by the proposing small business concern.

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON’s Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information on DON’s mission can be found on the DON website at www.navy.mil.

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	Navy SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil or appropriate Program Manager listed in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DSIP Support via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	DON SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil

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

Topic Numbers	Point of Contact	SYSCOM	Email
N241-001 to N241-004	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	sbir.admin@usmc.mil
N241-005 to N241-021	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N241-022 to N241-053	Mr. Jason Schroepfer	Naval Sea Systems Command (NAVSEA)	NSSC_SBIR.fct@navy.mil
N241-054 to N241-067	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@us.navy.mil
N241-068 to N241-069	Mr. Jon M. Aspinwall III (Acting)	Strategic Systems Programs (SSP)	ssp.sbir@ssp.navy.mil

PHASE I SUBMISSION INSTRUCTIONS

The following section details requirements for submitting a compliant Phase I proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposing small business concerns 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.)

DoD SBIR/STTR Innovation Portal (DSIP). Proposing small business concerns are required to submit proposals via the DoD SBIR/STTR Innovation Portal (DSIP); follow proposal submission instructions in the DoD SBIR/STTR Program BAA on the DSIP at https://www.dodsbirsttr.mil/submissions. Proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through DSIP for the first time will be asked to register. It is recommended that small business concerns 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 electronically in DSIP by the Corporate Official prior to BAA Close will NOT be considered submitted and will not be evaluated by DON. Proposals that are encrypted, password protected, or otherwise locked in any portion of the submission will be REJECTED unless specifically directed within the text of the topic to which you are submitting. Please refer to the DoD SBIR/STTR Program BAA for further information.

Proposal Volumes. The following six volumes are required.

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

- **Technical Proposal (Volume 2)**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed ten (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 ten-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.
    - Work proposed for the Phase I Base must be exactly six (6) months.
    - Work proposed for the Phase I Option must be exactly six (6) months.

  - Additional information:
    - It is highly recommended that proposing small business concerns 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.
    - A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, proposing small business concerns are cautioned that if the text is too small to be legible it will not be evaluated.

- **Cost Volume (Volume 3).**

- Cost Volume (Volume 3) must meet the following requirements or the proposal will be REJECTED:
  - The Phase I Base amount must not exceed $140,000.
  - 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.
  - For Phase I, a minimum of two-thirds of the work is performed by the proposing small business concern. The two-thirds percentage of work requirement must be met in the Base costs as well as in the Option costs. DON will not accept deviations from the minimum percentage of work requirements for Phase I. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor (Total Subcontractor Costs (TSC)) as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator.
    - Proposing Small Business Concern Costs (included in numerator for calculation of the small business concern):
      - Total Direct Labor (TDL)
      - Total Direct Material Costs (TDM)
      - Total Direct Supplies Costs (TDS)
      - Total Direct Equipment Costs (TDE)
      - Total Direct Travel Costs (TDT)
      - Total Other Direct Costs (TODC)
      - General & Administrative Cost (G&A)

      NOTE: G&A, if proposed, will only be attributed to the proposing small business concern.
    - Subcontractor Costs (numerator for subcontractor calculation):
      - Total Subcontractor Costs (TSC)
    - Total Cost (i.e., Total Cost before Profit Rate is applied, denominator for either calculation)
  - Cost Sharing: Cost sharing is not accepted on DON Phase I proposals.

- Additional information:
  - 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.
  - Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.
  - The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3. 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).

- **Company Commercialization Report (Volume 4)**. DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Phase I Proposal section of the

DoD SBIR/STTR Program BAA for details to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award.

  All proposing small business concerns must review and submit the following items, as applicable:

  - **Telecommunications Equipment Certification.** Required for all proposing small business concerns. 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 proposing small business concerns must include as a part of their submission a written certification in response to the clauses (DFAR clauses 252.204-7016, 252.204-7018, and subpart 204.21). 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 the instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.
  - **Disclosures of Foreign Affiliations or Relationships to Foreign Countries.** Each proposing small business concern is required to complete Attachment 2 of this BAA, “Disclosures of Foreign Affiliations or Relationships to Foreign Countries” and upload the form to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
    - Program Description
    - Proposal Fundamentals
    - Phase I Proposal
    - Attachment 2
  - **Certification Regarding Disclosure of Funding Sources.** Each proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. The disclosure and certification must be made by completing Attachment 4, Disclosure of Funding Sources, and uploading to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
    - Phase I Proposal
    - Attachment 4
  - **Majority Ownership in Part.** Proposing small business concerns 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. Complete certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

  - Additional information:
    - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at

https://navysbir.com/links_forms.htm to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
  - Additional Cost Information to support the Cost Volume (Volume 3)
  - SBIR/STTR Funding Agreement Certification
  - Data Rights Assertion
  - 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
- Do not include documents or information to substantiate the Technical Volume (Volume 2) in Volume 5 (e.g., resumes, test data, technical reports, or publications). Such documents or information will not be considered.
- A font size smaller than 10-point is allowable for documents in Volume 5; however, proposing small business concerns are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

PHASE I EVALUATION AND SELECTION

The following section details how the DON SBIR/STTR Programs will evaluate Phase I proposals.

Proposals meeting DSIP submission requirements will be forwarded to the DON SBIR/STTR Programs. Prior to evaluation, all proposals will undergo a compliance review to verify compliance with DoD and DON SBIR/STTR proposal eligibility requirements. Proposals not meeting submission requirements will be REJECTED and not evaluated.

- **Proposal Cover Sheet (Volume 1).** The Proposal Cover Sheet (Volume 1) will undergo a compliance review to verify the proposing small business concern has met eligibility requirements and followed the instructions for the Proposal Cover Sheet as specified in the DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).** The DON will evaluate and select Phase I proposals using the evaluation criteria specified in the Phase I Proposal Evaluation Criteria section of the DoD SBIR/STTR Program BAA, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. The information considered for this decision will come from Volume 2. This is not a FAR Part 15 evaluation and proposals will not be compared to one another. Cost is not an evaluation criteria and will not be considered during the evaluation process; the DON will only do a compliance review of Volume 3. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

  The Technical Volume (Volume 2) will undergo a compliance review (prior to evaluation) to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  - Not to exceed ten (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, except as permitted in the instructions above.
- 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.
- Work proposed for the Phase I Base must be exactly six (6) months.
- Work proposed for the Phase I Option must be exactly six (6) months.

- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will only undergo a compliance review to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  - Must not exceed values for the Base ($140,000) and Option ($100,000).
  - Must meet minimum percentage of work; a minimum of two-thirds of the work is performed by the proposing small business concern. The two-thirds percentage of work requirement must be met in the Base costs as well as in the Option costs. DON will not accept deviations from the minimum percentage of work requirements for Phase I.
  - Cost Sharing: Cost sharing is not accepted on DON Phase I proposals.

- **Company Commercialization Report (CCR) (Volume 4).** The CCR (Volume 4) will not be evaluated by the Navy nor will it be considered in the Navy's award decision. However, all proposing small business concerns must refer to the DoD SBIR/STTR Program BAA to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Supporting Documents (Volume 5) will not be considered in the selection process and will only undergo a compliance review to ensure the proposing small business concern has included items in accordance with the PHASE I SUBMISSION INSTRUCTIONS section above.

- **Fraud, Waste, and Abuse Training Certificate (Volume 6).** Not evaluated.

ADDITIONAL SUBMISSION CONSIDERATIONS

This section details additional items for proposing small business concerns to consider during proposal preparation and submission process.

Due Diligence Program to Assess Security Risks. The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally-funded award. Please review the Program Description section of the DoD SBIR/STTR Program BAA for details on how DoD will assess security risks presented by small business concerns. The Due Diligence Program to Assess Security Risks will be implemented for all Phases.

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. Proposing small business concerns 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 $1,800,000 or lower limit specified by the SYSCOM). As with Phase I, the amount proposed for TABA cannot include any profit/fee by the proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. 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 small business concern receiving TABA will be required to submit a report detailing the results and benefits of the service received. This TABA report will be due at the time of submission of the final report.

Request for TABA funding will be reviewed 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 (to include the purpose and objective of the assistance)
- 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 indirect costs, profit, or fee by the SBIR proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern 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 in the proposal as follows:

- Phase I:
    - Online DoD Cost Volume (Volume 3) – the value of the TABA request.
    - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as “TABA” in the section titled Additional Cost Information when using the DON Supporting Documents template.
- Phase II:
    - DON Phase II Cost Volume (provided by the DON SYSCOM) - the value of the TABA request.
    - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as “TABA” in the section titled Additional Cost Information when using the DON Supporting Documents template.

Proposed values for TABA must <u>NOT</u> 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 proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern will be eliminated from participating in the DON SBIR/STTR Transition Program

(STP), the DON Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must participate in the virtual Navy STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

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 award, the proposing small business concern 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 (defined by National Security Decision Directive 189). A small business concern whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DON Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DON Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the government Contracting Officer, noted in the contract.

Majority Ownership in Part. Proposing small business concerns 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 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 proposing small business concerns 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, small business concerns must register with the SBA Company Registry Database.
b. The proposing small business concern 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 5).
c. Should a proposing small business concern become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposing small business concern 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 proposing small business concerns register in SAM, https://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, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal. A small business concern selected for an award MUST have an active SAM registration at the time of award or they will be considered ineligible.

Notice of NIST SP 800-171 Assessment Database Requirement. The purpose of the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 is to protect Controlled Unclassified Information (CUI) in Nonfederal Systems and Organizations. As prescribed by DFARS 252.204-7019, in order to be considered for award, a small business concern is required to implement NIST SP 800-171 and shall have a current assessment uploaded to the Supplier Performance Risk System (SPRS) which provides storage and retrieval capabilities for this assessment. The platform Procurement Integrated Enterprise Environment (PIEE) will be used for secure login and verification to access SPRS. For brief instructions on NIST SP 800-171 assessment, SPRS, and PIEE please visit https://www.sprs.csd.disa.mil/nistsp.htm. For in-depth tutorials on these items please visit https://www.sprs.csd.disa.mil/webtrain.htm.

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 proposing small business concern 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: https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections. 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 technical merit of 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).

SELECTION, AWARD, AND POST-AWARD INFORMATION

Notifications. Email notifications for proposal receipt (approximately one week after the Phase I BAA Close) and selection are sent based on the information received on the proposal Cover Sheet (Volume 1). Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Debriefs. 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 proposal of the proposing small business concern 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. Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of the BAA must be served to: osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil. A copy of a pre-award Government Accountability Office (GAO) protest must also be filed with the aforementioned email address within one day of filing with the GAO.

Protests related to a selection or award decision should be filed with the appropriate Contracting Officer for an Agency Level Protest or with the GAO. Contracting Officer contact information for specific DON Topics may be obtained from the DON SYSCOM Program Managers listed in Table 2 above. For protests filed with the GAO, a copy of the protest must be submitted to the appropriate DON SYSCOM Program Manager and the appropriate Contracting Officer within one day of filing with the GAO.

Awards. Due to limited funding, the DON reserves the right to limit the number of awards under any topic. Any notification received from the DON that indicates the proposal has been selected does not ultimately guarantee an award will be made. This notification indicates that the proposal has been selected in accordance with the evaluation criteria and has been sent to the Contracting Officer to conduct compliance review of Volume 3 to confirm eligibility of the proposing small business concern, and to take other relevant steps necessary prior to making an award.

Contract Types. 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 the section of the DoD SBIR/STTR Program BAA titled Proposal Fundamentals, 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 small business concern per topic. The maximum Phase I proposal/award amount including all options 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 $1,800,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of less than $1,800,000 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.

Contract Deliverables. Contract deliverables for Phase I are typically a kick-off brief, progress reports, and a final report. Required contract deliverables (as stated in the contract) must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

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.

PHASE II GUIDELINES

Evaluation and Selection. All Phase I awardees may submit an **Initial** Phase II proposal for evaluation and selection. The evaluation criteria for Phase II is the same as Phase I (as stated in this BAA). The Phase I Final Report and Initial Phase II Proposal will be used to evaluate the small business concern's potential to progress to a workable prototype in Phase II and transition the 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 BAAs prior to FY13 will be conducted in accordance with the procedures specified in those BAAs (for all DON topics, this means by invitation only).

Awards. 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 small business concerns (e.g., the Navy 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. Consequently, DON will assign SBIR/STTR Data Rights to any noncommercial technical data and noncommercial computer software delivered in Phase III that were developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

Navy SBIR 24.1 Topic Index

N241-023	High Reliability Flame Detector
N241-024	Vertical Launch System High Speed Interface
N241-025	Advanced Artificial Intelligence/Machine Learning Techniques for Automated Target Recognition (ATR) Using Small/Reduced Data Sets
N241-026	Automatic Boresight Alignment of Optical Sensors
N241-027	Precision Stabilization of Large, Wide Field of View Imaging Sensors.
N241-028	High Volume Low Pressure (HVLP) Style Spray for Rapid Cure Ultra-High Solid (UHS) Coating Systems
N241-029	Advanced Acoustic Hailing
N241-030	Acoustic Training Data Prioritization
N241-031	Silver-Oxide/Zinc Battery Test Measurement and Diagnostic Equipment (TMDE) Tool
N241-032	Air Cushioned Vehicle Erosion Resistant Coatings
N241-033	Inert Gas Reclamation for Minimally-Enclosed Directed Energy Deposition (DED) Additive Manufacturing (AM) Equipment
N241-034	Modular and Scalable Extended-Sonobuoy Deployment System
N241-035	Coordinated Effectiveness Assessment
N241-036	Virtual Well Deck Operations Trainer: Line Handling
N241-037	Weapons Scheduling for Uncertain Weapon-Target Assignment
N241-038	Runtime Software Verification for Non-Standard Compute Infrastructure
N241-039	Portable Boats & Small Craft Assembly Kits
N241-040	Additive Manufacturing of Textured Piezoelectric Ceramics
N241-041	High Power Optical Splitter for Laser Weapon Systems
N241-042	Compact Rapid Attack Weapon (CRAW) 100HP Electric Powerplant
N241-043	Extended Reality (XR) for Use in Naval Shipyard Industrial Environments
N241-044	Rapid Scalable Time Synchronization
N241-045	Composite Launch Tube (LT) for the Compact Rapid Attack Weapon (CRAW)
N241-046	Micro Inertial Measurement Unit for Maritime Navigation

N241-047	[DON has removed topic N241-047 from the 24.1 SBIR BAA]
N241-048	Virtualized Naval Tactical Data System Interfaces over Ethernet
N241-049	Shipboard Proof Testing Apparatus for Field-Expedient Parts
N241-050	Forces Afloat Man Overboard Persons in the Water (PIWs) Recovery
N241-051	Enhanced Radome Design
N241-052	Energy Harvesting for Underwater Persistent Systems
N241-053	Additively Manufactured Polymer Tooling for Rubber Compression Molding
N241-054	Probabilistic Forecasts of High Impact Weather on Medium Range to Subseasonal Timescales using Artificial Intelligence
N241-055	Generative Text Engine for Form Completion
N241-056	Autonomous, Mission-based Traffic Engineering
N241-057	Networking Platform for Real-time Communication of Personnel Health Status and Location during Shipboard Emergencies
N241-058	Multi-Sensor Prototype for Non-Destructive Corrosion Evaluation and Characterization
N241-059	Wideband Interference Suppression
N241-060	Ultra-High Reliable and Efficient Unmanned Surface Vessel (USV) Modular Generator System
N241-061	Multi-variable Unmanned Anti-Submarine Warfare (ASW) system assessment and optimization toolkit
N241-062	Innovative Low Profile, Foldable, High Power Microwave Antenna
N241-063	Naval Shipboard Embedded Battery Containment System
N241-064	Advanced Wearable Integration and Synchronization Hub (AWISH)
N241-065	Advanced Nondestructive Inspection System for Detection and Characterization of Corrosion under Thick Coatings
N241-066	Laser Magazine
N241-067	Common Software Platform for Learning-based Robots
N241-068	Fast Micro-Electromechanical Systems (MEMS) Shutters for Stellar Sensing Applications

N241-069 Deterministic Precision Machining of Miniature Optics in Hard Ceramics

N241-001 TITLE: Durable Wheel End Drive for Amphibious Vehicles

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Design and develop a new or improved drive axle for the Amphibious Combat Vehicle with greater durability when subjected to operation in an amphibious environment.

DESCRIPTION: The United States Marine Corps is fielding the Amphibious Combat Vehicle (ACV) designed to operate over harsh off-road terrain and in oceans and rivers. The ACV currently uses traditional Constant Velocity (CV) Joints on the wheel end drives that require excessive maintenance because they develop holes and tears in the inside and outside CV Boots. The Marine Corps is interested in innovative approaches to develop a more durable wheel end drive. The design must protect the current CV Boots, replace the Boot with a more durable material, or redesign the wheel end drive joint so that it does not require a grease filled boot covered joint.

Proposed concepts should:

- Address the ability to function in extreme operating environments which include but are not limited to -40 degrees Fahrenheit (°F) to +120°F, hot desert blowing sand, full salt water immersion, operation to and from the beach in surf zones up to 6 foot Significant Breaker Height (SBH) and mud (soft soil of 30 Rating Cone Index (RCI)) which includes suspended abrasive items such as rocks, gravel, sand, and coral.
- Allow for terrain traverse with combined 3 g-force (G) vertical and 0.7 G horizontal load on suspension station, racking load at diagonal corners for 1 G vertical load, North Atlantic Treaty Organization (NATO) tree impact (5" tree at 32 kilometers per hour (kph)-8365 pound equivalent static load), and fatigue loads for 30 year vehicle life.
- Allow for a maximum of 4,350 newton-meters (NM) of torque, a maximum angle of 40 degrees (short duration), and a maximum rotation speed of 2,682 RPM.
- Support steering in the forward and reverse directions on 40% side slopes and ascending, descending, starting, and stopping on a dry hard surfaced longitudinal slope up to and including 60% grade in both forward and reverse direction.

PHASE I: Design a more durable wheel end drive in consideration of the operating environment in which the drive system will be exposed. Demonstrate, via modeling or testing, the feasibility of the concept(s) in meeting Marine Corps' needs and establish that the concept 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 that will address technical risk reduction.

PHASE II: Develop a scaled prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals established for the Marine Corps' amphibious vehicles. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into a design that will meet Marine Corps requirements. Working with the Marine Corps, prepare a Phase III development plan to detail the strategy for transitioning the technology for Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the durable wheel end drive system for Marine Corps use. Working with the Marine Corps, integrate the prototype wheel end drive system into a vehicle for evaluation to determine its effectiveness in an operationally relevant environment. Provide support to the Marine Corps during test and validation to certify and qualify the system for Marine Corps use. Develop manufacturing plans and capabilities to produce the system for both military and commercial markets.

This technology is directly applicable to large military vehicles such as the Marine Corps ACV. Successful development and characterization of a durable wheel end drive system has direct application to various military and commercial applications such as amphibious rescue vehicles. Reductions of weight and complexity in the suspension can be of substantial value.

REFERENCES:

1. MIL-STD-810G Environmental Test Methods and Engineering Guidelines. http://www.everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810_13751/
2. MIL-STD-889B Dissimilar Metals.http://www.everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL_STD_889B_955/
3. Description of a flex joint/Giubo. https://en.wikipedia.org/wiki/Giubo

KEYWORDS: Provide a minimum of six key words separated by semicolons. Drive; axle; constant velocity joint (CV Joint); boot, Giubo; amphibious

N241-002 TITLE: Medical Echelon of Care Conceptual Models for Wargaming

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

OBJECTIVE: Develop Medical Echelon of Care models for wargaming, sufficient to withstand review board scrutiny to support model verification, validation, and accreditation, as required. The focus is on developing and implementing the models referenced herein, not on the underlying mechanics of the Program Manager Wargaming Capability (PM WGC) materiel solution simulation framework.

DESCRIPTION: This SBIR topic addresses two parametrics of interest for future inclusion in the Neller Wargaming and Analysis Center (NWAC), formerly the Marine Corps Wargaming and Analysis Center (MCWAC). Both parametrics are related to medical echelon of care. In the table below, the two major parametrics considered are “Echelon of care” and “Time requirements between echelons of care”. The specific conceptual model requirements are listed for each parametric.

ID	JCA	Parametric	Parametric Description	Conceptual Model Requirement
L4	Logistics	Echelon of care	Represent the different classes of casualties and echelons of care	Represent **entity-level casualties** including time of injury, class of injury (per International Classification of Diseases, 9th Revision (ICD-9)), location, detailed injury information, rate of recovery, and return to combat effectiveness.
L5	Logistics	Echelon of care	Represent the different classes of casualties and echelons of care	Simulate application of the six echelons of care per Fleet Medical Pocket Reference of 2016.
L6	Logistics	Echelon of care	Represent the different classes of casualties and echelons of care	Output updates to casualty status based on care and movement: location, detailed injury information, rate of recovery, and return to combat effectiveness.
L7	Logistics	Time requirements between echelons of care	Represent the time to transition a casualty from one echelon of care to another	Output time and location of entities as they transition echelons of care.
L31	Logistics	Maneuvering shock trauma team with vehicle capabilities, resuscitation capabilities, and a shock trauma bay with blood supplies and independent power supply.	Represent a maneuvering shock trauma team.	Simulate specific trauma services provided by shock trauma teams.

L32	Logistics	Maneuvering shock trauma team with vehicle capabilities, resuscitation capabilities, and a shock trauma bay with blood supplies and independent power supply.	Represent a maneuvering shock trauma team.	Simulate movement of casualties as enabled by shock trauma team transportation capabilities.
L33	Logistics	Maneuvering shock trauma team with vehicle capabilities, resuscitation capabilities, and a shock trauma bay with blood supplies and independent power supply.	Represent a maneuvering shock trauma team.	Represent shock trauma team levels of supply.
L34	Logistics	Maneuvering shock trauma team with vehicle capabilities, resuscitation capabilities, and a shock trauma bay with blood supplies and independent power supply.	Represent a maneuvering shock trauma team.	Modify casualty survival rate based on trauma team actions.
L35	Logistics	Maneuvering shock trauma team with vehicle capabilities, resuscitation capabilities, and a shock trauma bay with blood supplies and independent power supply.	Represent a maneuvering shock trauma team.	Represent location of shock trauma teams.
L36	Logistics	Medical facilities.	Represent casualty survival rate based on trauma team actions.	Modify casualty survival rate based on surgical capacity of medical facilities.
L37	Logistics	Medical facilities.	Represent number of surgeons at medical facilities.	Represent the surgical capacity of medical facilities by number of surgeons.
L38	Logistics	Medical facilities.	Represent capabilities at medical facilities.	Identify medical facility capabilities in accordance with Fleet Medical Pocket Reference of 2016.

The purpose of the models is to support realistic evaluation of medical support systems within USMC future concept and capability development and Operational Plan assessment wargames. The prototype would provide medical treatment simulation from time of injury to return to combat effectiveness via the various echelons of care.

Some examples under the above headings include, but are not limited to:

- Establish baseline performance characteristics of existing medical support systems under a given scenario.
- Model novel ways of treating/transporting/managing Marine casualties occurring in austere environments within challenging operating environments, with imposed limitations on naval medical support.
- Model the complex relationships between location and type of injury, types of medical transport available, location and capabilities of the various echelons of care available, eventual return to combat effectiveness, and associated critical time and resource metrics.

Full satisfaction of each conceptual model requirement is the end goal, however partial solutions will be considered. This topic specifically focuses on developing the mathematical, algorithmic, and data aspects of the conceptual models. The mechanism by which these conceptual models would be integrated with existing wargaming kinetic models resident within the NWAC is not the focus. Documentation of the conceptual models with Cameo Systems Modeler (Cameo/SysML) is desirable, but not necessarily a strict requirement, if another representation is more suitable [Ref 2].

PHASE I: Develop concepts for an improved representation of medical echelon of care in wargaming M&S that meets the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs and establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by evaluation of the plan of attack for the development effort including data availability. Provide a Phase II development plan with performance goals and key technical milestones, and that addresses technical risk reduction.

PHASE II: Develop prototype conceptual models. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for medical echelon of care M&S. System performance will be demonstrated through prototype evaluation over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop medical echelon of care conceptual models for evaluation to determine effectiveness in an operationally relevant environment within the NWAC. Support the Marine Corps for M&S Verification, Validation, and Accreditation (VV&A) to certify and qualify the system for Marine Corps use.

The conceptual models described herein are not only a high priority within the Marine Corps [Refs 1, 3], but are equally applicable across the Services, to support not only wargaming, but also analysis, training, and experimentation. Successfully developed conceptual models would likely be of great interest across these communities. DoD components and prime contractors are in need of accurate medical casualty/echelon of care simulation representation to support gap analysis and solution assessment. Potential civilian applications include emergency medicine and care after the emergency room.

REFERENCES:

1. “Commandant’s Planning Guidance.” 38th Commandant of the Marine Corps, 2019. http://www.marines.mil/Portals/1/Publications/Commandant's%20Planning%20Guidance_2019.pdf?ver=2019-07-17-090732-937
2. “IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)”, IEEE Standard 1730-2022, https://standards.ieee.org/ieee/1730/10715/
3. “Force Design 2030 Annual Update, June 2023. 38th Commandant of the Marine Corps. https://www.marines.mil/Portals/1/Docs/Force_Design_2030_Annual_Update_June_2023.pdf

KEYWORDS: MCWAC; NWAC; USMC; M&S; Modeling and Simulation; medical; conceptual model; analysis; Neller Center; wargaming; Force Design;

N241-003 TITLE: Lower-Cost Textiles for Dismounted Signature Management

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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(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 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 novel approach(es) to textile solution(s) in Marine Pattern (MARPAT) camouflage that lower the cost, increase the manufacturability/scalability, increase the lifecycle, increase ability to launder, and increase the wearability over current signature management textiles. This effort shall apply the developed concept(s) to a Flame Retardant (FR) textile. The textile/material solution(s) developed in this effort are intended to be used in a tactical environment to reduce individual dismounted Marine signature, applicable to a suite of items, in the Infrared Spectrum (IR) from Near Infrared (NIR) through to Long Wave Infrared (LWIR). The intent of this capability is to degrade the ability of adversaries to detect, identify, and recognize a Marine, increasing Marine lethality and survivability in a sensor contested environment.

DESCRIPTION: Detection, recognition, identification, and targeting of dismounted warfighters is a critical variable in past and future fights. Currently dismounted infantry and infantry-like Marines are at an increased risk from various IR imagers from the ground and air. Publicly accessible information and videos on recent events (i.e., the Ukraine-Russia conflict) have demonstrated how accessible and proliferated a variety of sensors are due to recent technological advancements in detector technology. The 2016 Marine Corps Operating Concept cites a '"Battle of signatures" where "Tomorrow's fights will involve conditions in which "to be detected is to be targeted is to be killed." Adversaries will routinely net together sensors, spies, Unmanned Aircraft Systems (UAS), and space imagery to form sophisticated "ISR-strike systems" that are able to locate, track, target, and attack an opposing force… No matter the means of detection, unmanaged signatures will increasingly become a critical vulnerability… Defensively, our units will need to adapt how they fight, emphasizing emissions control and other means of signature management to increase their survivability." [Ref 4]

The current combat ensemble provides visual (VIS) and Near Infrared (NIR) signature mitigation. Current VIS is provided in MARPAT with a digital pattern breakup by utilizing four (4) distinct colors in two (2) color-way patterns, Woodland and Desert, for use in their respective environments. NIR signature management (typically defined as 700-1,000 nanometers) is achieved through the camouflage pattern, breakup, and pigments of the dyestuffs. Near-term improvements and updates to military textiles with Short Wave Infrared (SWIR) (most typically defined as 1,000-1,700 nanometers with some emerging devices seen in the upper ranges of 1,700-2,500 nanometers) mitigation through adjustments in dyestuffs are being evaluated for adoption; these values are ITAR restricted and will be made available to Phase I awardees. Current Marine Corps clothing and equipment items do not have Midwave Infrared (MWIR) (typically defined as 3-5 micrometer wavelength) or LWIR (typically defined as 8-14 micrometer wavelength) signature mitigation. LWIR imaging sensors based on uncooled microbolometer technology are a particularly pervasive threat as costs associated with such systems continue to go down, while the performance of commercial systems available worldwide are competitive with military-grade capabilities. The intent for this SBIR topic is to explore the development of novel lower-cost textile(s) that incorporate(s) current signature mitigation from VIS to NIR, tentative requirements for SWIR, and a significant increase over current capabilities in MWIR and LWIR signature mitigation. The textile(s) developed in this effort should focus on reducing the probability in identification (of a user), reducing the range of detection, and/or reducing targeting accuracy if detected through NIR, SWIR, MWIR, and LWIR sensors. While there are limited commercially available fabrics that mitigate signature from VIS to LWIR, these fabrics are often cost ineffective for the general Marine infantry. Another disadvantage of some current commercial or developmental technologies is overall low comfort or wearability, due to retention of heat, from a user perspective. Additionally, many of these commercial technologies have a short lifespan or use, and must be stored, cared for, and laundered in certain manners. Finally, the existing technologies and current developmental efforts have been developed for Army use, in Operational Camouflage Pattern (OCP), and not focused on MARPAT. The intent of the effort is to address the described issues and produce a material/textile solution(s) for tactical use that mitigate individual signature in VIS-LWIR with a reduction in cost, increased wearability, focus on development of MARPAT camouflage solutions, increase ease of storage/transportation, and increase lifecycle use when compared to current commercially available solutions. A textile with such attributes should be perceived as a piece of protective equipment, providing a capability for the Marine force to operate in austere environments undetected.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 MCSC 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop new and novel concepts to address the cost reduction of Signature Mitigating textile(s) through use of (but not limited to) different materials, additives, applications, finishes, formation and/or manufacturing methods, in Woodland and Desert MARPAT. Vendors shall not be limited in types of materials, structures, additives, and/or finishes and are encouraged to explore innovative or unconventional ideas and methods for textile(s). Consider scalability, launderability, storage and logistical considerations, lifecycle use, general wearability, and function for use in a range of climatic environments to develop successful novel methodologies and concepts for lower-cost signature mitigating textile(s). Proposed textiles may be reversible for multi-use. Provide a theoretical (written) concept for Desert MARPAT and Woodland MARPAT.

Phase I deliverables will include production and delivery of fabric swatch(es)/sample(s) of the most promising concept(s) down selected from the various conceptual approaches- emphasizing quality of solutions rather than quantity. The end state for Phase I will be a physical material/textile sample(s), (a minimum of twelve-by-twelve inch, 12in x 12in, but preferably larger) that mitigates VIS-LWIR signature. The physical sample shall be one of the following: solid color, Operational Camouflage Patter (OCP), Desert or Woodland in Woodland MARPAT. No new or alternative digital camouflage patterns shall be developed for this effort. If not demonstrated in a physical sample, a, with a theoretical (written) concept shall be provided for Woodland and Desert MARPAT. Vendors shall explore and identify any visual (color) tradeoffs or trade space associated with Woodland MARPAT when intersected with success in the NIR, SWIR, MWIR, or LWIR ranges. Phase I deliverables shall also provide a written report detailing ways to optimize and further development in the Phase I Option or a Phase II potential effort. If I Phase I Option is exercised, further develop the most promising textile(s) and conceptualize several end item configurations (in the form of drawings) to be considered for prototypes in Phase II.

The Phase I effort will not require access to classified information. Controlled Unclassified Information (CUI) may be provided to vendors upon award of Phase I.

PHASE II: Explore the novel Phase I technology(s) and/or alternative proposed concept(s) to mature a lower-cost (compared to what is currently commercially available) Woodland and Desert MARPAT signature mitigating textile for use in an operationally relevant environment on a dismounted Marine. Snow MARPAT may be considered in this Phase. These textile(s) proposed may be refined to areas of interest which include, but not limited to, overgarments/ponchos, personnel covers, and personal hide sites. Concepts should consider multi-functionality of the textile(s) to reduce the burden of number, size, and weight to the Marine. Further refine visual appearance; tune NIR and SWIR values to meet current and potential future USMC requirements (available with a signed NDA), further develop MWIR and LWIR signature mitigation, reduce cost, increase wearability, decrease or address logistical/transportation/storage concerns, and increase lifecycle and explore launderability of proposed textiles. Textile(s) matured in Phase II must be practical for a dismounted infantry Marine to wear, use, transport, and care for. Practical for a dismounted infantry Marine can be defined as creating no to minimal (maximum of 16 oz/sq yd for the textile, objective under 7 oz/sq yd) additional burden in terms of weight as well as the textile must function (in terms of use) in all weather and not be damaged by elements (rain, hail, snow, etc), and the care/ transportation of the textile (must be packable in a deployers bag, must be able to be stored in non-climate controlled facilities during travel to and from facilities, must be launderable if necessary). CUI and classified metrics, additional data, and further description to needs may be provided to the vendor upon award of Phase II.

Examine the application of concepts to substrates, including those with Flame Resistant (FR) performance, with delivery of a minimum of one (1) developmental swatch (minimum of twelve-by-twelve inch, 12in x 12in) of a FR signature mitigating textile. Phase II deliverables will also include textile testing on proposed fabric solution(s) to include but not limited to the tests defined in Table 1. Phase II will result in the delivery of fifty to one hundred (50-100) yards of each non-FR textile concept (minimum of one (1)) demonstrating a minimum of two of the Marine Corps camouflages (Woodland, Desert, and Snow MARPAT). In addition to the textile yardage, submit three (3) prototypes utilizing the proposed fabric(s) in an existing military baseline configuration. Baseline patterns for this configuration will be provided for fabrication of prototypes upon award. In addition to the baseline prototypes, propose novel end items, fabrication, or applications in the Phase II report. Deliver a concise brief, unclassified, brief that explains the high-level principles of how their technology meets the user’s operational and maintenances needs.

If exercised, Phase II Option shall further refine the textiles, including the FR capability if warranted, and prototypes in the form of: IR capabilities, cost, scalability, launderability, storage and logistical considerations, lifecycle use, general wearability, and function for use in a range of climatic environments. If warranted, develop other substrate(s) that could be applied to other areas of interest such as combat uniforms, armor and load carriage, outerwear, or cold weather gear.

Test Type	**Test Method**
Break Strength	ASTM D 5034
Tear Strength	ASTM D 1424
Weight	ASTM D 3776

Air Permeability	ASTM D737
Dry Time	MM-TS-07 (AATCC)
Colorfastness to Light	AATCC TM16 A or E
Colorfastness to Laundering	AATCC TM61 test 1A
Colorfastness to Crocking	AATCC TM8
Colorfastness to Perspiration	AATCC TM15
Toxicity Reference	MIL-PRF-32679 Table I or MIL-PRF-43637F 3.13 available via ASSIST
pH	AATCC TM81- Reference MIL-PRF-32679 Table I or MIL-PRF-43637F 3.12 available via ASSIST
Dimensional Stability Report after Laundering:	according to AATCC 135
Launderability at 0, 1, 5, 10, 15, 20, and 25 cycles (document with written report and photos)	AATCC 135, settings to be determined by vendor dependent on application
Hemispherical Directional Reflectometry (HDR) or Delta T	Use a SOC-100 HDR or spectrophotometer with black body and calibrated sensor (report calculation methods) *This test(s) is optional, but encouraged*

For vendors awareness, the Phase II and III efforts will likely require secure access, and the contractor will need to be prepared for personnel and facility certification for secure access.

Work produced in Phase II may become classified. See note in the Description.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the textile(s) and technology(s) for Marine Corps use in the Program Manager Infantry Weapons (PM IW) teams (Individual Armor and Clothing and Equipment). Transition the developed processes and novel textile(s) though a multitude applicable end item forms. Continue to improve manufacturing processes, supply chain robustness and availability, lower cost through economies of scale on developed textile(s), Continue to expand technology to additional substrates, including those with FR capabilities. Assist in development of briefings or trainings on technology and use of items, understandable and digestible at the lowest level. Information regarding specific textiles and items for transition will be provided upon award.
These processes and textile(s) can be transitioned to all other services for their signature management programs as applicable. The technology and processes developed in this SBIR could be used in programs outside of Clothing & Equipment and may be applicable to other portfolio's such as Land Systems. A successful signature mitigating textile(s) with a lower cost would be applicable to all individual 'kit' and would dramatically change Warfighters ability to operate undetected in a contested environment.

REFERENCES:

1. "Changes to Camouflage Spectral Reflectance Requirements Session #18: SWIR Values." JAPBI Brief -7 November 2019, p. 6. https://www.dla.mil/Portals/104/Documents/TroopSupport/CloTex/Changes%20to%20Camo.pdf?ver=2019-11-21-111440-410
2. Olsen, Frode Berg. "Methods for Evaluating Thermal Camouflage." RTO-MP-SCI-145 - RTO SCI Symposium "Sensors and Sensor Denial by Camouflage, Concealment, and Deception." Brussels, Belgium, 19-20 April 2004. https://www.sto.nato.int/publications/STO%20Meeting%20Proceedings/RTO-MP-SCI-145/MP-SCI-145-16.pdf
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4. “Marine Corps Operating Concept How an Expeditionary Force Operates in the 21st Century.” Department of the Navy, Headquarters United States Marine Corps, September 2016, p. 10. https://www.mcwl.marines.mil/Portals/34/Images/MarineCorpsOperatingConceptSept2016.pdf

KEYWORDS: Signature; Signature Management; Sensors; Materials; Textiles; Clothing and Equipment; Protective Clothing; Dismounted Signature; Infrared

N241-004 TITLE: Atmospheric Water Generation – On The Move (AWG-OTM)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials;Sustainment

OBJECTIVE: Develop an Atmospheric Water Generation – On The Move (AWG-OTM) system in a form factor to occupy a limited footprint within the cargo space of a Utility Lightweight Tactical Vehicle (ULTV) and Joint Light Tactical Vehicle (JLTV) with the ability to scale to support other operational units in multiple operational environments. The system shall be required to leverage Onboard Vehicle Power (OVP) or alternative power sources (e.g., solar or wind power generation) to produce 24 gallons of potable water over a period of 24 hours. The developed system shall incorporate the ability to "add-on" modules to separately purify and treat water from raw and brackish sources.

DESCRIPTION: The USMC currently requires a portable, compact means to generate potable water at the point of need, with or without a water source, to sustain small teams for an extended duration in austere environments. As part of its future force modernization efforts, the Marine Corps seeks to deploy small, disaggregated units to locations where access to life-sustaining resources like water will be limited or unavailable. These units are to specifically support the U.S. Marine Corps' Expeditionary Advanced Base Operations (EABO) a form of expeditionary warfare that involves the employment of mobile, low-signature, naval expeditionary forces that operate from a series of austere, temporary locations.

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

- Support an operational unit of four personnel (T=O)
- Operate at a low temperature of 40°F (T); 35°F (O)
- Produce NLT 12 gallons of potable water over a 12-hour period with a relative humidity range of 30-99% (T); 20-99% (O)
- Can be powered by on-board vehicle power systems (T), or alternative energy sources (e.g., solar, batteries) (O), ensuring average and peak power draw does not exceed vehicle power requirements
- Ensure levels of Toxic Industrial Chemicals (TICs) and Toxic Industrial Materials (TIMs) are within required limits (T=O)
- Can fit, and be secured, in the intended light tactical vehicle (MRZR Diesel, Ultra Light Tactical Vehicle (ULTV), Joint Light Tactical Vehicle (JLTV)) (T=O)
- Provide Mineralization for taste (T=O)
- Provide External potable water storage and purification (T=O)
- Adhere to applicable MIL-STD 810 standards: Environmental, Shock and Vibration, Transportability (T=O)
- Adhere to applicable MIL-STD-1472 standards: Weight, Lifting, Displays, Alarms (T=O)
- Adhere to applicable TB MED-577 standards: Sanitary Control and Surveillance of Field Water Supplies (T=O)
- Achieve complete system integration and integration with vehicle (T=O)
- Achieve regulatory approval of water output
- Operate from current or planned small unit conventional and alternative 28VDC power, and single-phase 120VAC, sources (T=O)
- Require little to no maintenance and is intuitive to operate/appropriate for an incidental operator (does not require intensive training or certification) (T=O)
- Reduce supported operational unit or supporting logistics unit's demand for conventional petroleum fuel and fuel-burning generator operation in the purification of potable water and the distribution/transportation of potable water (TB MED-577) supplies via ground or air delivery. (T=O)

PHASE I: Develop concepts for AWG-OTM systems that meet the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps requirements. 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 addresses technical risk reduction.

PHASE II: Develop 3-5 prototype AWG-OTM systems for evaluation to determine their capability in meeting the performance goals defined in the Description. Demonstrate technology performance through prototype evaluation and modeling over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements; and for evaluation to determine its effectiveness in an operationally relevant environment approved by the Government. Prepare a Phase III development plan to transition the technology to Marine Corps use. The technology should reach TRL 6/7 at the conclusion of this phase.

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. The prototypes shall be TRL 8 at the conclusion of testing.
Commercial applications may include, but not be limited to: humanitarian aid, disaster relief, homeland security, emergency services, recreation, and automotive applications.

REFERENCES:

1. "MIL-STD-810H, Department of Defense Environmental Engineering Considerations and Laboratory Tests." 31 January 2019. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810H_55998/
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5. UTV and ULTV Spec Sheet https://navysbir.com/n24_1/N241-004-REF-5-UTV_and_ULTV-Spec_Sheet.pdf

KEYWORDS: Water; potable; atmospheric; energy; extraction; efficiency

N241-005 TITLE: Electrically Small Antennas at High Frequency

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

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 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, develop, simulate and demonstrate an electrically small antenna using metamaterials that can operate at frequencies from 2–30 MHz. The antenna will be used to transmit/receive Skywave radio-wave signals to provide Beyond Line of Sight (BLOS) communications on Navy aircraft.

DESCRIPTION: In the absence of satellite communication channels, current and future missions require aircraft to communicate at High Frequencies (HF) for BLOS communications. The principle constraint on modern air platforms are size and weight which drives the need for smaller, lighter, efficient radio and antenna technologies. The innovative use of metamaterials has shown to be a promising technology to reduce size and weight while achieving effective power characteristics when compared to conventional antenna designs at other portions of the RF spectrum. Therefore, it is hypothesized that the use of metamaterials in antenna design could dramatically reduce the size of the antenna and may improve other antenna parameters such as enhancing bandwidth and increasing gain at HF. The challenge is to determine if metamaterials can significantly reduce the size and weight of an HF antenna, be affordable, and be suitable for installation on Navy platforms. Innovative solutions are being sought to develop an HF antenna that can meet the design goals shown below. In addition, there is the need for a conformal antenna to minimize drag on the aircraft and reduce risk of damage.

Antenna Design Goals:
(a) Weight—reduced in half as compared to conventional
(b) Volume—1/5 as compared to conventional
(c) VSWR—No worse than conventional, over full frequency range, 2-30 MHz
(d) Gain—3 dB improvement over conventional

Conventional HF Antenna Examples:
(a) Chelton 435 Towel Bar Antenna, appx 8 in. (20.3 cm) stand off from aircraft skin (moldline) by 10 ft long (3 m)
(b) Shunt-fed embedded HF antenna found in airplane vertical stabilizer

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Investigate suitable metamaterials for an antenna at HF, create a digital model, and demonstrate the feasibility of the design to meet the antenna goals defined above. Document—with detailed analysis—the predicted performance with modeling and simulation. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Using the results from Phase I, develop a prototype antenna; demonstrate in the lab, and/or chamber that the prototype can transmit and receive at HF; and measure the performance of the prototype across the frequency band. Work with NAVAIR to perform initial qualification testing on sample sections of the antenna to gain insight into suitability of the design to operate under representative conditions. Deliverables of Phase II will be the prototype array and a final report, which documents the performance of the prototype.

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

PHASE III DUAL USE APPLICATIONS: Further develop the prototype produced in Phase II and work with the Navy to install on a rotorcraft. Demonstrate that the antenna can transmit and receive at HF for a military application.

This technology would be extremely useful for other airborne systems such as law enforcement, safety, and corporate transport. The technology would be helpful for situations where SATCOM is too expensive, not viable (e.g., Polar Regions or deep valleys), and if the SATCOM hardware is too large.

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KEYWORDS: antenna; high frequency wavelength; electrically small antenna; ESA; metamaterials; military helicopters; Beyond Line of Sight; BLOS; Skywave HF Transmissions

N241-006 TITLE: Two-color Mid-Wave Infrared (MWIR) LED Array Infrared Scene Projector (IRSP)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Design a two-color Mid-Wave Infrared (MWIR) light emitting diode (LED) array with a Read-in Integrated Circuit (RIIC) to provide the capability for system design and integration of a high-fidelity Infrared Scene Projector (IRSP) to support testing and evaluation (T & E) of sensor and seeker. Develop a side-by-side structured two-color LED array with narrow spectral bandwidths with two different spectral bands between 3–5 µm.

DESCRIPTION: Chemical sensing, IRSP, and spectroscopy applications require improved MWIR [3–5 µm]) LED arrays. A 1024 X 1024 dual-band MWIR LED array that incorporates narrow-band emission LEDs to provide electromagnetic radiation in two spectral bands is highly beneficial. The narrow-band emission of LEDs will enable more precise spectral emissions for analysis of chemical composition, provide the core technology for smaller, lighter IRSPs, and provide the capability for better wavelength selection of two-color absorption spectroscopy. Narrow-band LED arrays with enhanced efficiencies that increase the brightness of individual LED pixels to replicate temperatures above 1500 K will improve signal levels for both chemical sensing and spectroscopy. The two-color LED arrays of an IRSP will improve the fidelity of projection systems for more effective Hardware-in-the-loop (HITL) and live-virtual-constructive (LVC) testing of missile warning systems (MWS). It will be extremely difficult to meet all these needs using current technologies.

The simulation of range-dependent high-fidelity threat signatures in complex environments for rendering images of HITL engagements is necessary for two-color MWS HITL ground testing and performance evaluation. Enhanced high-brightness LED arrays must provide a high-dynamic range and sufficient bit-depth to render variable thermal environments. Current IR scene projectors based on resistive emitter arrays have performance shortcomings such as low-radiance, slow-frame rates, and small-frame sizes. MWIR narrow-band emission LEDs will be optimized to produce higher in-band radiance at higher frame rates and larger frame sizes than existing technologies. Existing MWIR LED arrays produce photons over a broadband spectrum and have low photon-generation efficiency that affects spectral banded light levels and induces cross-band detection of narrow-band detectors. These issues make broadband LEDs unattractive for narrow-band detection. By contrast, a dual-band IRSP or spectroscopes incorporating two-color narrow-band LED arrays, which exhibit higher efficiency and brightness, will better match detection requirements. A collocated side-by-side two-color pixel design of a two-color LED array will allow independent electrical control of each color pixel and 16-bit continuous wave operation in a 1024 X 1024 format.

This SBIR topic will investigate two-color narrow-band LED arrays with emissions wavelengths centered for chemical sensing, sensor, or spectroscopy detection. The LED array will have a cross-talk value of less than 1% at an effective temperature of 450 K, designed to enhance the MWIR LED efficiency and brightness. Proposed approaches include designing, fabricating, and characterizing two-color MWIR LED arrays using narrow-band emission LEDs that match the in-band MWIR wavelength ranges. An electronically multiplexed LED array suitable for high-fidelity hardware-in-the-loop will have a Phase I LED array approach designed and a Phase II demonstration.

These attributes improve spatial and spectral resolution for chemical detection, IRSP, and spectroscopy applications. Improved chemical sensing and spectroscopy have applications for warfighter battlefield safety. The LED spectral bands will be determined for the warfighter's desired application. The two-color array design will include a RIIC approach with 16-bit capability. The LED will be designed for high-frame rates, low-cross talk, and variable set temperatures to improve the ability to design high-fidelity systems. These design features will improve electrical efficiency, which will improve reliability to lower lifecycle costs. This will allow the test programs to tailor flight test scenarios based on HITL test results, reduce their flight hour requirements, and improve overall test efficiency. For chemical sensing and spectroscopy, this capability will support the needs of the warfighter for the analysis and detection of biological or chemical agents. The Navy is in need of enhanced MWIR scene projectors that are smaller and lighter weight for placement on MWS HITL and flight line T & E.

PHASE I: Write a final report of the design and feasibility of a high-brightness two-color mid-wave-infrared LED array structure including the RIIC concept. The Phase I effort will include prototype plans to be developed in Phase II.

PHASE II: Develop a 1024 X 1024 two-color LED array structure with independently controlled pixels by a RIIC. Demonstrate a two color MWIR (3–5 µm) narrow spectral band (< 100 nm) LED array with a 300–1500 K dynamic range and 16-bit resolution and per specifications based on the research and development of results developed during Phase I for DoD applications.

PHASE III DUAL USE APPLICATIONS: The two-color IR LED array is developed for integration into two-color IR scene projector. Transition the IRSP to the Navy.
A two-color IR LED has potential application for industrial chemical sensing and safety protection. An IRSP has application for both firefighter and medical scenario training.

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KEYWORDS: Mid-Wave Infrared (MWIR); light emitting diode (LED); Infrared Scene Projector (IRSP); EO/IR; sensor; projector

N241-007 TITLE: Multi-Information Distribution System for Software Defined Radios

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Integrated Network Systems-of-Systems; Sustainment

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 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: Research, design, develop, and test (Pilot) a Development, Security, and Operations (DSO) Pipeline for a Software Defined Radio (SDR) Capability.

DESCRIPTION: This SBIR topic will focus on process and cultural innovation for PMA/PMW-101 adopting DSO in accordance with (IAW) DoD CIO Software Factory Guidance. PMA/PMW-101 is moving towards a SDR leveraging Government and Industry Partner Third-Party Applications. The intent is to create a PMA/PMW-101 Sandbox for third-party vendors to innovate, modify, improve, and expand upon the PMA/PMW-101 Software Baseline. The project will improve and provide rigor to PMA/PMW-101's engineering support structure, governance, and technical authority to include software performance, Cyber Security, regression testing, verification, and validation.

Innovation: Implement Continuous Authority to Operate (cATO) and Zero Trust (ZT) policies into PMA/PMW-101's DSO Pipeline. Define, standardize, and implement Application Program Interface (API) IAW DoD Guidance and follow Software Acquisition Pathways. Once the software reaches the end of the DSO Pipeline, the software will be Cyber Security compliant and have minimal risk to the Fleet. Speed to the Fleet: A key aspect to DSO is pushing a low-risk, cyber secure, deployable software product to customers (i.e., aircraft, ships, etc.) for integration into their System of 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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Research and develop approaches on the adoption of DSO cATO & ZT policies, Application Programming Interface (API) DoD Guidance and Software Acquisition Pathways via the following:
1. Identify PMA/PMW-101 software capabilities to transition into DSO Environment .
2. Identify DSO Environment(s) into which to transition.

3. Identify DSO Environment Tools needed with a training path.
4. Identify the process to execute DSO to include a "Sandbox".
5. Develop a transition strategy to go from "On-Premise" to the "DSO Environment".
6. Determine the feasibility of the conceptualized approaches.
The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype that is capable of the following:
1. Pilot – The identified Software Suite to transition selected capabilities into the desired DSO Environment(s) and connect/interface with other selected DSO Environments.
2. Provide PMA/PMW-101 training with regard to DSO Architecture, Engineering, Operations, Security, and Agile Project Management (i.e., Scrum, Scrum at Scale, Large Scale Scrum, etc.).

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

PHASE III DUAL USE APPLICATIONS: Connect and interface PMA/PMW-101's DSO with other DoD DSO Pipelines/Software Factories in compliance with Department of Defense (DoD) Chief Information Office (CIO) Software Factory Guidance. PMA/PMW-101 will provide Program Office funding and support to solidify cATO, and ZT Policies in their DSO Pipeline. Leverage the DSO Pipeline to include the Sandbox for rapid, secure, third-party application prototype and fielding. For example, a third-party vendor would check their software into the Sandbox, verify that the software was compatible with the baseline executable, API, Interface Control Document (ICD), and Security Checks within DoD Policy facilitating risk reduction and maturation of third-party vendor software into our Product Line. This effort saves money, time, and the amount of human resources required to adopt and field innovative products leveraging the U.S. industrial base.

Commercial DSO Environments such as Amazon Web Services and others can leverage the architecture, business rules, and interfaces developed in this effort.

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KEYWORDS: Development, Security and Operations; DevSecOps; DSO; Innovation; Continuous Authority to Operate; cATO; Zero Trust; ZT; Process Improvement; Agile; Overmatch Software Armory; Open System Architecture (OSA)

N241-008 TITLE: Oxygen Sensor for Fuel Tank Environment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop an accurate oxygen sensor that can continuously operate in a fuel tank ullage environment with minimal maintenance required.

DESCRIPTION: On-Board Inert Gas Generator System (OBIGGS) is used to inert areas of the aircraft to reduce the risk of fire or explosions. Fuel tanks may utilize OBIGGS for both survivability and lightning protection, which require below 9% and 12% oxygen by volume, respectively. Feedback of the fuel tank ullage oxygen percentage would allow aircrew to select the proper oxygen concentration set-point for the situation, and receive feedback that the threshold has been reached. Due to requiring clean working environments, currently available oxygen sensors are not suitable for a fuel tank application. The desired oxygen sensor would be able survive in a fuel tank environment, accurately and continuously measure the oxygen concentration, maintain a small form factor, and require infrequent maintenance or repairs. The designed sensor would need to withstand the vibration loads and environmental requirements of a typical fighter aircraft flight profile, and meet the appropriate electrical criteria of a fuel tank environment. The oxygen sensor should be usable on any aircraft that is inerting fuel cells.

PHASE I: Identify the mechanism for the oxygen sensor that can withstand jet fuel and vapor. Develop an experimental bench top design to show the basic functionality and compatibility with the environment. Verify that the oxygen concentration readings are accurate in a lab setting. Develop a plan to address any technical hurdles with the design. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Produce an on-aircraft prototype of the oxygen sensor. Verify that size, power, and interface requirements are met. Perform appropriate environmental testing. Validate and demonstrate the sensor in a testing environment representative of a fuel tank.

PHASE III DUAL USE APPLICATIONS: Produce a final design that is ready for flight test. Provide documentation regarding sensor accuracy, operational limits, and failure analysis. Provide appropriate qualification documentation, including (a) environmental testing, (b) electrical testing/analysis, and (c) explosive atmosphere qualification.
Commercial aircraft fuel tanks could use oxygen sensor technology to ensure the tanks are inert. Additional applications may exist for storing commercial flammable liquids.

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KEYWORDS: Oxygen sensor; On-Board Inert Gas Generator System; OBIGGS; fuel tank; inert; oxygen; sensor

N241-009 TITLE: Adjustable Shock Absorber for Oversized Application

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop a large, adjustable shock absorber that can be tuned prior to compression in order to absorb energy and shock that varies in magnitude from one event to the next.

DESCRIPTION: The Navy requires a shock absorber that is larger in size than typical shock absorbers and that can be adjusted/ programmed to a specific setting prior to an event in order to optimize the resistance (i.e., rate of energy absorption for a given velocity and stroke position) given the expected initial conditions. This shock absorber will be required to dampen initial shock impulses and resist forces applied to it by converting kinetic energy to another form (such as heat or electricity) that can be safely dumped to the ambient environment. State-of-the-art shock absorbers are comparatively much smaller in size than required for this application. Prior research in this area of study has primarily focused on the fields of electromagnetism, and materials and fluid sciences, including rheology and tribology. However, innovative solutions leveraging other advances or developing new technologies are also welcome and encouraged. Although non-mechanical adjustment is preferred, the Navy is open to all ideas and will not limit innovation or disqualify a particular class of concepts. Many Navy and commercial applications utilizing relatively smaller shock absorbers and/or hydraulic cylinders would benefit from this technology if successful. The requirements of this shock absorber are as follows:

1. A shock absorber that is larger in size than typical shock absorbers, and that can be adjusted/programmed to a specific setting prior to an event in order to optimize the resistance (i.e., rate of energy absorption) given the expected initial conditions.
2. The shock absorber shall be required to damp initial shock impulses and resist forces applied to it, converting kinetic energy to another form of removable energy.
3. Heat must be released; electricity must be dumped/recovered.
4. The shock absorber design may include typical components, such as a cylinder, piston rod, accumulator, and check valve; or utilize a completely novel design.
5. Non-mechanical settings adjustment is preferred, but not mandatory.
6. Scalability of this technology is a desired objective.
7. The shock absorber shall satisfy all requirements in the military standards for vibration (MIL-STD-167-1A [Type 1]), shock (MIL-DTL-901E [Grade A]), electromagnetic interference (MIL-STD-461G), and environmental factors (MIL-STD-810H).
8. The shock absorber shall be operable in an industrial and marine environment.
9. Shock absorber shall fit within a space of 23 in. by 23 in. by 109 in. (58.42 cm by 58.42 cm by 276.86 cm) compressed.
10. Shock absorber stroke shall be no greater than 9 ft (2.74 m).
11. The shock absorber weight, including supports, shall not exceed 10,500 lb. (4,762.72 kg).
12. The shock absorber connects to a wire rope via multiple sheaves. Due to the nature of the application, the piston rod (or equivalent) will experience a different amount of input force and speed each time it is cycled. The velocity and force of the cable shock absorber shall be predictable in nature for set input loads.
13. The shock absorber shall be adjustable by adjusting the rate of stroke/energy absorption for low, medium, and high energy events (or with greater granularity).
14. The shock absorber shall compress during an event, and then extend to its original position after an event; this application does not call for a shock absorber that oscillates in the positive and negative directions during operation.
15. The shock absorber shall be adjustable to satisfy all specifications of the existing shock absorber operations.

16. The shock absorber shall be controllable/programmable to provide a force from nominally 0 lbf to 250,000 lbf, throughout its stroke and speed range, with a max stroke of 9 ft (2.74 m) and a speed range of 0 ft/s to 40 ft/s (0 m/s to 12.2 m/s), all while maintaining positive tension on the wire rope.
17. The shock absorber shall be controllable/programmable in its return to starting position by providing nominally 0 lb. to 35,000 lb. (0 kg to 15,875.73 kg) of force and 0 ft/s to 5 ft/s (0 m/s to 1.52 m/s).
18. The shock absorber shall provide a resistive force of up to 35,000 lb. (15,875.73 kg) indefinitely while in its starting position.
19. The tunable shock absorber shall have a minimum of 3 settings.
20. It is desirable that the shock absorber is capable of adjusting its setting within 5 seconds; however, if longer times are necessary to adjust the shock absorber setting, the setting shall be constantly maintained throughout repetitive cycles without deliberate adjustment.
21. The shock absorber shall operate within a temperature range of -13°F and 149°F (-25°C and 65°C) and withstand a storage temperature range of -27 °F and 160 °F (-33 °C and 71 °C).
22. The shock absorber shall provide functionality repeatedly for multiple cycles, at a minimum cycle time of 45 seconds, for 28 consecutive cycles in 21 minutes.
23. The shock absorber will experience cyclic loading so consideration in later phases shall be given to how repeated use will affect performance from a thermal and stress/fatigue standpoint.
24. The shock absorber shall be capable of supporting a cyclic operation sustained rate of 4,200 (Threshold)/5,600 (Objective) total cycles sustained over 30 operating days (12 hrs.).
25. The shock absorber shall be capable of supporting a surge cyclic operation sustained rate of 270 (Threshold)/310 (Objective) total cycles sustained over four (4) (Threshold)/6 (Objective) operating days (24 hrs.).
26. The shock absorber shall be capable of supporting a cyclic operation of at least 500,000 cycles within a 25-yr life without failure in fatigue.
27. The shock absorber shall be capable of monitoring and providing real-time information on the stroke position as well as the conditions of the system (e.g., hydraulic pressure and temperature).

The ability to provide dynamic control throughout the shock absorber stroke is not required.

Innovative solutions leveraging other advances or developing new technologies are also welcome and encouraged.

PHASE I: Design and develop a concept for an adjustable shock absorber that utilizes technologies that will allow it to function at the scale required for this application. Demonstrate feasibility using modeling and simulation, including 3D computer-aided design (CAD), fluid mechanics, stress analysis, control theory, and other appropriate design methodologies. Clearly explain the means by which the shock absorber response is adjusted. Full-scale designs are preferred, even at this preliminary stage, as size is considered one of the primary challenges. Subscale designs are allowable assuming the concept is scalable. A subscale design has value in that it can be used to inform creation of a physical prototype, which will be required in Phase II. If only a subscale design is provided during Phase I, supporting documentation will be required to assess whether the subscale system can be scaled-up effectively to meet requirements. Prepare a Phase II plan that includes prototype development plans.

PHASE II: Design and build a shock absorber prototype based on Phase I work. Prototype design may also include design of a system capable of subjecting the shock absorber to forces that vary in magnitude. Demonstrate the technology by performing preliminary tests that impart characteristic forces on the shock absorber. Utilize sensors and data acquisition to illustrate how the shock absorber absorbs energy/shock, and how the absorption changes when tuned to different settings. Employ iterative design, incorporating changes based on lessons learned during repeated testing. Complete the design, perform final testing, and validate that the concept meets operational needs and will work at scale. Prepare a Phase III commercialization/transition plan that includes construction of a full-scale prototype and verification against requirements.

PHASE III DUAL USE APPLICATIONS: Design, develop, and fabricate a full-scale working adjustable shock absorber based on work completed during earlier phases. Perform final testing at full-scale velocities and forces to validate and verify performance. Demonstrate adjustability by absorbing low, medium, and high energies as described.

Shock absorbers are used in countless mechanical applications in both the private sector and the DoD to attenuate unexpected shocks and in hydraulic and pneumatic mechanical control systems. The most commonly known applications for shock absorbers are in automobiles to prevent excessive bouncing when a vehicle wheel encounters a road hazard or a pothole. With an adjustable shock absorber, a mechanical control system can increase its functional range without being physically replaced, dramatically increasing the functional range of hydraulic and pneumatic control systems.

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KEYWORDS: Shock Absorbers; Hydraulics; Dampeners; Control Systems; Rheology; Tribology; Electromagnetics

N241-010 TITLE: Generalized Fragment Mass Estimation Library from 3D Stereoscopic Data

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Sustainment; Trusted AI and Autonomy

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 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 general purpose fragment mass estimation library that complements high-speed 3D stereoscopic data for use in high-fidelity multiphysics hydrocodes.

DESCRIPTION: High Speed Video (HSV) systems (hardware and software) have evolved significantly over the past 10 years. One relatively new area of study and application involves Three Dimensional (3D) stereoscopic systems based on HSV hardware, which are then utilized to identify fragments in-flight emanating from a warhead. These 3D stereoscopic systems have been evaluated by the DoD for use in fragment characterization tests, usually referred to as “arena tests” with varying degrees of success depending on the metric of interest. Fragment position, speed, and vector information offers the greatest confidence; however, fragment mass remains an elusive parameter in such assessments. This parameter is a key measure in the U.S. Navy’s and DoD’s vision of leveraging advanced diagnostics, and the data generated from these, in the calibration of High Fidelity Multiphysics hydrocodes currently in use. Given these challenges, there is a need for innovative engineering solutions that allows the U.S. Navy and the DoD to bridge the last data gap related to 3D stereoscopic HSV systems by creating a general purpose fragment mass estimation library for use in high-fidelity codes.

Solutions (e.g., General Purpose Mass Estimation Library) must be able to leverage the 3D stereoscopic raw data independent of intrinsic hardware used. Additionally, the solution must generate verifiable and validated fragment mass data from said 3D stereoscopic raw data. The solution must work for all possible types, namely natural (e.g., random shapes), pre-scored and preformed fragments, as well as multiple materials such as—but not limited to—steel, aluminum, titanium, or tungsten compositions. The solution must be able to create accurate mass assessment for fragments in the range of 10 to 2500 grains, traveling at speeds ranging from 500–9000 ft/s (152.4–2743.2 m/s). Mass estimate generated from the solution must be calibrated to have uncertainties less than +/- 4% for fragments at 2500 grains, and less than +/- 20% for fragments at 10 grain levels (e.g., Mass Estimate threshold) from verifiable and validated data source(s). Based on this, the mass tolerance threshold would follow a linear relationship (e.g., Mass Tolerance Threshold [fragment mass, in grains] = 0.0394 * fragment mass + 1.604, Mass Tolerance Threshold has units of grains as well).

Verifiable and validated data sources for calibrating the proposed solution may be, but are not limited to, experimental or other empirical datasets, including any other representative Modeling and Simulation (M&S) techniques. Calibration must be performed at laboratory scale to include full mass scale. The solution may leverage precomputed data/regressions and/or any Machine Learning (ML) techniques. If ML techniques are utilized, open source tools/methods must be leveraged to the greatest extent possible. As part of the solution, a verification and validation package on the general purpose mass estimation library must be created along with any other required SBIR reporting, allowing full transparency to Subject Matter Experts (SME) in the U.S. Navy and DoD.

The solution must be able to generate mass estimates within seconds on a per fragment basis and within minutes for an entire populated 3D stereoscopic raw data set potentially consisting of thousands of fragments. The solution must have an appropriate and well-documented interface or Application Programming Interface (API) if relevant, so that other software tools may be able to leverage it effectively. The solution must be compatible with use inside modern Operating Systems (OS) such as Microsoft Windows and Linux. The solution must provide clear text data output consisting of estimated mass, as well as any ancillary graphical depiction of the post-processing results including statistical uncertainties in output values.

PHASE I: Identify and evaluate potential technologies/methodologies applicable for the solution. The feasibility study may include limited/initial lab scale test or M&S efforts that help provide grounding to a proposal/study. A preliminary design of the general purpose library and methodology will be performed that includes identification of current/future resources in the form of existing software packages and/or empirical or M&S datasets. Create (1) a preliminary engineering development plan that includes an evaluation of potential numerical/ML methodologies, calibration plans, and testing program needed and (2) a preliminary post-processing and analysis plan for the general purpose library that includes the proposed analysis/computational logic flow needed in order to meet the mass estimate uncertainties across the range of parameters indicated. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a working prototype. Demonstrate the prototype, including applicable testing of any post-processing features, and with laboratory scenarios/data including full scale scenarios, with comparison of the output data and associated uncertainties. Proposed solution must demonstrate capability for expansion in light of new test or M&S data enhancing the verification and validation package. Integrate the solution into a larger software package as directed by the Government or provide technical support in the event that the Government integrates it. Deliver source code, binaries, libraries, trained ML, verification and validation package, design specifications, configuration and user's manual for Government evaluation. Provide technical support for Government use of prototype libraries within a larger Community of Interest of Subject Matter Experts (SMEs).

PHASE III DUAL USE APPLICATIONS: Transition the updated solution to the U.S. Navy. Receive feedback from users and perform/release updates addressing feature requests and bug fixes. Enhance the text and visual capabilities per user feedback along with the verification and validation package expanding into further fragment ranges. Provide continuing technical support for Government use of libraries within a larger Community of Interest of SMEs. Update the technical report and user's manuals as required.

Commercial applications involve DoD contractors supporting the Tri-Service community, the Department of Homeland Security, the U.S. Coast Guard, the FBI, and other Government Agencies interested in fragment/debris flyout. Additional interest in this technology includes, but is not limited to, the motion picture industry, chemical manufacturing, the oil and gas industry or any other organization that utilizes high-pressure vessels, and is concerned about accurate characterization of flying debris or fragments from industrial accidents.

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KEYWORDS: munitions; warhead characterization; fragments; mass estimation, hydrocodes; Machine Learning

N241-011 TITLE: Generative Artificial Intelligence for Scenario Generation and Communications Analysis

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 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 the capability to rapidly generate high threat density scenarios with tactically representative red (adversary) threats that adapt in real time. Additionally, this effort will develop the capability to conduct automatic analysis of blue (friendly) communications to understand speed and accuracy of information exchange.

DESCRIPTION: As the carrier airwing of the future prepares for the high-end fight, the training paradigm will shift to almost exclusively Live, Virtual, Constructive (LVC) environments due to expanded range capabilities of the peer threat competitors and Operations Security (OPSEC) considerations. As a result, warfighters are able to train as they fight with higher fidelity scenarios that more accurately represent red kill chains. This high-fidelity, data rich environment provides unique opportunities for instructional strategies to better support end-to-end training and improve readiness. Specifically, LVC environments increase the amount of—and access to—data that can support improved scenario generation, performance assessment, and debrief when utilized appropriately. However, LVC training is not without its challenges. These challenges include resource requirements to develop these high-fidelity scenarios as they can be cumbersome and labor intensive. Moreover, scenarios that do not contain significant variations may lose utility very quickly as operators can begin to anticipate scenario outcomes after a few exposures. Consequently, a need exists for rapid generation of real-time, adaptive, high-fidelity scenarios. Additional challenges lie in the assessment of performance. The carrier airwing of the future will rely on integrated tactics that require a level of coordination and information exchange across platforms that have not been required in past tactics. The complexity of coordination associated with integrated tactics necessitates a significant amount of voice communications across the different platforms to provide Situational Awareness (SA) and elicit decision-making. While communication is critical to cross platform coordination and overall tactical execution, it remains one of the most challenging training objectives to meet during Air Defense events.

As such, this effort seeks to alleviate identified challenges with scenario generation and performance assessment through the investigation of generative artificial intelligence (AI) (e.g., DALL-E, ChatGPT) or other forms of AI to support scenario generation and communications assessment. This SBIR effort shall focus on utilizing AI to learn from pilot-in-the-loop red threat behavior to rapidly generate constructive threat presentations that adapt to trainee behavior in a tactically feasible manner. Additionally, AI shall be applied to further the state-of-the-science in communications analysis [Ref 6]. Specifically, AI shall support analysis of blue recorded communications and provide an initial assessment in terms of accuracy of the words said (relative to ground truth) and speed at which they are said. This analysis will include digesting communication recordings, assessing quality of communications-based accuracy and speed, and then providing these results via automated debrief.

These capabilities will improve the quality of training and readiness via end-to-end training enhancements. First, high-fidelity Air Defense scenarios that can be rapidly generated and are adaptive will yield greater training utility and provide cost avoidance associated with scenario development manpower and human-in-loop threat support manpower. Next, development of a communications analysis and debrief capability will improve SA, and decision making will benefit the Fleet by decreasing instructor workload, reducing human error and manpower time requirements, and automatically provide instructors with information on communication protocol adherence and timeliness to improve SA and increase debriefing capabilities.

This effort will specifically look at Air Defense training scenarios within LVC environments to increase speed at which high-fidelity, adaptive scenarios can be generated and assessed to enhance operator performance. This capability will be developed with the intention of a transition path to the Next Generation Threat System (NGTS).

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Research and develop an integration plan for development of a proof of concept, standalone, capability to rapidly generate high-threat density scenarios with tactically representative red threats that adapt in real time. This will include investigating unclassified sample data to determine appropriate AI models for future development. Additionally, Phase I will focus on identifying the most appropriate AI model or models to support automatic analysis of blue communications based on accuracy and speed results. An unclassified sample dataset will be provided to help support this investigation and to understand speed and accuracy of information exchange. Both objectives will use generative or other forms of AI. Performance assessment should focus on communications but may also include tactical assessments. Noise filtering shall be investigated to support communication analysis as the noise content in the operational environment for Air Defense is significant.

Demonstrate the feasibility of application into the larger, integrated training system. The plan shall detail integration into NGTS to allow for transition into an operational LVC environment. Additionally, the plan shall include a Subject Matter Expert (SME) evaluation of capabilities and methods for conducting an Analysis of Alternatives to identify best practice method moving forward for training delivery.
Provide prototype plans to be developed under Phase II.

PHASE II: Research, develop, design, and deliver a proof-of-scenario generation and communication assessment capabilities for Air Defense training scenarios through execution of the integration plan developed in Phase I. During Phase II, the sample data provided will be more tactically and operationally relevant and classified at the SECRET level. Developers can expect the scenarios to be more tactically complex, have larger amount of communication, and communications will include significant background noise. Noise will include, but is not limited to, background noise (engines, alerts, etc.), static, and the like. Integration with NGTS will enhance the capability with scenarios and performance data already resident in NGTS. Design and develop the tool to include visualizations, usability documentation, and technology evaluation. Demonstration of the tool, along with documentation of usability of the training software is critical. Risk Management Framework guidelines should be considered and adhered to during the development to support information assurance compliance.

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

PHASE III DUAL USE APPLICATIONS: Introduce additional data from NGTS as well as other Live-and-Virtual entities within the scenario. Scenario generation shall be enhanced to include external (live and/or virtual) entities. The AI implementation should account for any differences or effects external entities may have on the AI model. The voice communication assessment capabilities shall be flexible as to be deployed in varying training configurations. Training locations may differ in their setup of radios and networked communications, which will require easy and configurable settings and controls. Integration testing and demonstration of capabilities will be conducted in a distributed simulation via Distributed Interactive Simulation (DIS) protocol at the SECRET level. Software shall be integrated with NGTS to facilitate transition into operational LVC environment. Documentation and any supporting materials shall be delivered to NGTS team for maintenance and future enhancements.

The AI voice assessment model can be leveraged in the private sector as a speech-to-text model in environments with high noise or when non-standard English speech is in use, such as the brevity communications made during a tactical aviation scenario. Most AI speech models are trained with common English phrases. The data and voice communications from the tactical aviation domain will provide more robust speech-to-text analysis for the private sector in areas such as air traffic control or brevity communications training.

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KEYWORDS: Artificial Intelligence (AI); Scenario Generation; Communications Assessment; Voice Analysis; Live, Virtual, Constructive; Automated Debrief

N241-012 TITLE: Real-Time Thrust Control of Solid Propellants

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics;Sustainment

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 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 throttle a solid propellant rocket motor where a rocket motor can be fabricated, and the performance (thrust/time) can be selected at ignition or modified during motor operation, allowing for smart/networked weapon systems that can also fill multiple warfighter needs and respond to evolving threats.

DESCRIPTION: Currently, solid rocket motors are designed to achieve a specified thrust profile based on a detailed analysis of assumed mission needs. Over the course of many years and significant investment, the solid rocket motor is designed, tested, and qualified to achieve this predetermined thrust profile. Thus, when a new missile enters the field, there is a precisely known thrust profile and capability; however, this limits the system to specific and planned threat engagements. Changes to the specified thrust profile result in costly grain redesign and requalification. As new gaps are identified, new missiles are developed to fill those gaps. This increases the number of boutique missiles the military must now manage with the associated logistical footprint.

This SBIR topic seeks to develop a solid propulsion system technology that allows for modulation of thrust at time of launch or during flight to optimize missile performance relative to real-time mission objectives. Real-time thrust control of solid propulsion is a game-changing technology that has the ability to enable collaborative munitions where in-flight missiles can be redirected and throttled to engage evolving threats. Throttleable solid propulsion will also allow for mission flexibility or multi-payload, single-motor capability. When a single system is able to support multiple roles, the need for new boutique systems is reduced, as are the associated development costs.

Thrust control of solid propellants has been demonstrated to varying degrees with technologies—including pintle nozzle—to control the nozzle throat area [Ref 1], high-pressure self-extinguishing propellants [Ref 2], pulsed motors [Ref 3], and electrically-activated propellant [Ref 4]. Some of these technologies are currently utilized in fielded rocket motors because of their ability to control thrust, but their use is very system specific and their thrust control is limited. This topic seeks new or evolved approaches to thrust control of solid propulsion systems. The technology may be complimentary to other thrust control solutions to build a more dynamic overall system.

The objective of this topic is to develop a technology that can create effects on an energetic system to allow for the variation of thrust/time within a rocket motor. The developed technology should maximize compatibility/usage of existing rocket motor materials (propellant oxidizers and binders, insulation, liners, motor cases) and existing industry fabrication methods, as well as leverage industrial best-practices and minimize transition hurdles. The technology needs to minimize the size and weight impact on the rocket motor as gains in flexible energy management can be lost to parasitic weight. Additionally, the technology needs to have a path to be usable in the challenging thermal (-65 °F–150 °F) (-53.9 °C–65.5

°C) and mechanical environments (shock/vibe) required to enter military usage. Hardware and software required to integrate with the technology also needs to be considered as the technology matures.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Identify and design a concept for real-time thrust control of a solid propellant rocket motor. Outline how the concept works (how and where effects are placed on the rocket motor to modulate thrust) and identify the individual components needed for insertion into a rocket motor. Maturity of the individual components will be assessed relative to the development needed for use in a solid propellant rocket motor. A notional system will be developed to demonstrate the bounds for thrust control. Lab scale testing and/or analysis will be performed to demonstrate the feasibility of the concept's ability to control rocket motor thrust. Testing may or may not include energetic material. Prepare a report outlining the findings of Phase I plus a technology maturation plan for Phase II. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a Phase II series of prototype rocket motors for evaluation. The prototypes will be used to evaluate the ability to achieve a wide variation of thrust/time profiles from identical motors. The prototype rocket motors will all be identical in design and materials (propellant, nozzle dimensions, igniter, etc.), so that testing can be done on any motor to achieve the desired thrust. The motor size will be based on the capability of the small business, but the propellant grain will not be smaller than 2 in. diameter X 4 in. length (5.08 cm diameter X 10.16 cm length). Pretest ballistics will be performed for each test to determine the thrust/time profile. The thrust/time profile will be preprogramed before each test. Post-test comparisons will be conducted to update models and ensure the prototypes are performing in a reasonably predictive manner. The intent is to demonstrate four different thrust/time profiles from identical prototype rocket motors. During Phase II, the sub-components will be identified and tracked for maturity. A final report will be provided that outlines the prototype design, fabrication, and testing. The report will also outline the less mature aspects of the technology and provide a plan to further mature the technology in Phase III.

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

PHASE III DUAL USE APPLICATIONS: Mature the thrust control technology, based on the results of Phase II, for higher fidelity static fire demonstrations. The developed rocket motors will be flight representative with subcomponents fitting into the cylindrical rocket motor (motor case and nozzle can be heavyweight if required). It is still allowable to have an external control unit to modulate the thrust. Demonstrate two static firings of identical rocket motors with different thrust/time profiles. Provide a final report that documents the design and testing results, includes a Technology Readiness Level (TRL) assessment, outlines the volume and mass requirements for a thrust-control system in a tactical missile, and outlines a path to further mature the technology.

The development of solid propellant thrust control would have applications to space-based systems including launching of satellites and satellite maneuvering.

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KEYWORDS: Solid Propulsion; Thrust Control; Throttling Propulsion; Energetic Material; Rocket Motor; Smart Munitions

N241-013 TITLE: Multi-target Bayesian Tracking for Air Anti-Submarine Warfare (ASW) Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment; Trusted AI and Autonomy

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 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 Bayesian tracker for Air Anti-Submarine Warfare (ASW) systems to improve tracking metrics when multiple targets (or target-like objects) are present in wide-area search missions.

DESCRIPTION: Future Air ASW missions will cover larger areas than currently fielded systems and must operate in scenarios with multiple targets and surface ships, including: finding a single submarine in regions of high surface ship traffic (fishing fleets and shipping lanes), detecting multiple adversary submarines that are closely spaced and following similar paths (wolf packs), or coordinating search activities with U.S. Navy surface ships and submarines. Improvements to track initiation and measurement association are necessary to maintain reliable system performance in these challenging scenarios.

Currently fielded track-before-detect approaches assume that a single undetected object such as a submarine, surface ship, or persistent clutter object, may be in the field at any given time, and as a result, performance is degraded when multiple objects ought to be promoted to contact followers at once. In addition, single hypothesis tracking can lead to confusion for low Signal-to-Noise-Ratio (SNR) targets with a significant number of clutter detections inside typical association gates. In the difficult association situations described previously, where tracks may cross or converge, the need for innovative approaches to the association problem are even more necessary. Advances in Bayesian tracking techniques have been developed to address these problems, even in the presence of substantial stationary clutter.
Successful approaches to the multi-target tracking problem will initiate contact followers when multiple targets (or target-like objects such as surface ships) are present in the field, and maintain track integrity when multiple tracks are temporally and spatially close (within the area of uncertainty of a single measurement).

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating

Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Design and develop an approach which reduces track initiation time by 30% when multiple objects are detected near the beginning of a mission which currently takes up to 10 pings. Show the proposed approach reduces false associations by 25% versus nearest-neighbor association when multiple targets are within the area of uncertainty of a single measurement. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop prototype multi-target tracking software. Demonstrate that the software prototype reduces track initiation time by 50% and reduces false associations by 33% in at-sea data.

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

PHASE III DUAL USE APPLICATIONS: Integrate the algorithm into the fleet-approved system for the Aircraft. The technology could be used in any field where Geo tracking is necessary. These technologies include Maritime tracking, Aircraft tracking, or Surface traffic tracking.

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KEYWORDS: Bayesian; Anti-submarine Warfare; ASW; Tracker; Multiple Targets; Clutter; Probability

N241-014 TITLE: Non-Destructive Evaluation for Corrosions/Defects of Naval Air Vehicles

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment; Trusted AI and Autonomy

OBJECTIVE: Develop an imaging system suitable for in-situ detection of hidden corrosions/defects in naval air vehicles.

DESCRIPTION: The deleterious consequences of fatigue and fracture in metallic structures arising from local microstructure, mechanical loading, thermal effects, and the corrosiveness of the maritime environment, usually lead to corrosions/defects of aircraft landing gears or other naval aerial platform surfaces. At the burgeoning of the corrosion/crack/fracture/damage, the damage areas are underneath some kind of protective coating or paints and therefore render conventional visible early inspection and evaluation ineffective. Early detection of the corrosion and related defects is critical, as it would reduce the remediation cost, improve the operational safety, and minimize mission downtime of fielded assets. Traditional methods for detecting corrosion defects are inefficient, and involve costly removal and replacement of the coatings and paints for visual inspection of the underlying surface. Removal and replacement of these polymer or painted sections involve costly operations in terms of labor and materials costs.

This SBIR topic seeks a solution of non-destructive evaluation (NDE) of hidden corrosion underneath paints or polymers. Corrosion of aluminum alloys generally develops as pitting or thinning, and in general changes a nominally smooth surface to an uneven and irregular surface, which can then result in cracking. The detection of this type of corrosion is not within line of sight. The detection of corrosion on aluminum formers that are under composite skins without disassembly would be very beneficial. Inspection through top coats would be ideal. The proposed solution should be able to detect defects with sizes greater than 0.005 in. (0.0127 cm) on a curved surface with a radius of curvature 2 in. (5.08 cm) radius or less. The proposed solution should be able to detect fastener corrosion. The proposed method should also detect corrosion on fastener threads without the need for disassembly.

This SBIR topic focuses on development of technologies that will image corrosion and defects through coatings and paints rapidly enough to support a sampled or completed NDE of an aircraft. The system should be portable that weighs no more than 12 lbs. (5.44 kg), be capable of expected constant system mobility without need for recalibration more than once annually, and sufficiently robust for operations under harsh maritime environmental conditions. The system needs to be in compliance with all FCC regulations. The preferred system prototype solution should yield detection results as close to real time as possible, and be equipped with a graphical user interface that is easy to use and understood by an operator with relevant training. It is also expected that any proposed system should have built-in wireless capability that can send imaging data to a remote user system for further detection analysis and evaluation.

PHASE I: Develop an imaging system with the capability to meet the operational, frequency, SNR, minimum corrosion/defect size, minimum paints/coatings thickness, and graphical user interface and wireless transceiver as stated in the Description. Detection of a defect is defined as the ability to accurately distinguish the defect from surrounding regions that do not contain the defect, and display the location and size of the defect in a graphic user interface. Demonstrate the feasibility of the concept to detect the aforementioned hidden defects via modeling and simulation. Concept feasibility will be supported by appropriate analyses and laboratory experiments. Provide a Phase II development plan that includes performance goals and key technical milestones. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype suitable for evaluation. Evaluate the performance of the prototype with regard to the goals defined in Phase I on a Navy provided test panel that is equivalent to testing on an in-service Navy asset under similar field conditions. Based on the initial results of the evaluation, refine the prototype and demonstrate that the final prototype meets the performance specifications stated in the Description. Deliver the final prototype at the end of the Phase II that is ready for field testing by the Navy.

PHASE III DUAL USE APPLICATIONS: Transition the technology into a system that can be acquired by the Navy. The Phase III plan should include testing, validation, certification, and qualification for Navy use.

With the ability to inspect aluminum material/structure under polymer and paint, this will provide the private sector with new instrumentation for detecting degradation of aluminum material. This instrumentation will certainly improve the maintenance of commercial aviation assets.

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KEYWORDS: Nondestructive Inspection; NDI; Corrosion detection; aluminum formers; fastener corrosion; imaging corrosion; Al corrosion

N241-015 TITLE: Enhanced Emissivity in High-Speed Window Materials

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Space Technology

OBJECTIVE: Identify and develop methods to enhance the emissivity of sensor window materials capable of surviving high-speed flight environments.

DESCRIPTION: Weapons technology advancement has been driving missile systems to strive for greater speeds, ranges, and accelerations; all of which put much greater thermal and mechanical stresses on the system. Often the weak link in these designs is the sensing aperture, whether it be an Electro-Optic/Infrared (EO/IR) window or a Radio Frequency (RF) radome. In addition to being a structural material, these must also be transparent within the relevant wavebands, and maintain this transmission throughout the flight. This limits material choice significantly, and forces performance trade-offs to survive the high enthalpies.

Over the duration of a flight profile, transient heating of a window typically involves an energy balance of convective heat transfer, radiative heat transfer and conduction between the window, the external environment the weapon is flying through, the internal environment of the weapon, the weapon structure the window is attached to and the radiative exchange between the window and both the external and internal environments. The majority of the flight profile results in a strong convective aeroheating input into the window with some periods of aerocooling where the window is hotter than the surrounding recovery temperatures. As the window rises in temperature, radiative heat loss to both the external and internal environments also occurs. As the window temperature gets hotter, the magnitude of that radiative heat loss increases by a factor of temperature to the fourth power and at higher temperatures can result in equilibrium temperatures hundreds of degrees cooler than without the presence of radiative heat loss. Heat removal due to convection is limited in effectiveness due to the flight speeds involved and the negative effects of relying on internal convection to sink heat to the interior of the weapon. Enhancing the conduction of windows is limited in effectiveness without unintentionally altering the electromagnetic properties; plus the structural attachment location of the window is at similar temperatures, preventing the needed thermal gradient to conduct heat away into those surrounding structures. Radiation, however, is different; while the distribution of energy “available” to be radiated is simply a function of temperature (known as the blackbody curve), each material has its own emission spectrum, which describes at what wavelengths energy can be emitted. There is often, and in the case of IR windows necessarily, a gap in which the material cannot emit radiation. If part of the blackbody curve lies within this gap, that energy cannot be radiated, and as such can’t contribute to cooling the window.

This is particularly a problem for IR windows, which rely on this gap in order to function. The typical mid-wave IR (MWIR) band is from 3–5 µm, meaning there can be little to no emission within these wavelengths, and typically not much below this as well. Even at the relatively low temperature of 500 °C, nearly 50% of the available energy lies between 1 and 5 µm, where essentially no emissions are expected to occur. This only gets more significant as temperatures climb and the blackbody curve shifts to shorter wavelengths.

If even narrow emission peaks could be engineered at shorter wavelengths, without interfering with the desired transmission window, it could increase energy dissipated through radiation drastically. At 1000 °C, a half micron band centered around 2.25 µm contains 15% of the energy available in the entire spectrum, roughly the same as all emission above 6 µm (which is about where state-of-the-art MWIR windows begin emitting). If this unused energy can be taken advantage of, the range of environments a window could operate in could be greatly expanded, and with it the mission space and possibly the performance of the system as a whole. A similar approach was used on the space shuttle, with the black tiles on the bottom used to maximize emissivity; it just didn't have the complication of needing to be a functioning aperture.

A successful project would produce a set of test articles demonstrating a significant increase in emissivity while maintaining transmission characteristics at high temperatures (> 1000 °C for IR materials, > 1250 °C for RF materials) within the chosen waveband (MWIR, X-Band, Ka-Band, etc.). The test articles must also demonstrate resiliency to stresses which would be encountered in high-speed flight. Testing for this may vary depending on the proposed solution, but may include: high high-temperature mechanical tests, thermal shock tests, electrical tests, arcjet/plasma torch testing, and microstructural examinations.

PHASE I: Develop a process/material that demonstrates significantly increased emissivity of the chosen window material without degradation of transmission in the relevant waveband. Show that the concept can feasibly meet the requirements of high-speed flight through analysis, modeling, and/or characterization of materials of interest. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop and deliver notional full-scale prototypes (minimum of two) that demonstrate functionality under the required service conditions, including thermal and mechanical stresses. Produce sufficient test samples for material characterization efforts to show viability for high-speed flight as described in the Description section.

PHASE III DUAL USE APPLICATIONS: Work with a program office to produce a system-applicable window. Participate in qualification testing equivalent to the system, including environmental and hypersonic wind tunnel testing.

There have been some recent efforts looking into controlling emissivity to provide efficiency increases in thermophotovoltaic power generation, which this could possibly feed into. Space applications are also possible, as the only way to dump heat in a vacuum is through radiation. There could be some niche private sector applications, which utilize high-temperature windows as well, but unless commercial high-speed travel grows, this market is limited.

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KEYWORDS: Window; Aperture; Hypersonic; Emissivity; Infrared; Radome

N241-016 TITLE: Frost Icephobic Coating for Subfreezing Environmental Control Systems (ECS) Components

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an icephobic coating that mitigates frost formation on downstream heat exchangers inside an Environmental Control System (ECS) environment for extended periods of time with minimal maintenance required.

DESCRIPTION: Unconstrained thermal operations for an aircraft is driving integrated thermal management designs. Condenser icing is a limitation for an aircraft air conditioning system using a high-pressure water separator to remove moisture from cooling air.

Inside the aircraft's ECS, frost can occur downstream of the Air Cycle Machine's (ACM) turbine outlet where the turbine expands the air and drops the temperature. Most ECSs are open loop in design, allowing moist air into the system, and that moisture can reach the turbine outlet cold area. To mitigate that moisture impact, high pressure water separators are utilized to remove the majority of the humidity. In addition, hotter air (trim air) is routed at the turbine's outlet to the condenser heat exchanger to prevent the temperature from going below freezing (example 35 °F–40 °F [1.67 °C–4.44 °C] as the controlled temp) [Ref 2]. This trim air wastes overall bleed air and limits the overall cooling capacity of the ECS due to the temperature regulation above freezing. The reheating and cooling of the bleed air in the water extraction process is carried out in a cross-flow plate-fin or tube heat exchanger called the condenser. The condenser causes water droplets to form on the hot side fin surfaces from the process of heat transfer from a cold side air/fluid stream. Frost can form on the cold side due to less than 100% water separation. On the hot side, frost can form due to bleed air cooling below its dew point during certain flight conditions [Ref 2]. Ultimately, frost buildup leads to ice accretion shedding, increasing pressure drops affecting the ACM performance, and greater thermal resistance [Ref 2]. Newer ECS designs (subfreezing condensers) aim to eliminate more moisture and mitigate icing from forming quickly on components downstream of the turbine's outlet. However, even lower temperatures lead to quicker frost formations on the condenser exchanger and duct interfaces.

The simplest approach to mitigate these frosting issues is to design fin surfaces that prevent frost formation in the first place. Such an approach can be accomplished by encapsulating target surfaces with an icephobic (ice resistant) coating. The difficulty in mitigating ice and frost in subfreezing temperatures using icephobic coatings/surface treatments is that fast impinging moisture freezes very quickly, penetrating the coating microstructure and locking/anchoring the ice in place. In addition, icephobic coatings are typically used to facilitate ice shedding, but this SBIR topic seeks surface treatments that can prevent condensed droplets from freezing into ice in the first place. New or alternate icephobic coatings/surface treatments for heat exchanger geometries that could potentially eliminate frost growth by preventing freezing of condensed water or direct deposition of water vapor to ice crystals on the surface is the primary goal of this topic. Metrics for performance will include water condensation rate, decreased frost onset time, and reduced frost thickness.

PHASE I: Demonstrate the feasibility of the proposed formulation for the icephobic coating/surface treatment to minimize ice formation in heat exchanger/condenser components that are inside the ECS. Identify the anticipated merits of the preferred solution related to thermal performance, manufacturing, installation, durability, and cost. Develop a plan to address any technical hurdles with the coating/surface treatment. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Fully develop and analyze the selected Phase I solution for a range of condenser environments and frost icing conditions. Develop subscale and/or full-scale hardware to demonstrate the selected approach for a representative heat exchanger geometry and establish the technology and manufacturing readiness level.

PHASE III DUAL USE APPLICATIONS: Produce a final icephobic coating/surface treatment that is ready for primary applications in advanced military fighter aircraft and possibly future commercial applications. Provide documentation for icing and ECS operational limits. Provide appropriate qualification documentation for environmental testing.

The icephobic coating technology could be used on commercial aircraft ECS. Additional applications may exist for naval refrigeration applications.

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KEYWORDS: Icephobic; coating; heat exchanger; icing; frost; condenser

N241-017 TITLE: Speedy UAV Swarms Detection, Identification, and Tracking using Deep Learning-Based Fusion Methodology for Radar and Infrared Imagers

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate an innovative deep learning-based fusion methodology for speedy radar and infrared cameras that can effectively detect, identify, and track unmanned aerial vehicle (UAV) swarm with high probability of detection and low probability of false alarms in the best overall track accuracy within the processing and time constraints availabl.

DESCRIPTION: The use of UAVs of various sizes and shapes is growing very rapidly for a wide variety of defense, commercial, and other applications. Along with their advantages in ease of operation and low cost, the widespread availability of UAVs has posed significant security threats in both defense and civilian arenas. As part of the effective UAV threat mitigations for the DoD, it is first necessary to be able to detect and identify UAVs in the airspace in a timely manner before UAV interdiction strategies can be executed arenas [Refs 1-3]. Straightforward adoption of currently fielded airspace surveillance technologies will not suffice as UAVs are much smaller in physical size and fly at lower altitudes. Furthermore, recent advances in UAV technology have enabled the capability of large swarms of UAVs flying together in either uncoordinated or coordinated groups. These UAV swarms with continuously growing swarm sizes pose an even more serious and emerging threats to the Navy forces, assets, and installations. These UAV swarms pose additional challenges to counter them over that posed by dealing with UAVs one or two at a time. In fact, there are reports that suggest that the Chinese military is strategizing attacking the U.S. aircraft carrier battle groups with swarms of multi-mission UAVs during a conventional naval conflict [Ref 4]. Many target detection and tracking systems rely on passive medium wavelength infrared/long wavelength infrared (MWIR/LWIR) thermal infrared cameras. LWIR camera in particular offers unique advantages and their performances are not adversely degraded from scattering by water-based aerosols, snow, rain, fog, and clouds in the atmosphere. However, it is still challenging to detect and identify small UAVs using IR imagers alone due to the low contrast in the thermal imagery, especially in environments cluttered with background noise. The various growing configurations of current and emergent UAVs and growing threats of UAV swarms, make a single optimized sensor solution in a timely fashion impractical and ineffective. The breadth of this UAV swarm threat is both wide in scope and deep in complexity. It therefore warrants a more capable solution tailored for different circumstances. To maintain a more robust situation awareness and to provide much improved protection for naval assets and forces against current and future UAV swarm threats, it is therefore logical to consider a speedy counter UAV swarms system comprising of a suite of multiple sensors with different modalities [Ref 4].

It is the objective of this SBIR topic to develop sensor fusion methodology from phased array radar system [Ref 5] and MWIR/LWIR infrared cameras to combine data from different and orthogonal modalities to generate inferences that would not be possible from a single sensor alone. To deal with a large swarm of targets, a phased array radar system can steer a narrow beam quickly to identify and target multiple targets in multiple directions simultaneously without having to physically move the system, as opposed to a spinning antenna from a legacy radar system. The target scope of data fusion from multiple sensors is to achieve much more accurate and faster results in UAVs detection, identification, and tracking than those derived from single sensors, while compensating for their individual weaknesses. Fusion of multiple sensors in a UAV swarms target acquisition and cueing system requires managing, interpreting, and analyzing a large set of heterogeneous input data. It is also expected that the sensors fusion and the detection/tracking algorithm would enable the detection, identification, and tracking of the UAV swarm in a matter of a few seconds instead of minutes. The low system latency of detection/identification/tracking of swarms of increasing UAV numbers is particularly critical in combat scenario to allow sufficient time to counter the threats. Recent advances in deep learning presents the ability to manage diverse and complex data. In particular, deep learning technique enables learning relationships between dissimilar input signals, such as the behavior pattern and relationship of the UAVs within a swarm. Multi-sensor learning is capable of understanding in detail real-world problems, as well as filling the missing or corrupted sensor data. Deep learning-based algorithm combined with multiple sensors for counter UAV swarm application has never been developed before for low-latency target detection and tracking. In order to exploit the advances in LWIR/MWIR imaging, radar systems, and deep learning, the Navy is seeking an innovative, game-changing approach in this application of deep learning on multi-sensor data fusion and exploitation system for accelerated UAV swarm detection, identification, and tracking.

Fusing tactical data from radar and infrared cameras poses significant challenges due to the diversity and complexity of the data, for example track count, accuracy, update rates, and uncertainty. The data sources often have different formats, resolutions, and phenomenologies, making it difficult to correlate the data accurately. Additionally, the tactical data can be affected by external factors such as weather, environmental conditions, and UAV swarm movements, which can lead to misinterpretation or misclassification of the data. Fusion algorithms must be able to handle these challenges and effectively fuse the tactical data to provide a reliable, real-time view of the UAVs swarm with the following performance:
First, the system must be able to ingest data from radar and infrared cameras in real time or near-real time, while maintaining data quality and consistency.
Second, the system must be able to normalize the data to ensure consistent data models, allowing for accurate correlation and temporal and spatial fusion of the radar and infrared camera sources.
Third, the system must be designed to handle the challenges associated with radar and infrared camera data, including different formats, resolutions, and phenomenologies. Due to differing collection footprints and inconsistent collection overlap of radar and infrared cameras processing their individual data and focusing on information level fusion (e.g., knowledge graph fusion) is acceptable.
Fourth, the system must be able to provide decision makers with a clear, accurate, and actionable view of the UAV swarm, improving classification confidence, and enabling effective decision-making with: (a) a probability of UAV swarm detection-to-track more than 90%; (b) a classification accuracy of more than 90% across the set of UAV swarms when only trained on simulated data; (c) a probability of false alarms less than 10% at the UAV swarm detection range up to 10 km; (d) common atmospheric obscurants reducing the visible transmission coefficient at UAV swarm detection distance down to less than 10% relative to that in vacuum; (e) the UAV swarm appearing a couple of pixels wide in a dim setting; (f) techniques to automatically analyze the data associated with UAV swarm tracks, hypothesize, and make ID classification over processed spatial resolutions of 2–70 cm/pixel; and (g) a deep-learning model and the algorithm having a provision that allows a growing library of current and future-generation UAVs.

PHASE I: Design, document, and demonstrate feasibility of a robust deep learning-based algorithm for a fusion system of radar and MWIR and LWIR cameras of the developer's choice that meet or exceed the requirements specified in the Description. Identify the technical risk elements in the detection, identification, and tracking algorithm design for a UAV swarm of over 10 UAVs and provide viable risk

mitigation strategies. Demonstrate the feasibility of the approach utilizing commercial off-the-shelf (COTS) computer for the algorithm to perform at a 5 Hz or higher solution rate.
The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop, optimize, demonstrate, and deliver the fusion algorithms developed in Phase I for the selected system of radar, MWIR, and LWIR sensors for this project. The designs will then be modified as necessary to produce a final prototype. Work with the government team to test the algorithms against data collected from candidate sensors relevant to the Navy. Pertinent information will be provided to the awardee if necessary. Collect relevant training and testing data using contractor-provided UAV swarms of interest with at least 10 UAVs to validate their performance claims. Illustrate how the technology can be successfully expanded for detection, identification, and tracking of a UAV swarm of 20 to 50 UAVs against the aforementioned atmospheric and range conditions. Besides the algorithms, deliver all developed tools and data to the government.

Implement algorithm prototypes in a realistic environment that enables thorough testing of algorithms. Incorporate applications to support testing, for example, operator displays and decision support systems. Demonstrate and validate algorithm's effectiveness. Deliver an algorithm description document, engineering code, and test cases. Explore and document other potential methodologies identified in Phase I.

PHASE III DUAL USE APPLICATIONS: Include upgrades to the analysis, M&S, and T&E results. Provide mature prototypes of radar and infrared fusion system to perform broad area search for UAV swarm in a single image.

Phase III goals are:
(a) super-resolution processing to produce a higher resolution (HR) image from a lower resolution (LR) one with increased image content and without inducing artifacts;
(b) training models focused upon consistent UAV swarm features such as spatial characteristics while giving low weight to variable characteristics like color and background;
(c) create and adapt training data to build generalized broad area search target detection, classification, and tracking UAV swarm models that perform well using radar and infrared camera imagery and video;
(d) collection of relevant radar and infrared camera data for training and testing machine learning models;
(e) interfacing with C-UAV offensive device;
(f) adapting processing capabilities for onboard edge device demonstration;
(g) adding additional algorithms that optimize usage of the radar, infrared camera fusion system to operate without user input; and pursue civilian applications and additional commercialization opportunities, for example, enhanced surveillance for homeland/boarder security, identification of camouflaged/hidden targets, and nighttime facial recognition.

Regarding commercialization, a potential commercial venue/application could be the commercial maritime market, where improved neighborhood awareness can increase operational safety in the oceans. In addition, this work could be applied to track anomaly detection in other domains, including air traffic management and Space Domain Awareness. The Space Domain Awareness is becoming more and more relevant, as proliferated constellations of satellites continue to grow, and it becomes more important to track debris and space objects. Commercial companies like Exo-analytics and Kratos provide space objects tracking as a service and could provide an avenue for commercialization
An additional commercialization opportunity is tracking software with increased performance for valuable application in the automotive industry, as many manufacturers are pursuing more automation and aim to fuse the information from a variety of data sources, including onboard cameras and radars.

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KEYWORDS: Multi-Sensor Fusion; radar; camera; algorithm; deep learning; track accuracy

N241-018 TITLE: Acoustic Watermarking for Air ASW Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Integrated Network Systems-of-Systems; Sustainment

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an active sonar watermarking capability for Air Anti-Submarine Warfare (ASW) sonobuoy systems that improves wide area search timelines, sonar track localization, and enables communication with other platforms such as Unmanned Underwater Vehicles (UUVs). Additionally, provide some method that indicates that the active transmission is from an authentic source.

DESCRIPTION: Sonar waveform watermarking embeds a digital message into an active sonar transmission so that the receiver can recover information from the transmitter, as well as conduct the usual echo detection and ranging. In future Air ASW systems, many active sonar sources will be operating in close proximity—both time and space—to each other. While this improves detection performance, a means of unambiguously providing detection association to a specific source will improve the system’s track accuracy for a target. This SBIR topic seeks to develop a digital watermarking technology embedding information in each source ping that can be successfully interpreted at low signal-to-noise ratios (SNRs) and can assist in assigning sources to ambiguous echo detections (i.e., detection association).

This technology will reduce sonar search times by at least 25% against fast targets. Watermarking source transmissions will allow more sources to operate simultaneously and unambiguously, while maintaining a high degree of correct echo-to-source association. Watermarking technology will improve the target Area of Uncertainty (AOU) by at least 15% by increasing the number of near simultaneous detections used during target tracking.

The watermarking technology should degrade detection probabilities by less than 1 dB when operating in a wide range of ocean channel conditions, at SNR 2 dB higher than the theoretical Minimum Detectable Level (MDL). The watermarking should degrade Doppler estimation accuracy by less than 5% and range accuracy by less than 10% in realistic ocean channels that include Doppler and time spreading.
The watermarking must be applicable to narrowband waveforms such as Continuous Wave (CW) pulses, and should also be applicable to wideband waveforms such as Frequency Modulated (FM) waveforms. The same watermarking technology can be used to embed short acoustic communication messages in active sonar transmissions that are received by other platforms in close proximity such as surface ships, and unmanned underwater vehicles even when the receiving platform is operating with high self-noise. These short acoustic communication messages can be a means to provide authentication and transmission assurance.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a digital watermarking technology applicable to wide area search systems to enable successful detection association with a set of at least four sources, maximizing source de-confliction, and being able to clearly identify the source that generated the detection. Demonstrate, using simulations, the watermarking technology does not reduce signal detection by more than 1dB at MDL+2dB. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype underwater acoustic source that includes embedded watermarks on typical Air ASW waveforms. Develop acoustic software that can be used for at-sea testing. Demonstrate the watermarking technology can successfully identify a specific source from at least 32 different sources. Demonstrate the watermarking technology can successfully transmit and interpret messages at low SNRs.

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

PHASE III DUAL USE APPLICATIONS: Make recommendations for this technology to be included into the Production Sonobuoy Specification. Demonstrate during an at-sea data-gathering event the watermarking technology functions as designed. Provide an interface documentation description for the integration of this capability into an active ASW sonobuoy system. This technology will primarily benefit military applications. Surface ship multistatics would benefit from this capability. A commercial application would be to include watermarking into audio files to provide a means of authentication and protection.

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KEYWORDS: Watermarking; embedding information; assurance; tracking; detection association; source de-confliction

N241-019 TITLE: Wideband 16x12 Non-Blocking Radio Frequency Switch

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop a dynamically reconfigurable, minimal latency 6U Virtual Path Cross-Connect (VPX) wideband non-blocking radio frequency (RF) switch that can simultaneously handle thousands of diverse signals from multiple apertures to multiple channels on a single processing card to increase autonomy while addressing emerging and dynamic threats.

DESCRIPTION: Signal intelligence (SIGINT) is the intelligence obtained by the interception of communications and electronic signals. An Electronic Support Measure (ESM) provides the passive capability to search, intercept, collect, classify, geo-locate, monitor, copy, exploit, and disseminate these signals over a specific RF range. A key subsystem to an ESM is the RF distribution, a unit which routes the incoming RF signals to the appropriate channel for processing and analysis. Current 6U RF switches are limited in the exploitation of the frequency spectrum due to size, weight, power, and cooling (SWaPC) constraints associated with the frequency response of the components in the signal conditioning path.

This SBIR topic's goal is to develop a 16x12 non-blocking switch that operates from 1.5 MHz to 18 GHz. The proposed non-blocking RF switch should maintain present 6U SWaPC constraints. The non-blocking RF switch must be a single processing card while maintaining the following open interface standards: ANSI / VITA 46.0 VPX Baseline Standard.

The non-blocking RF switch must be able to route any of the 16 input apertures to any of the 12 output tuner channels while remaining dynamically reconfigurable via a sensor open systems architecture (SOSA). The Application Programmer Interface (API) and Interface Control Documents (ICD) will be supplied during Phase I.

An RF Cascade analysis of the design should address the non-blocking RF switch's performance in signals' Gain, Isolation (input-coupled and output-coupled), Noise Figure (NF), Input third order Intercept Point (IIP3), 1 dB Compression Point (P1dB), and switching time at a minimum. Hardware must be delivered with software and firmware APIs and development kits for rapid integration into U.S. Government Labs.

Design tasking in Phase I and Phase II will not be classified. Analysis tasking associated with hardware in Phase II may become classified.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004.

PHASE I: Design and develop an initial non-blocking RF switch solution for airborne platforms in maritime environments including an assessment of the ability of the technology solution to meet SWaPC form factor as detailed in the Description above. Additional ICDs and APIs will be supplied in Phase I to develop a conceptual architecture of the RF switch. An initial design of the RF Switch is required as a product of the Phase I effort, along with initial SWaPC analysis. The Phase I Option should lay out initial design requirements for the operating bandwidth of the RF switch; the RF switch's NF, Isolation, IIP3, and P1dB; verification of operational performance requirements through modelling and simulation (M&S); and prototype plans to be further developed under Phase II (e.g., associated documentation; i.e., initial block diagram, schematic, capabilities description).

PHASE II: Develop and demonstrate a prototype hardware and firmware solution, or engineering demonstration model (EDM), which builds upon the proposed solution and architecture developed in Phase I with a brass-board, proof-of-concept design. A design review should be conducted early in the development phase. The effort shall include a lab demonstration, that is, the prototype hardware should be delivered at the end of Phase II, ready to be tested by the U.S. Government. The final report should include a lab demonstration plan and results, and a transition plan for Phase III focusing on an integration of the RF switch, including further technical maturation and manufacturability of the resulting prototype for an airborne military environment.

Analysis tasking associated with hardware in Phase II may become classified. Please see note in the Description paragraph.

PHASE III DUAL USE APPLICATIONS: Refine the design, lab (or ground) test, and integrate the RF transceiver solution within a government systems integration lab (SIL). If not completed during Phase II, the Phase III design should focus on the manufacturability, production, and sustainment for compliance with the military operating environment (military standards and handbooks such as MIL-STD-810, MIL-STD-704F, MIL-STD-461, MIL-STD-464C should be used as reference until exact specifications are supplied). Phase III deliverables will include documentation not addressed during Phase II such as, but not limited to, Critical Design Review (CDR), associated Qualification Testing and analysis to support Flight Testing, performance requirements, associated ICDs, and manuals.

Dual use in the commercial sector is presently limited; however, some commercial companies are addressing this with the FAA. FedEx is reviewing to install self-defense systems similar to military aircraft and helicopters, and its proposal for anti-missile infrared laser countermeasures to the FAA states "in recent years, in several incidents abroad, civilian aircraft were fired upon by man-portable air defense systems". As missile protection for commercial aircraft (RF systems) continues to be explored, a modified EMS system may be used as an early warning system.

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KEYWORDS: Signal Intelligence; SIGINT; radio frequency; RF switch; ESM; Electronic Support Measures; ANSI/VITA; Digital Signal Processing; DSP; High bandwidth Processing; Signal Detection; Spectral Awareness

N241-020 TITLE: High-Speed Wavelength Division Multiplexing (WDM) Optical Backplane for Avionics Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; Microelectronics; Sustainment

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 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 high-speed (100–400 Gbps) optical backplane based on Wavelength division multiplexing (WDM) for onboard avionics applications.

DESCRIPTION: Current airborne military (mil-aero) core avionics, electro-optic, communications, and electronic warfare systems require ever-increasing bandwidths while simultaneously demanding reductions in Size, Weight, and Power (SWaP). The effectiveness of these systems hinges on (1) optical communication, computation, and networking components that realize high connectivity and throughput, (2) reconfigurability, (3) modularity (plug and play), (4) low-latency, (5) large link budget, and (6) compatibility with the harsh avionic environment. The traditional use of copper traces to support board-to-board communications in sensor and mission computing applications requires hundreds upon hundreds of electrical pins and a spider web of connecting copper traces. For example, the latest embedded system backplane standard, VITA 65 – OpenVPX, has connectors with 728 pins on a 6U size card and 280 pins on a 3U card, and still does not provide enough bandwidth for current or future generation systems. This situation complicates the integration of processing cards within mission computers, sensors, and imaging systems. The saturation of high-speed traces throughout the backplane can generate electrical impedance problems, creating bandwidth limitation problems [Ref 16].

In the commercial data center sector, the bandwidth capacity needs to increase along with reduced power consumption, which has increased the demand for efficient interconnects. These functions are not available with traditional interconnects, which are copper-based, thus further enhancing the utility, and in turn the need, for an optical interconnect technology refresh. Moreover, companies are innovating new solutions with multiple variants of 100 to 400 Gbps+ optical transceiver modules. Although these solutions are designed to enable network operators to address increasing bandwidth demand through simplified network architecture, these solutions are not directly compatible with the complexity of modern digital avionics networks [Ref 1]. Traditional optical implementations based on single-wavelength fiber optic transceivers operating at up to 28 Gbps per lane, 100 Gig Ethernet switches, along with the OpenVPX and Sensor Open Systems Architecture (SOSA™) standards, is testing the boundaries of optical connectors and backplanes in avionics [Ref 2–5].

Future avionics signal transmission rates are expected to increase to 100 Gbps per lane and higher over 50 µ OM4/OM5 fiber. The use of high-speed digital fiber optics and wavelength division multiplexing in avionics backplanes can enable a significant increase in aggregate bandwidths beyond traditional electrical and optical networking implementation limitations. A 100 Gbps (scalable) and WDM-based optical backplane with OpenVPX capability and SOSA™ compatibility will be required for future data transmission and networking in avionics [Ref 6]. As such, a high-speed WDM optical backplane for onboard avionic networking that extends beyond the current state-of-the-art technologies is desired [Ref 7–14].

The proposed WDM optical backplane should minimally meet the SOSA™ roadmap expectations. The proposed high-speed WDM optical backplane must operate across a -40º-+95ºC temperature range and maintain performance upon exposure to typical naval air platform vibration, humidity, temperature, altitude, thermal shock, mechanical shock, and temperature cycling environments [Ref 15]. The proposed approach should incorporate a quick routing capability to overcome latency and connectivity limitations and enable future avionics network architectures.

PHASE I: Develop a WDM optical backplane hardware engineering design with OpenVPX capability and SOSA™ compatibility. Demonstrate the feasibility of the optical backplane design and packaging. The Phase I effort will include prototype plans to be developed in Phase II.

PHASE II: Optimize the backplane design for future avionics networking and sensors. Build and test the optical backplane in a simulated avionics environment that is compatible with OpenVPX and SOSA™. Deliver one optical backplane—including active and passive components—for future WDM avionics application.

PHASE III DUAL USE APPLICATIONS: Support transition of the technology being developed to military aircraft platforms, commercial data center and defense avionics industries.
Commercial sector telecommunication systems, fiber-optic networks, and data centers will benefit from the development of the WDM-based optical backplane such as mitigating the bandwidth limitations. These applications will be able to drive more data input at a higher speed.

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KEYWORDS: OpenVPX; SOSA; Wavelength Division Multiplexing; optical backplane; multimode fiber optic; higher bandwidth

N241-021 TITLE: High-Temperature, High-Efficiency Electrical Starter/Generator

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a high-temperature, high-efficiency ES/G and a system generator control unit (GCU), with the goal of optimizing heat load, output power, size, and/or weight of future power systems.

DESCRIPTION: The Navy is interested in pursuing new Electrical Power Generating System (EPGS) technologies for increasing efficiency, specific power, power density, and power capacity for 270 Vdc More-Electric Aircraft (MEA) systems. The EPGS is the main power source for MEA and the solution should provide motoring for main engine start capabilities. Improvements to the existing EPSG, or a new novel power generation system architecture/design, will be considered.

A 200-kW EPGS that converts rotational shaft power to 270 V is of interest. The generator should be able to produce this voltage and power across at 1.00-to-1.75 speed range—with the higher region of the speed range around 24,000 rpm. The generator should be capable of proving a stable power source for continuous and intermittent power across the operating speed range. It should be able to source stable electrical power into high step-load Constant-Power Loads (CPL) commensurate with MIL-PRF-22140B. The EPGS should also be able to maintain typical MIL-STD-704F power quality metrics while considering relevant line impedances for generating into the dynamic CPLs.

The offeror should show feasibility of the benefits and performance capability during Phase I using modeling, simulation, and analysis of the electromagnetic, thermal, rotor dynamics, reliability, fault conditions, etc. Careful consideration should be made that this is a mission-critical component for most MEA systems. The analysis should be provided for both steady-state and transient conditions.

The Navy requires new technologies to increase the efficiency and power capacity of today's EPGS. The electrical starter/generator (ES/G) (ES/G) is the main power source for a MEA systems, providing motoring and main engine start capabilities for the aircraft. Improvements to the existing EPGS, or a new novel power-generation system architecture/design, will be considered. This effort should focus on providing an ES/G system to provide a minimum generator power output of: 200 kW (continuous), 250 kW (2-minute overload), 300-500 kW (5-second overload), and > 500 kW (0.5-second overload). The power generation operating range should be able to generate 270 Vdc and power across a 1.00 to 1.75 speed range (with peak speeds at roughly 24,000 rpm).

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Define generator design approach and develop an implementation plan. Validate approach analytically or provide test data or bench top hardware that would validate approach. Ensure maximum use of computer modeling and simulation techniques in this phase. Demonstrate a thorough working knowledge of applicable military standards. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop and demonstrate generator technology that can provide 200 kW of continuous power that can be fitted into the aircraft. Ensure that the generator package includes a GCU that is capable of controlling generator functionality. The package will be subjected to proof-of-concept testing at full qualification levels.

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

PHASE III DUAL USE APPLICATIONS: Package and integrate new generator for use in the aircraft. Provide unit(s) to be subjected to full qualification testing and flight test profiles. The notable benefits include the increased efficiency and power capacity of the ES/G, reduction of system volume and weight, and interconnected complexity. It will improve thermal performance over the current system while also providing better engine and air vehicle performance. It will significantly reduce engine heat loads throughout the mission while focusing on heat rejection impacting the ES/G.

Specific industries, such as the automotive, marine, industrial machinery, agricultural machinery, and construction machinery, could benefit from this innovative ES/G technology. All of the above would provide significant benefits to both military and commercial aircraft applications.

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KEYWORDS: Generator; Generator Control Unit; Voltage Regulator; Electrical Power; Alternating Current; Direct Current

N241-022 TITLE: Precision Sensing for AS(X) Submarine Tenders

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Develop a precision sensing system capable of providing real time relative positioning and orientation between a submarine and its tender in open water during resupply operations.

DESCRIPTION: Submarines are typically resupplied in port, or under benign sea state 2 conditions typically found in sheltered waters that may be far from the submarine's operational area.
In higher sea states, the differing movement of the tender ship and the smaller submarine becomes a major obstacle to high-precision transfer of supplies. The tender, submarines, and the resupply materiel will move in their own frame of reference. Precise sensing of relative pose is critical when applying automation of motion mitigation to support the tender's operations during transfers. The sensing system must operate in real-time, and accurately provide the distance to the transfer destination on the submarine, as well as the relative velocities between the two vessels in six degrees of freedom (DOF) in Sea State 3 (Objective) and 4 (Threshold). No satisfactory commercial sensing system exists currently.
The system must be operable and accurate in a marine environment, day and night, including in conditions of fog, salt spray, icing, etc. The sensors and computers performing analysis of the sensor data will be based on the tender, without excluding possibilities of establishing other temporary vantage points for transfer operations. The system must be operable at a distance to the submarine of up to 50 feet over the side of the tender, and 30 feet vertical from the location of transfer equipment on the tender. The position sensing system should also be usable for vertical lift transfers. No permanent targets or sensors may be installed on the submarine.

The system must provide an indication of when sea conditions permit safe operations for the capabilities of a given transfer method. The actual transfer method is outside the scope of this SBIR topic. A design for the sensing system is expected to enable this technology to operate on other platforms as needed.

PHASE I: Develop a design to address precision sensing for AS(X) submarine tenders during underway replenishment of submarines. Identify sensor choices, locations and methodology for sensor data analysis, yielding real-time 6-DOF motion identification outputs. Validate the feasibility of the approach in a marine environment by providing computer simulations or other evidence. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype system in Phase II.

PHASE II: Develop a prototype system for evaluation based on the results of Phase I. Develop a test methodology to show how the technology will be evaluated to determine if the system has the potential to meet Navy performance goals described in the Phase II SOW. The goals will be defined by the Navy in Phase II. Testing in a two-body wave tank or an equivalent marine environment is expected. Develop plans for full-scale testing in an open water environment in Phase III.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. Perform full-scale testing in an open water environment and further refine the technology for Navy use. The same technology needed to transfer supplies from tenders to submarines can also be used for other Navy ship-to-ship transfers, as well as offshore oil and wind industry applications.

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KEYWORDS: Relative Position Measurement; Underway; Inertial Measurement Unit; Precision Real Time Sensing; Sensing in Marine Environment; Cargo Transfer at Sea

N241-023 TITLE: High Reliability Flame Detector

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

OBJECTIVE: Develop a flame detector capable of identifying flaming fires in the quickest amount of time while also discriminating against false and nuisance alarm sources.

DESCRIPTION: Optical Flame Detectors (OFDs) are generally designed for large spaces with the expectation that there will be little to no interference from structural members (e.g., frames, bulkheads, etc.) and personnel. Previous installations on the Navy ships have experienced nuisance and false alarms due to lighting conditions and movement of equipment and personnel in the monitored space.
Each inadvertent Peripheral Vertical Launching System (PVLS) sprinkling event caused by a nuisance or false alarm generated from the flame detector costs ~$270k, resulting from PVLS equipment damage. High false and nuisance alarm rates without an underlining system understanding causes watchstanders to lose confidence in system credibility. This instills watchstander indifference towards alarms/faults potentially resulting in the ship's force not responding to an actual fire event. The innovative nature of the required work is to transition commercially used technology into a non-ideal environment, represented by the high-traffic open spaces and crowded, compact spaces experienced on Navy vessels.

The Navy is seeking a shipboard qualified flame detector solution that reliably functions in compact, crowded spaces and can be integrated with the Fire Detection and Actuation System (FDAS) Navy Program of Record. Flame detector solutions should indicate power and alarm status at the sensor location and perform an automatic functional self-test. The sensor must integrate into the DDG 1000 FDAS, be adequately sized for shipboard application and meet vibration, EMI, and shock requirements.
Flame detectors should not register a false alarm when directly aimed from 3 feet dead ahead in constant or intermittent sunlight, 100 watt incandescent light, 40 watt fluorescent light, 2-D cell flashlight, and Shielded Metal Arc welding at maximum amperage of two carbon steel plates, or lit cigarette at 1 foot dead ahead.

The flame detector shall be selected based on the radiant emissions expected from the burning fuel or material to be detected and have a discrimination capability to prevent false alarms when exposed to non-fire related radiant emissions. It shall also be capable of detecting a 1 foot by 1 foot n-heptane pane fire in less than 30 seconds at a distance of no less than 60 feet, a 100 kW wood crib fire within 2 minutes at a distance of 60 feet, and a 10 kW propane fire within 5 minutes at a distance of 20 feet as well as other Class A and B fires.

The flame detectors shall be listed or approved in accordance with either FM 3260 or EN 54-10, shall be tested in accordance with MIL-PRF-32226, and shall be able to meet vibration, Electromagnetic Interference (EMI), and shock requirements within MIL-STD-167-1, MIL-STD-461E, and MIL-DTL-901E, respectively.

PHASE I: Develop the concept of a system to detect and evaluate flames with automatic functional self-test which will reduce or eliminate false alarms. Demonstrate the feasibility of the concept in meeting Navy needs. Demonstrate that the flame detector solution can be readily and cost-effectively manufactured through standard industry practices by material testing and analytical modeling. The Phase I Option, if exercised, should include the initial layout and capabilities to demonstrate the application in Phase II.

PHASE II: Develop and deliver a prototype sensor for integration into the DDG 1000 FDAS that is adequately sized for shipboard application and meets vibration, EMI, and shock requirements. Also develop a modular test bed in which prototype evaluation can occur to demonstrate capability to detect flames while eliminating false alarms. Perform testing at a facility determined to be appropriate by the government to prove detection capability as well as false alarm rejection. Final product will be integrated with FDAS Navy Program of Record.

PHASE III DUAL USE APPLICATIONS: Assist with Navy integration of the flame detector solution into fleet FDAS systems.

Commercial OFDs are used in warehouses and open spaces as fire detection. The developed flame detector can be used in any such application where environmental interference can be expected and alternative methods of fire detection such as smoke and heat detectors are not feasible due to ventilation or tall overheads.

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KEYWORDS: Fire Detection; Fire Detection and Actuation System; FDAS; Flame Detection; Survivability; Ordnance Safety; Personnel Safety

N241-024 TITLE: Vertical Launch System High Speed Interface

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a high-speed interface within the MK41 Vertical Launch System (VLS) architecture.

DESCRIPTION: One of the biggest challenges VLS has with integration of new missiles and new capabilities relates to its low-speed interfaces and legacy technology of current platform hardware. The evolution of existing missiles and the advent of new missiles to meet an ever-changing threat have made upgrades to both system performance as well as reduced life cycle costs a necessary objective. Lifecycle cost reductions are needed in the redesign of the architecture where current legacy serial data exchange limits upgrades at both the launcher as well as the missile, and requires additional manhour expenditures for both maintenance as well as missile availability. Existing network interfaces are limited in speed and bandwidth, resulting in fenced performance limits affecting system availability and maintainability. Additionally, these interfaces, in their current configuration, establish a limit for optimization efforts between missile and weapon control system design and upgrade. A technology to redesign the interface between the Weapon Control System and the Missile to take advantage of High-Speed Ethernet capabilities will result in augmented magazine capacity, increased weapon availability, and reduced lifecycle costs.

Increased data rates would increase availability time for VLS in the fleet; for example, current Tomahawk upgrades can take hours per missile, which inhibits any launcher maintenance or action during that period. A key element to address these performance limitations is a redesign of the interface between the Aegis Combat System and the VLS Launch Control Unit, and the missile. The transition to a Gigabyte Ethernet architecture and definition of the Interface Control Document and Interface Design Specification requirements is sought to remedy these performance restrictions. Currently there are no commercial solutions to this issue.

A solution is needed to significantly enhance the performance of this interface while maintaining backward compatibility of existing data flows and timing. The solution must provide on-the-fly software upgrades and reduce downtime of VLS launch capabilities. Novel constructs that build upon current state-of-the-art network design will have the following specifications:

- Utilization of 802.3 1000BASELX (Gigabit) Ethernet Interface standard
- Interface of greater than 66 fiber ports (and extensible beyond this limit)
- Achieve benchmarks of 40MB in less than one minute and 400 MB in under 10 minutes, simultaneously, over 25% of the fiber ports

In-depth characterization and testing are critical for elucidating the mechanisms to achieve advanced data rates and digital assurance. Some critical considerations for any High-Speed Interface Processor (HSIP) would include design tradeoffs, Time Sensitive Networking protocol, development of a standard interface and compliance with Cybersecurity requirements. It is expected that the hardware developed can meet surface ship environmental requirements (e.g., MIL-DTL-901 Grade A shock, MIL-STD-167 Shipboard Vibration, 0-50C Ambient Temperature and MIL-STD-461 EMC). The awardee must propose adequate test protocols to demonstrate the suitability of the proposed technology to satisfy Navy requirements.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for a common High-Speed Interface Processor (HSIP) to provide missile digital data that meets the parameters in the Description. Demonstrate that the concept can feasibly meet the requirements through analysis, modeling, and experimentation of materials of interest. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver notional full-scale prototype(s) that demonstrate functionality under the required service conditions including thermal stresses. Demonstrate the prototype performance through the required range of parameters given in the Description and as identified through Technical Interchange Meetings with the government.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use in the MK41 VLS program. Support the manufacturing of the components employing the technology developed under this topic and assist in extensive qualification testing defined by the Navy program. Potential commercial uses for high-speed interface processing performance improvements exist in the commercial industrial process, spacecraft, and aircraft industries.

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KEYWORDS: Vertical Launch System; Gigabyte Ethernet; Time Sensitive Networking; VLS Launch Control Unit; Advanced Data Rates; Cybersecurity.

N241-025 TITLE: Advanced Artificial Intelligence/Machine Learning Techniques for Automated Target Recognition (ATR) Using Small/Reduced Data Sets

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Trusted AI and Autonomy

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an innovative automatic target recognition (ATR) capability that leverages state-of-the-art Artificial Intelligence/Machine Learning (AI/ML) technology to support naval mine countermeasure (MCM) operations using reduced data sets.

DESCRIPTION: ATR is the ability for a system or algorithm to recognize and identify targets, objects of interest or threats based on data obtained from sensors. In Navy mine countermeasure (MCM) operations, sensors collect data to identify and localize targets of interest in marine environments.
The Navy is interested in developing state-of-the art AI/ML ATR processing algorithms, or techniques to facilitate target detection and identification using smaller data sets to train the algorithms and perform ATR. The Navy's existing Minehunting systems collect data using forward-looking sonar, a pair of side-scan sonars, and a volume search sonar. Identification and localization of underwater objects is challenged by both a reliance on large, curated data from the onboard sensors that are needed to train and perform ATR and the amount of time required to conduct ATR operations. Current MCM ATR algorithms require large amounts of data (over 200 hours of acoustic video and 1,000-2,000 target images) to train the algorithms. This training data is quite costly to obtain because it must be collected in a variety of representative operational environments.

The proposed solution should demonstrate reduction in the amount of data required to train algorithms by an order-of-magnitude smaller without degradation to identification performance (Pid) and no increase in the Probability of false alarms (Pfa). If possible, the solution should incorporate advanced ML techniques such as One Shot, Multi Shot, Few Shot etc. as well as others that yield the benefits sought.
The ATR will be initially integrated into the Navy's Generalized ATR (GATR) framework to improve detection and classification performance. The capability could eventually be integrated into a towed body to support in-stride ATR.

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of

Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept to facilitate target identification using smaller data sets that meets the requirements described above. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be feasibly developed into a useful product for the Navy. Feasibility will be established by testing and analytical modeling.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype for evaluation as appropriate. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II SOW and the Navy requirements for the algorithms. Demonstrate performance across a broad set of Government -Furnished Information (GFI) data. Performance will be validated against Government-provided target truth. Prepare a Phase III development plan to transition the technology to Navy use.

It is possible that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Produce and support a final prototype that will be integrated into developmental and operational frameworks used by the AN/AQS-20 Mine Hunting Sonar Post Mission Analysis (PMA)/ Generalized ATR (GATR) system. Additionally, AI/ML algorithms developed may be inserted onboard the AN/AQS-20 Mine Hunting Sonar towed body. Due to the nature of the effort coupled with the anticipated implementation of DEVSECOPS, technology insertions may also be accelerated and/or incrementally introduced into various other MCM sensors (e.g., Mk18 FOS, AQS-24, Barracuda, etc.).

Technology developed under this effort is applicable to any domain that requires subsea platform autonomy such as subsea oil and gas pipeline inspection.

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KEYWORDS: Artificial intelligence; machine learning; mine countermeasures; acoustic sensor; automatic target recognition; few-shot learning

N241-026 TITLE: Automatic Boresight Alignment of Optical Sensors

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a capability for automated in-situ boresight alignment of multi-spectral imaging sensors and lasers.

DESCRIPTION: The Navy is fielding a suite of imaging sensors (cameras) with unprecedented capability. These sensors will provide both wide field of view (WFOV) and narrow field of view (NFOV) video imaging across a full 360° in both visible and infrared (IR) bands. Imagery from these cameras has a variety of uses from navigation to target detection, identification, and tracking. WFOV cameras will cue potential targets of interest to NFOV cameras which will then center on the target location for higher resolution inspection of the target. Therefore, knowing the axis along which each camera is looking, relative to a common reference (the position of the camera on the vessel) is critical in sensor coordination and cueing.

The optical axis of an imaging sensor normal to the center point of its focal plane, or a NFOV reticle at or near the center, is its boresight. The optical axis of laser devices, such as a NFOV rangefinder, must also be boresight aligned with the imaging sensor reticle in order to receive reflected energy from the intended target. The mechanical mount and positioning structure of the sensor serves to point the optical axis in the desired location. However, mechanical tolerances naturally cause a difference between the mechanical axis of the sensor's mount and the true optical axis. For deployed sensors, ship vibration and harsh environmental conditions can cause alignment to degrade over time. Calibration to correct or compensate for misalignment of the optical and mechanical axes is known as boresight alignment. Therefore, boresight alignment applies across multiple elements to include the imaging sensors, laser(s), and line-of-sight (LOS) pointing by the director mount. Boresight alignment is an important step in preparing the sensor for deployment and it is particularly critical for NFOV, high magnification cameras.

Mechanical and optical alignment of the Navy's optical sensor modules, known as line replaceable units (LRUs), is typically done in the factory or some centralized Government facility, both when the sensor is newly manufactured and after depot overhaul of the system. When the system is installed on a ship as an assembly, or following organizational level maintenance of the LRUs of a LOS director, the combination of factory alignment and mechanical tolerances is insufficient to ensure alignment across imaging sensor, laser, and LOS director elements. This results in manual, labor intensive processes that require skilled technicians to execute differing procedures across multiple systems. The current process also requires the ship to be in port with distant objects within view and is not practicable while the ship is underway. Therefore, if alignment could be performed in-place utilizing automated processes and a minimum of additional equipment, the current difficulties of calibration could be eliminated, thereby resulting in a reduced mean time to repair and significant cost savings. In addition, performance of the imaging system could be maintained while underway as environmentally induced misalignment could be periodically corrected or compensated for.

The Navy needs a technique (realized in software and hardware) for in-situ boresight alignment of optical imaging sensors (cameras) and rangefinders. There is no current capability commercially available. Techniques that generate an offset table for registration of the imagery to the baseline frame of reference are acceptable. The technique must also be useful for cameras operating in the IR spectra as well as the visible spectrum. The solution must be applicable to imaging sensors where multiple focal plane arrays use the same aperture as well as systems that have co-located but separate apertures. Most Navy systems of interest incorporate lasers that operate in the short-wave infrared (SWIR) for range finding so the solution should include the facility to calibrate in conjunction with the laser (which also may be subject to misalignment). The visible, near infrared (NIR), SWIR, and mid-wave infrared (MWIR) bands are of most interest however, a technique that could be extended to the long-wave infrared (LWIR) is attractive. The technique should provide boresight alignment to an accuracy of 100 micro-radians or better. Solutions that require a minimum amount of added hardware (hardware added either permanently to the sensor baseline or installed temporarily for the calibration process) are desired. Likewise, the solution should be largely automatic, requiring no more skill or human intervention for calibration than typically required of the operator during normal system operation. A technology that requires no added hardware and is fully automated, if feasible and sufficiently precise, represents a full solution to the problem. Solutions that require the cooperation of other vessels or aircraft, solutions that are only feasible in certain locations of the ocean (e.g., along known coastlines), and solutions that can only be deployed to specific ship classes or require extensive modification of the vessel are not of interest. Solutions that make use of two or more imaging sensors (either co-located or not) working together are potentially acceptable, although it should be noted that the feasibility decreases rapidly as the number of cooperating sensors required for calibration goes up. For this effort, NFOV cameras are of primary interest. However, the fundamentals of the technique should be extensible to any format and magnification imaging system. Note that the Navy does not intend to furnish tactical or otherwise representative imaging system hardware for this effort. The proposed solution should therefore include the means for test and demonstration on surrogate hardware, provided as part of the solution. A prototype (hardware and software) of the technology will be delivered to NSWC Crane Division at the conclusion of Phase II.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for an automated boresight alignment technique that meets the objectives stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy’s need by any combination of analysis, modelling, and simulation. Analyze the accuracy of the proposed technique in compensating for axial misalignments in NFOV multi-spectral imaging systems. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype automated boresight alignment technique for imaging sensors based on the concept, analysis, preliminary design, and specifications resulting from Phase I. Demonstration of the automated boresight alignment technique shall be accomplished through test of a prototype in a laboratory or controlled outdoor environment utilizing surrogate cameras, lasers, and mounts. At the conclusion of Phase II, prototype hardware and software shall be delivered to NSWC Crane along with complete test data, installation and operation instructions, and any auxiliary software and special hardware necessary to operate the prototype.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Government use. Develop specific hardware, software, and operating instructions for specific Navy optical sensor systems. Establish hardware and software configuration baselines, produce support documentation, production processes, and assist the Government in the integration of the boresight alignment technology into existing and future imaging sensor systems.

The technology resulting from this effort is anticipated to have broad military application. In addition, there are scientific, security and commercial navigation applications. This would include commercial aircraft maintenance and assembly, power generation plants, machining, and automotive maintenance.

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KEYWORDS: Rangefinder; Imaging Sensor; Boresight Alignment; Video Imaging; Narrow Field of View; Optical Axis.

N241-027 TITLE: Precision Stabilization of Large, Wide Field of View Imaging Sensors.

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a capability to accurately stabilize high performance, large, wide field of view (WFOV) imaging sensors during operations in adverse maritime environments.

DESCRIPTION: Imaging sensors (cameras) are used for a wide variety of purposes by naval vessels while underway. This includes general observation of the surroundings for purposes of navigation, specific search for objects both airborne and in the water, identification of other vessels, and target acquisition and tracking for weapons systems. WFOV cameras are typically used for navigation and general situational awareness while narrow-field of view (NFOV) cameras are used for target tracking and identification as well as scanning specific sectors of ocean and sky, searching for particular (and usually very small or very distant) targets. Both types of cameras require stabilization to compensate for ship motion and the buffeting effect of wind and wave during heavy sea states. NFOV cameras are almost always deployed on stabilized gimbal mounts that respond quickly to ship motion in the three axes of roll, pitch, and yaw. These cameras are used to move to a specific target cue or coordinate. Once a target is within view, these systems can employ feedback for stabilization or use inputs from inertial sensors to maintain target tracking.

WFOV cameras are very often used in “staring” mode. In this mode of operation, the camera does not scan or move to a target cue. The camera stares in a pre-defined direction (with respect to the platform), whether a target is present or not. In panoramic applications, multiple WFOV cameras can be assigned individual sectors of coverage and the composite image stitched together. In this way, even full 360° coverage can be achieved. However, this presents particular problems not experienced by NFOV systems. In general, WFOV imaging systems are typically larger than NFOV sensors, especially for multi-spectral systems, and their greater mass requires larger mounts and greater power input if active stabilization is to be used. In systems with 360° coverage and stitched panoramic output, the mount may be somewhat simplified since effects of ship yaw can be compensated for electronically. However, ship pitch and roll are extremely detrimental to the image quality as they inhibit proper stitching of the image and lead to images with a constantly moving horizon.

The Navy is fielding a suite of imaging sensors with unprecedented capability. These sensors will provide both WFOV and NFOV video imaging across a full 360° in both visible and infrared (IR) bands. Adequate stabilization technology exists for the NFOV sensors. However, the WFOV sensors present a particular challenge, as described above. The Navy needs a stabilization technology for large WFOV sensors that achieve 360° panoramic imaging through sector coverage. Currently there is no commercial capability that can meet the requirements. The desire is to provide imagery that can be efficiently processed (for example, through stitching) and achieves a stable horizon for easy viewing. Electronic stabilization cannot provide a solution in high sea states, so a mechanical solution is required. This is further complicated by the design of the sensor, which packages multiple cameras and apertures into a single unit.

For purposes of initial design and demonstration, the full sensor package to be stabilized can be viewed as a rectilinear “box”, approximately 65 inches across the face, 42 inches deep, and 29 inches high. The box has a weight not to exceed 560 lbs and a center of mass at the true center of the box. The sensor package covers a 135° sector of the vessel. The sensor package defined by this box’s dimensions must be stabilized for ship motion in ±20° roll and pitch displacement, 7.5°/sec roll and pitch velocity and 5.0°/sec2 roll and pitch acceleration (with ±40° roll and pitch displacement, 20°/sec roll and pitch velocity and 10°/sec2 roll and pitch acceleration as an objective). Stabilization to a minimum accuracy of 25 mirco-radians (15 micro-radians as an objective) in elevation is required. As an objective, the sensor package should also meet stabilization requirements while experiencing the vibration levels in MIL-STD-810H table 528.1-I. A solution that presents the minimum size, weight, and power (SWaP) necessary to achieve the required stabilization accuracy is desired. While the dimensions, weight, and center of mass listed above define the Navy’s current need, a solution that is extensible to both larger and smaller packages with variation in the center of mass represents a solution with broad utility that is highly desirable.

Note that the Navy does not intend to furnish tactical or otherwise representative imaging system hardware for this effort. The proposed solution should therefore include the means for test and demonstration on surrogate hardware, provided as part of the solution. A prototype (hardware and software) of the technology will be delivered to NSWC Crane Division at the conclusion of Phase II.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for a WFOV imaging sensor stabilization system that meets the objectives as stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy’s need by any combination of analysis, modelling, and simulation. Analyze the accuracy of the proposed technology in compensating for ship motion. The Phase I Option, if exercised, will include the initial design specifications and capabilities description necessary to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype sensor stabilization system based on the concept, analysis, preliminary design, and specifications resulting from Phase I. Demonstrate the technology using a surrogate payload in place of the Navy’s imaging sensor package in either actual or simulated sea states sufficient to achieve the roll and pitch described above.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Government use. Develop specific hardware, software, and operating instructions for specific Navy imaging sensors. Establish hardware and software configuration baselines, produce support documentation, production processes, and assist the Government in the integration of the stabilization technology into existing and future imaging sensor systems.

The technology resulting from this effort is anticipated to have broad military application. In addition, there are scientific and commercial applications, for example, the stabilization of telescopes and motion picture cameras.

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KEYWORDS: Stabilization; Imaging Sensor; panoramic imaging; Wide Field of View; WFOV; video imaging; Narrow Field of View; NFOV

N241-028 TITLE: High Volume Low Pressure (HVLP) Style Spray for Rapid Cure Ultra-High Solid (UHS) Coating Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Develop paint spray equipment for ultra-high solid (UHS) coatings that allow application at low thickness for specific, targeted areas such as propulsors or geometrically complex superstructure.

DESCRIPTION: The application of Type VII UHS epoxy coatings for naval applications relies entirely on commercially available airless coating spray equipment. The equipment used to spray the UHS coatings consist of a single or plural component mix pneumatic pumping/proportioning unit, in-line heaters for viscosity control, high pressure hoses and static mixers followed by a spray whip connected to a spray gun. Because of the viscosity of the UHS coatings system, it is typical for heat to be applied by the inline heaters to reduce the viscosity to achieve a properly atomized spray pattern at the tip of the spray gun. Various spray tips are used as well to properly atomize the spray fan or cone shape of the coating being delivered to the surface being painted. The current systems deliver the coating at high pressure and high volume, which causes difficulty in controlling film build and spread during application. For most of the work performed where UHS systems are employed, the result of coating application does not require a finished surface akin to an evenly spread, uniformly thick coating without surface flaws.
In an ever-growing need, the maintenance community relies on MIL-PRF-23236 Type VII UHS coatings for corrosion control in areas where legacy thin film coatings were historically applied in multiple thin layers to achieve the desired surface finishes and thickness. Transitioning to UHS coating applications increased the difficulty of achieving the surface finish and increased dry film thickness (DFT) that affect ship component fit of covers, plates, and other equipment assemblies in new ship designs. Controlling the volume of flow and spray pattern of UHS coatings in many applications will dramatically improve production efficiency when preserving naval assets.

Developing a spray gun that can achieve adequate volume and tailored spray capabilities is not trivial. To achieve the atomized spray desired, the developmental spray gun will have to control incoming pressures up to 7250 psi (50MPa), meter coating volume to a level to achieve control of spray atomization, pattern, and thickness control while allowing sufficient flow and productions levels as not to allow the rapid cure nature of the UHS coating to solidify within the application equipment past the static mix blocks or in the lines due to too slow coating deposition. The gun should be light enough for use by the applicator for long periods, handle the heat generated by fluid temperatures used to modify coating viscosities, and be able to spray coating film metered between 2 – 10 min/max mils wet film thickness, (WFT) per pass with an average targeted range of 2 – 5 mils per pass by an applicator.

Existing UHS spray technology is not well suited for applications where highly detailed work is required. Technologically advanced structures continue to be developed for marine service using light weight corrosion prone materials in seawater. When the structure being coated is geometrically complex, it becomes difficult to apply coatings properly and with any level of detail. Developing the capability to tailor spray parameters will provide significant advantages for controlling the application of UHS coatings, providing the asset with the necessary corrosion protection and functionality to operate as intended in a highly corrosive seawater marine environment.

The Naval Research Enterprise (NRE) produced an in-house prototype spray gun using existing commercially available gun bodies and was successful at achieving and demonstrating basic spray capabilities. However, the prototype was highly dangerous as the components were not designed for such high fluid pressures. Additionally, the ability to fully realize the desired performance of the gun itself was never met. Development was necessary with respect to flow, volume control, and atomization behavior of the coating. The science behind the operation and thus the ability to tailor to a wide range of spray conditions were not addressed since a production problem with a new Navy asset necessitated a hastily designed and constructed spray gun prototype for just that application. NRE engineers surveyed commercial industry manufacturers that supply coating equipment and were not able to identify such a spray gun with the desired capabilities. Discussions with equipment manufacturers indicated they had no desire to invest in such a design since their customer base was satisfied with the existing technology. However, as with the development of UHS coatings, the Navy's need drove UHS development, and the commercial sector followed suit as the demand began to increase. It is likely the same process will play out for this effort. When applicators who routinely use UHS systems have an alternative spray gun that allows them to control their application parameters to a higher degree, the equipment manufacturers will likely follow suit. The Navy currently has several designs for autonomous vehicles in operation and under development which require controlled coating applications. Over the past few years, the need has grown significantly.

To properly spray high solids/rapid cure coatings, a balance of pump pressure, temperature, flow rates, distance from pump, and a host of other factors need to be met. Existing commercial products are designed to meet a wide range of capabilities. However, the need to restrict many of these parameters will cause significant issues and are counter to how both the equipment and coatings were designed for use. R&D and innovation is needed to address how to change the parameters to achieve desired properties; (tightly controllable surface thickness and finish) over a wide variety of applications where a high-volume coating is being applied in a low volume situation without affecting coating cure properties or performance. Additionally, a new spray gun must be developed to ensure applicators can safely apply the coatings which are under high pressure metered down to some working pressure while having the ability to adjust the spray to geometrically complex structures in the field. The Navy needs a method to apply existing high-performance coatings in a way to achieve asset operation that supports asset design.
On average, the cost of such equipment is dictated by the complexity of the design, required machining, and availability of incorporated parts. Sales of spray guns assumed to be within the same complexity of design range from $3K to $7K each. The design should weigh no more than a comparable style commercial gun because weight and balance affect the applicator's ability to spray for long durations. Physical weight should not exceed 3 lbs. and fall within a box 8" W X 8" L X 2.5" D dimensionally. In addition, the design should account for ease of use when spraying in tight geometries, for example, in a rectangle that is 12" W X 14" D X 72" L. Supply lines for fluid and potentially compressed air should be attached in a way that they allow flexibility at the applicator's wrist. The gun should be able to sustain continuous spray for several hours at a time, and not suffer from any internal erosion of moving parts or fluid pathways.

To date no Commercial Item Description, (CID) exists for such a spray gun. CID A-A-50310 is a spray gun CID however it is not applicable to this design and should not be used as a reference. However, the pumping system to which the gun will attached falls under the CID A-A-59780 accessible through Assist Online at Defense Logistics Agency https://quicksearch.dla.mil/quicksearch.aspx. During the demonstration phase, the prototype gun will be attached to a plural spray pump that meets this CID. Coatings that will be sprayed through this prototype are qualified to MIL-PRF-23236, Type VII, Class 5, 5/18, 7, 7/18, &13 Grade C. All the specifications listed are available as Distribution A to the public and can be found at the DLA quick search website mentioned above.

The product shall be a packaged spray gun with all the necessary components for operation and connectivity to plural component spray equipment, like that of existing commercial spray gun sales. If adapters or any component deemed proprietary is needed for use, it shall be included in the end products inventory. The company identified for commercialization shall have the ability to provide repair and maintenance components and services as necessary to support end user needs. Beyond the immediate need for GFE components, the military industrial complex has immediate needs for coating specific equipment and designs for UHS coatings that require detailed spray capabilities. Those organizations both government and commercial will require this equipment. In addition, some of those commercial entities rely heavily on outside commercial coating applicator companies to perform the applications. Many of these companies also perform routine maintenance on military assets e.g., surface ships, submarines, barges, etc., and will likely adopt the use of this product to other activities as it will improve their ability to provide a level of control over the process they struggle to manage. In many instances coating appearances plays a larger role in acceptance of the final coating product, than intended coating performance. Coatings companies strive to perfect the applications so the job can be accepted by the owners of the assets they were hired to coat.

PHASE I: Define and develop a concept for an UHS delivery system that meets the specifications identified in the Description. Modeling and simulation should be used to articulate the feasibility of the design features and functionality, and to provide a computerized working model and detailed diagrams. The concept for a working prototype shall be at a level so that prototype construction and operation methodology are well defined. The Phase I Option, if exercised, will require the small business to provide a written report detailing the design concept, proposed functionality, construction methodology and materials, and marketing strategy to develop the desired product. The report shall include the initial design drawings and specifications with sufficient detail to complete construction of the working prototype in Phase II.

PHASE II: Develop and deliver a working spray gun prototype that meets the requirements detailed in the Description. The prototype will be required to function as designed and be demonstrate using a plural component proportioning pump like that used in industry. Recommendations will be made to identify such equipment if necessary. Demonstrate performance in house prior to demonstrating to the government. Upon completion of the government demonstration, the prototype shall be delivered to the government for additional testing if the prototype has met the performance criteria. A total of four prototypes units will be required to be constructed for field testing at industrial sites specified by the Topic Author.

PHASE III DUAL USE APPLICATIONS: Assist the Navy to transition from prototype to full production. In the early stages the Phase III product will initially role out to specific Navy organizations that currently require coatings applications which are driving the spray gun development. The spray gun will be introduced into the system that supports GFE. It will be through this effort that the Navy will validate performance during complete preservation of GFE components and certify it for Navy use. Commercial interest will be driven by the need for controlled coating application where high volume deposition fails. The polyurea/insulation community has high volume and low volume spray guns (e.g., GX-7 vs GX-8 respectively) where controlling the volume of coating being deposited is driven by application requirements and type. Industrial coating application such as refineries and chemical plants where complex structure is involved would benefit from tighter application controls to reduce overspray and film build. It would also reduce the cost of materials through wastage.

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KEYWORDS: UHS thin film deposition; Airless spray guns; UHS coatings application; Marine coating anticorrosive coatings; Tunable spray atomization and thickness control; Low volume rapid cure spray gun

N241-029 TITLE: Advanced Acoustic Hailing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; Integrated Sensing and Cyber

OBJECTIVE: Identify and develop advanced acoustic hailing systems to provide a highly effective alternative for embarked security teams that encounter non-responsive boats and craft.

DESCRIPTION: Acoustic Hailing systems are prevalent in the security industry, especially with law enforcement and Commercial Cargo Ships. However, marinized capabilities scaled for U.S. Navy boats and combatant craft do not currently satisfy size/weight requirements; small craft have limited weight, space, and power which require systems to fit within the load bearing capabilities of 34 to 40 foot craft. The Navy seeks to develop an Acoustic Hailing system that has utility in operation of 34 ft, 40 ft and similar U.S. Navy boats and combatant craft. Proposed deterrent systems will be required to keep a steady low angle beam on target from a distance up to 1000 meters and be effective within all environments, conditions, and regions that Expeditionary boats and craft operate. A successful deterrent system would allow embarked security teams to have a concept of operations that does not require that they enter an approaching craft's threat zone, reducing the risk to personnel on both sides by providing an annoying and clearly audible deterrent sound out to 1,000 meters in open water. A marinized Acoustic Hailing system will complement the operational profile of small boats/craft, which can include extreme environmental conditions in which the U.S. Navy operates.

Intelligibility criteria for the Acoustic Hailing voice communication should be minimally at the normal acceptable intelligibility, i.e., about 98% of sentences are correctly heard with single digits understood. The modified rhyme test, phonetically balanced word test and articulation index/speech transmission index are incorporated in the intelligibility criteria.

PHASE I: Develop a concept for a marinized advanced acoustic hailing system for a relevant vessel similar to a U.S. Navy 34 to 40 foot Patrol Boat that meets the requirements in the Description. Demonstrate the feasibility of the operational concept via physics-based modeling and simulation. Define the proposed components of the system hull, mechanical and electrical interfaces, to include power sources as well as any additional functioning design concepts of the system. Provide a preliminary concept design and an associated component validation plan. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype Acoustic Hailing system capable of being integrated with a U.S. Navy 34 to 40 foot Patrol Boat. Evaluate the prototype to determine its capability in meeting the performance goals defined in the Phase II SOW and the Navy requirements for the 34 to 40 foot Patrol Boats. Demonstrate system performance through prototype evaluation and testing, modeling, and analysis. Evaluate results and accordingly refine the deterrent system concept. Ensure that the prototyped hardware clearly shows a path to development of a marinized system. The prototype model is to be made available for Government demonstration or testing, as required. Prepare a Phase III development plan to transition the technology to Navy use.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the fully hardened Acoustic Hailing system for Navy use to include demonstration/sea trials on a relevant vessel. Support for participation in fleet demonstration is aimed at transition with the intent to purchase and integrate the system into the U.S. Navy Patrol Boat Fleet.
A deterrent system of this type should benefit any number of working craft in the fishing, oil, or research industries operating in open water or contested environments.

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KEYWORDS: Intelligibility; Acoustic Hailing; U.S. Navy 34 to 40 foot Patrol Boat; Force Protection; Distributed Maritime Operations; Contested Environment

N241-030 TITLE: Acoustic Training Data Prioritization

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 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 tool for assessing training data with artificial intelligence or machine learning (AI/ML) algorithms that provides desired data prioritization results from current or new data for effective, complete, and precise training.

DESCRIPTION: Systems that detect and track submarines are migrating to AI/ML to improve the probability of detecting submarines and to limit the probability of false alerts. The current paradigm for training AI/ML is to use large sets of data. However, the cost associated with training AI/ML on large amounts of data is high and may not result in optimal training results.

There is not currently a commercial tool to assess how comprehensive a training set truly is, how much of the training data is effectively redundant, or whether some data over-represents unusual conditions. Additionally, there is not currently a tool that would enable researchers to determine a priori whether a newly collected data set would add useful diversity to the existing training data. This lack of tools for assessing training data for AI/ML algorithms results in a current state where all data is collected for training, resulting in possible excessive training costs as well as possible over-training to specific data which may not be representative of the full range of conditions in which the system will function during hostile tactical operations.

The Navy seeks a tool for analysis of acoustic data collected by undersea warfare systems to enable selection of data that is diverse, representative, and as small as practical for training of AI/ML algorithms. Acoustic data used for detection of submarines is collected on arrays of transducers, whether towed line receive arrays such as the Multi-Function Towed Array, or hull-mounted source/receiver arrays such as the 576-element AN/SQS-53C hull-mounted sonar array. The signals from the transducers are formed into beams representing the acoustic environment as a function of bearing at any given point in time. Key characteristics of data sets will include both meta-data (e.g., season, latitude and longitude, time of day) and attributes of the data (e.g., volume reverberation levels, numbers of “clusters” associated with reflectors such as bathymetric features, marine entities, surface ships, submarines, and wakes).
The tool developed will need to demonstrate the training data prioritization technology which reduces the amount of training data used to allow the AI/ML algorithm(s) to maintain or improve performance. Performance of the system is determined by the Receiver Operating Characteristic (ROC) curve, where recorded data is run through the system to determine the number of true positives are achieved as a function of false positives.

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for an AI/ML training data prioritization tool that meets the requirements in the Description and demonstrate the feasibility of that concept using unclassified data obtained or created by the company. If the unclassified data is not acoustic data, then it must be clearly extensible to the acoustic data use case. Feasibility will be demonstrated through analysis and modeling. Demonstrate the ROC curve associated with training on all data and how the ROC curve is maintained or even improved when AI/ML is trained using the prioritized subset of all data.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design, develop, and deliver a prototype AI/ML training data prioritization tool for testing and evaluation based on the results of Phase I. Demonstrate the prototype meets the requirements in the Description. The government will provide data sets used to train current AI/ML algorithms that are used in the AN/SQQ-89A(V)15 sonar system, and a MatLab implementation of at least one such algorithm.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The Navy will establish a contract vehicle to apply the training data prioritization technology to AN/SQQ-89A(V)15 in support of additional AI/ML algorithm development opportunities, not limited to Undersea Warfare systems.

Given the emerging importance of AI/ML in numerous major industry sectors this technology can be used in many training areas. Science and engineering professions would do well their training centers to incorporate the technology because of ever changing information data.

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2. “The Essential Guide to Quality Training Data for Machine Learning: What You Need to Know About Data Quality and Training the Machine.” Cloudfactory. https://www.cloudfactory.com/training-data-guide
3. Rim of the Pacific (RIMPAC) international maritime exercise website, available 6 Apr 2023 at https://www.cpf.navy.mil/RIMPAC/

KEYWORDS: Artificial intelligence or machine learning (AI/ML); training data for AI/ML algorithms; acoustic data; undersea warfare systems; data that is diverse and representative; Multi-Function Towed Array; AN/SQS-53C hull-mounted sonar

N241-031 TITLE: Silver-Oxide/Zinc Battery Test Measurement and Diagnostic Equipment (TMDE) Tool

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

OBJECTIVE: Develop a man-portable Battery Test Measurement and Diagnostic Equipment (TMDE) tool for assessing health status and remaining useful battery life of Silver-Oxide/Zinc (AgO/Zn) batteries to provide a cost savings while increasing safety and readiness.

DESCRIPTION: AgO/Zn battery cells are safe for use onboard submarines and are a field-proven power source for underwater vehicles with a wet-life of about 24 months. One of the main challenges associated with deployment of AgO/Zn battery cells is the lack of a reliable and accurate way to measure the battery's state of charge, state of health and remaining useful life at any stage of application/in-situ. Currently, the AgO/Zn battery (up to 120 cells in series) set assembled with 365 ampere hour (Ahr) capacity is de-commissioned based on the pre-determined wet-life duration instead of cell state-of-health due to a lack of commercial ability to assess state-of-health without extensive analysis or destructive testing. This results in potentially healthy batteries being removed from service before the end of useful life. The Navy is seeking a man-portable (preferably hand-held or laptop installed) Test Measurement and Diagnostic Equipment (TMDE) tool that can detect early signs of battery degradation and predict the remaining useful life of AgO/Zn batteries, other, application and scalability to additional battery chemistries are also desired.

A TMDE tool would result in cost reduction, risk reductions, and better sustainment of fleet underwater vehicles by removing batteries from fleet once a 'true' End of Service Life was met based on battery condition versus timed maintenance. It would achieve these benefits by allowing maintenance activities to provide requisite Objective Quality Evidence (OQE) to determine life extensions, informing maintainers of the real-time battery conditions that indicate a thermal event, allowing operators and maintainers to make more informed and safer decisions, and enable targeted replacement of weak cells in a battery set instead of replacing the entire battery set. The latter would increase the life of a battery set, thereby reducing the amount of battery sets needed to be purchased and increasing operational availability. The former would reduce schedule risks when planning and conducting operations.

The tool developed must be non-destructive and user-friendly with a graphical user interface (GUI) to display metrics to accurately describe battery condition. It should utilize advanced sensor technologies to assess the state-of-health and remaining useful life of AgO/Zn battery sets prior to deployment, transport, maintenance, or storage. If the device is handheld, it should be battery powered by 20VDC or less, and rechargeable using standard 110VAC.

PHASE I: Develop a concept for a portable Battery Test Measurement and Diagnostic Equipment tool that meets the requirements in the Description. Establish feasibility by developing system diagrams as well as Computer-Aided Design (CAD) models that show the tool's design concept, and provide estimated weight and dimensions of the concept. Feasibility will also be established by computer-based simulations that show the system's capabilities are suitable for the Navy's needs. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and fabricate a prototype for demonstration and characterization of key parameters of the TDME tool as detailed in the Description. Conduct a prototype demonstration capable of full-scale operation according to the design. Complete relevant testing to prove the full-scale metrics. Based on lessons learned through the prototype demonstration, develop a substantially complete design to allow for

Navy integration. Ensure that this design includes all ancillary equipment required to operate components such as the TMDE tool and control software when applicable to the proposed concept.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. Although a fully operational TMDE tool is initially targeted for use in maintenance and sustainment of underwater vehicles, it should have the ability to support additional battery chemistries and be suitable for shipboard use.

The TMDE tool could be useful in commercial applications where safe, high energy density batteries are used. Examples would be oceanography, offshore oil rig inspection, UAVS, and robotics.

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KEYWORDS: Silver-Oxide/Zinc Battery; Battery/Cell State-of-Health; Electrical Test Measurement and Diagnostic Equipment Tool; Non-destructive battery testing; Battery State of Health Estimation Experimental Methods, Battery State of Health Model-Based Estimation Me

N241-032 TITLE: Air Cushioned Vehicle Erosion Resistant Coatings

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop coatings suitable for metal and marine composites to improve durability, decrease maintenance time and costs, and improve craft operational availability.

DESCRIPTION: Landing Craft, Air Cushion (LCAC) and Ship-to-Shore Connector (SSC) are Air Cushion Vehicles (ACVs), or “hovercraft”, providing amphibious transportation of equipment and personnel from ship-to-shore and shore-to-shore. Erosion has been an antagonist for the ACV industry for many years. In operation, ACVs produce high airflow rates at speeds up to 300 mph across mostly composite components and surfaces. This massive amount of air flow can be saturated with saltwater and sand particulates. ACV components are also exposed to constant vibrations, high winds, impacts, and other foreign object debris. ACVs require erosion protection to cover large internal composite surfaces while minimizing both cost of acquisition and manpower for installation and maintenance. After a comprehensive survey of the industry, multiple commercial products have been attempted with no viable solution found. The internal flow surfaces on the craft that must be preserved from erosion include the bow thruster nozzle, upper lift fan volute, lower lift fan volute, propulsor shroud, propulsor stators, and rudders. As each component is custom and designed specific to its location, it must maintain its shape and composition. Figures and dimensions of these components can be found in Reference 4 linked below. The Navy has researched and evaluated multiple erosion coatings and tapes with marginal success in the harsh environment. Current solutions are difficult to apply and repair in the field. The Navy is seeking an optimized erosion protection solution to decrease maintenance and inspection intervals on all ACV composite surfaces, increasing mission efficiency and readiness. This product solution should be manageable for the onsite maintainers to reapply and repair when needed, including inside an amphibious ship’s well deck or on an isolated beach in a deployed environment. A successful coating technology must bond to all contact surfaces and not present the possibility of separating or delaminating, causing further damage to other components. A solution that meets all ACV erosion requirements would result in lowered overall maintenance effort and cost.

PHASE I: Develop a concept for erosion prevention for ACVs that meets the requirements as described above. Demonstrate the feasibility of the concept in meeting Navy needs. Demonstrate that the durable erosion prevention application can be readily and cost-effectively manufactured through standard industry practices by material testing and analytical modeling. The Phase I Option, if exercised, should include the initial layout and capabilities to demonstrate the application in Phase II.

PHASE II: Based on the results of the Phase I effort and the Phase II Statement of Work (SOW), develop and deliver an erosion prevention application that meets the requirements in the Description. A production representative application will be installed on an actual ACV component or appropriate test platform for durability and wear testing. The technology will be evaluated and compared to other erosion prevention methods to determine its ability to meet specified requirements. These evaluation results will be used to refine the erosion prevention application into a design that will meet ACV Craft Specifications. Prepare a Phase III development plan and cost analysis to transition the technology to Navy use.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the erosion prevention application for use on the ACV program. The satisfactory ACV erosion prevention method will have private sector and commercial potential for hovercrafts of this scale operating in the near-shore or on-shore environment, which are all currently struggling with erosion prevention. Commercial applications include ferries, the oil and mineral industry, cold climate research and exploration. Other industrial and military machinery with high airflow could also benefit from technologies developed during this effort.

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KEYWORDS: Air Cushion Vehicle (ACV); Ship-to-Shore Connector (SSC); Landing Craft; Air Cushion (LCAC); Foreign Object Debris; High Velocity Airflow

N241-033 TITLE: Inert Gas Reclamation for Minimally-Enclosed Directed Energy Deposition (DED) Additive Manufacturing (AM) Equipment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Develop a modular system designed to reclaim inert gas used during the metal Directed Energy Deposition (DED) Additive Manufacturing (AM) process.

DESCRIPTION: Currently, AM equipment suitable for afloat use is limited. The current capabilities were installed to support the development integration requirements for AM equipment, but is limited to polymer machines. Current metal AM technologies are designed for the lab or machinery spaces ashore, and have not been configured for the harsh shipboard environment. The inclusion of a metal AM capability shipboard would drastically improve ship self-sufficiency and increase readiness.
There are increased needs for AM afloat as it is explicitly identified in the COMNAVSEA Campaign Plan 3.0 as a technology focus area. The Navy directly supports efforts to integrate AM into the Fleet and support a more self-sufficient ship. The Navy seeks to maximize its use of AM to fabricate "hard to source" or obsolete parts, reduce cost, field more effective systems, and reduce reliance on vulnerable supply chains through production at the point of need.

Current metal AM technology can be classified under powder bed fusion (PBF), DED, material extrusion, sheet lamination, or hybrid processes. These processes all have their benefits and limitations from a part production standpoint. At this time, these metal AM system installations are typically expected to be on the shop floor in industrial or lab settings. There is an interest to integrate these metal AM systems in more expeditionary settings to increase warfighter readiness and increase the Navy's distributed manufacturing capabilities and self-sufficiency. The operational conditions within these expeditionary settings include ship motion, ship vibration, shock, ventilation, and electromagnetic interference (EMI). In order to successfully install metal AM equipment and enable adequate operation of the equipment, the machine must not experience severe degraded performance under these conditions. Testing of these conditions in the lab environment should occur to determine system performance under shipboard environmental conditions.

Specifically related to this SBIR topic, these metal AM machines use an inert shielding gas to manufacture components, a consumable that is a logistical challenge in an expeditionary environment. This inert gas is utilized to provide an inert environment for the deposition of the material to form but is off-gassed into the atmosphere. Capturing, cleaning, reusing, and overall reclaiming this gas would be beneficial to utilizing this process in a deployed environment because there would only need to be a small amount on hand for startup that could then be reclaimed throughout the life of the builds. The solution must not impede on the operations of the DED process, ensuring that there are no capability reductions as a result of the gas reclamation. Another aspect to this solution is that the manufacturing envelope will not be completely sealed to the outside atmosphere, which adds complexity to the reclamation strategy. As a result, the company shall take this into account when selecting alternatives to investigate. In addition, this solution would require shipboard hardening, a small footprint not exceeding the footprint of the machine in which it is installed, high efficiency, modularity, and innovative approach to meet the topic criteria. This SBIR topic will address the current shipboard mitigation requirements associated with shipboard integration and performance of metal AM. The product developed from this topic could result in the establishment of a Navy vendor for shipboard AM equipment. In addition, the current modifications, costs, and qualification to Commercial Off the Shelf (COTS) equipment would no longer be required if the system was designed around the shipboard environment. AM has the potential for major readiness impacts for the Fleet, improving self-sufficiency and reducing the reliance on the supply chain.

PHASE I: Develop a concept for a gas reclamation system(s) into a minimally closed DED machine. This means that the manufacturing envelope will not be completely sealed to the outside atmosphere, which adds complexity to the reclamation strategy. As a result, the company shall take this into account when selecting alternatives to investigate. Feasibility shall be demonstrated by conceptual models, drawings, integration schematics, and description of workflow and operation. The concept during this stage should also consider the operation of the machine, requirements for installation, and lifetime maintenance that is necessary. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype which will be evaluated based on the overall integration into an existing machine. This prototype shall have no interruptions with the main functionality of the system and tie seamlessly into the existing workflow. It shall also be user friendly by providing an easy-to-use interface, warnings if something is out of normal operating parameters, and minimal maintenance. The prototype shall also be compact into as small of a form-factor as possible due to the limited space available in the expeditionary environment. The system should aim to be able to fit within the footprint of the identified DED machine or be no larger than the size of the machine.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the reclamation capability to Navy use. Use the feedback from Phase II and perform necessary changes to complete the prototype. The final product shall be a turn-key system that can be integrated into machines that are already deployed or planned to be deployed. This would include, but not be limited to, having Standard Operating Procedure (SOP) documentation, installation instructions, and troubleshooting tips and tricks, as necessary. The platform in which this machine would be targeted would be the installations of this type of equipment through the NAVSEA 05T1 AM Program Office’s Afloat Program of Record on the following, but not limited to, large deck platforms and regional maintenance centers.

The dual use of this developed final product outside of the military will be able to reach a wide breadth of companies with similar DED machines. The ability to have a system like installed on other machines means a logistical burden of resupplying inert gas for the manufacturing process is lifted from all users.

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KEYWORDS: Directed Energy Deposition; Gas Reclamation; Additive Manufacturing; Inert Gas; Hybrid Metal Additive Manufacturing; Expeditionary Additive Manufacturing; Gas Recycling

N241-034 TITLE: Modular and Scalable Extended-Sonobuoy Deployment System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 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 deliver an innovative low Size, Weight, Power and Cost (SWaP-C) Modular and Scalable Extended-Sonobuoy-Form-Factor Deployment System for an A-sized or extended A-sized Sonobuoy Form Factor Unit that can be easily integrated on multiple platforms.

DESCRIPTION: As underwater systems become increasingly prevalent in maritime operations, the Navy requires a means of deploying A-sized and extended A-sized sonobuoy form factor units as single and multiple payloads from various platforms including craft and vessels of opportunity. The Deployment System should be capable of deploying an encased A-Sized Sonobuoy and an encased extended A-sized sonobuoy form factor payload roughly the size of a cylinder 5.5 inches in diameter and 48 inches of length with a weight of 40 pounds. When deployed, the case (e.g., sonobuoy launch container) shall be left behind in the deployment system. Currently, there is no commercial technology that meets this requirement.

The Deployment System must be designed to be modular/reconfigurable such that it is capable of deploying 1 to 16 A-sized or extended A-sized sonobuoy form factor payloads depending on the platform’s available payload space. It must also not interfere with operations of the vessel and must be capable of deploying explosive payloads. For the purposes of this SBIR topic, deploy can mean released, launched, propelled or dropped in the water. However, the payload deploying mechanism must result in a consistent, repeatable, and safe separation of the payload.

At its maximum configurable size (16 payloads) the deployment system shall deploy each payload at a minimum distance of 3 plus or minus 0.5 meters. At its minimum configurable size (1 payload), the deployment system shall deploy each payload at a minimum distance of 0.5 plus or minus 0.1 meters. At its maximum configurable size (16 payloads), the deployment system must be capable of integrating on the deck of a vessel with a maximum footprint of 238 inches by 70 inches, a deck load of 3,400 pounds and electrical power of 28 VDC at 25 A supplied by the vessel. Coordination with NAVSEA will be critical to understanding the most current available space(s) aboard other platforms, crafts and vessels of opportunity, as well as any weight/power restrictions on the Deployment System.

The Deployment System must be simple enough in design to allow for sustained operations and must be capable of at least 100 deployments before repair or refurbishment with high reliability and little maintenance down time for 24 hour/7 day surge periods. The Deployment System must also include a communications interface. While a communications package is not part of this topic, the deployment system should be capable of interfacing with a data communications system. The interface is intended to provide a mechanism for future unmanned or autonomous deployment. The system shall adhere to all applicable environmental standards of the latest version of MIL-STD-810, such as shock, vibration, electromagnetic interference/emission, etc.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for an innovative Modular and Scalable Extended-Sonobuoy Deployment System that meets the requirements specified in the Description. Demonstrate the feasibility by modeling and simulation, analysis, and/or laboratory experimentation, as appropriate.
The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the Navy’s requirements. Perform detailed analysis, and live demonstration in a test environment as part of the evaluation. Provide detailed technical documentation of the design, including an interface control drawing and interface specification, to allow successful transition of the product.

It is probable that the work under this effort will be classified under Phase II (see Description for details).

PHASE III DUAL USE APPLICATIONS: Support the transitioning the technology to Navy use through system integration and qualification testing of the Modular and Scalable Extended-Sonobuoy Deployment System. If successful, the Modular and Scalable Extended-Sonobuoy Deployment System could be applied to other Navy platforms.

In addition to such DoD applications, the communication system could be used in commercial oil, gas, and oceanographic sensing applications.

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KEYWORDS: Deployment System; Low SWAP-C; Surface Vehicle, sonobuoy, A-sized sonobuoy; Easily Integrated; Reconfigurable; Sustained Operations

N241-035 TITLE: Coordinated Effectiveness Assessment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE);Integrated Network Systems-of-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 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: Provide an automated Tactical Effectiveness Service for Electromagnetic Effectors (TES-EE) within the decision support services of the Integrated Combat System which provides consistent and accurate real-time effectiveness assessment of electromagnet engagements for coordinated engagements among hardkill and softkill effectors across the force.

DESCRIPTION: Typical engagements conducted by Naval platforms employ either hardkill or softkill effectors. Kinetic effectors (hardkill) such as missiles, naval guns, or other types of projectiles defeat targets primarily using kinetic energy alone or with the assistance of energetics to physically damage or destroy the target, rendering it harmless as a threat. The effects of a kinetic engagement are generally straightforward to observe, and may include rapid changes of trajectory, observing a single target becoming many smaller targets, detection of explosions, inability to reacquire the target after impact, and many others. In short, the effects are typically easily observable using typical Naval sensor suites. A limitation of kinetic effectors is that they are limited in number, and once expended, are not easily replenished in the heart of a battle.

Conversely, electromagnetic (EM) engagements (softkill), such as those accomplished through lasers, high power microwaves, other radio frequency (RF) sources, or other electronic attack mechanisms, can be much more subtle in their effects and may not be directly observable by naval sensor suites. Where kinetic weapons like missiles typically take time to travel to the target, but once there, achieve a near-instantaneous effect, EM engagements may start immediately (think of applying laser energy to a target), but may take some amount of time to accomplish their purpose (that is, laser dwell time on a spot to burn a hole). Some EM effects may be observable, such as in the case of a laser burning a hole in the flight control surfaces of an unmanned aerial vehicle, causing it to plummet to the water below. Others, such as RF energy, may be achieving an effect to prevent the target from acquiring its target, but from outside observation, the target is still behaving nominally. EM effectors, unlike kinetic effectors, are not inherently limited to a finite number of shots, and therefore may represent a greater number of engagement opportunities than their kinetic analogs.

A challenge for naval forces is achieving efficient expenditure of effectors to balance adequate self-protection with mission completion. EM effectors offer the promise of defeating threats without the expenditure of limited kinetic effectors, which can then be preserved for the most stressing threats. The ability to defeat threats with a mix of kinetic and EM effectors opens the possibility of optimizing the use of engagement resources to defeat the greatest number of threats while prolonging the amount of time the force can stay in the fight. This is only possible if the predicted effectiveness of a weapon can be determined and the actual effect against a live target can be assessed in real-time. Herein lies the challenge inherent to EM weapons, and subsequently the challenge in effective kinetic/EM coordination. To effectively make use of EM weapons, the warfighter (or the combat system acting on the warfighter's behalf) must be able to determine if the EM weapon being employed is achieving the desired effect. The greater confidence the warfighter has that the weapon will achieve the intended effect against the target, the more likely he or she is to rely on it in real circumstances. Similarly, in live operations, the ability to confidently determine whether the EM weapon is being effective on an engagement-by-engagement basis is critical to efficient and effective employment of coordinated kinetic/EM engagements. Currently, there is no commercial means to make this assessment.

The Navy needs a means by which to assess in real time the softkill effectiveness expectation that EM weapons are having against a threat to make decisions about whether additional engagement resources may be needed. Moreover, confidence in the predicted effectiveness of EM weapons as well as the real-time performance may even lead to warfighter decisions to employ them first, ostensibly preserving kinetic effectors. This tradeoff is a challenge when conducting engagements from a single ship, and only grows more complex as we scale to the Integrated Combat System (ICS) vision of force-level engagement coordination of kinetic and EM effects. An automated TES-EE is needed to determine how real-time effectiveness of EM engagements can be consistently determined and provided to the warfighter across the spectrum of naval EM weapons (e.g., directed energy, electronic attack, high-power RF/microwave, etc.). An operator must be able to confidently rely on the effectiveness of data being provided in order to make decisions regarding employment of supplemental weapons for the engagement.

The solution will leverage all available sensor and data feeds available on a surface ship to assess effectiveness of EM Effectors and communicate that to the ICS as a success/no-success or percent chance of success assessment of the desired EM Effector intent. Effectiveness assessments should be presented to operators as a combination of an ‘alert’ and relevant data for each effector engagement pairing via current operator graphical user interfaces and may leverage updates to display architectures planned by ICS. Transition is expected to be via the ICS program, notionally as a hosted application, service, or container(s) as best supports the implementation.

The solution will provide a description of mechanisms for assessing the real-time performance of EM Effectors (such as SLQ-32(V)7, LEED, NULKA, etc.) against nominal threats in the context of a surface Navy combat system. Additionally, the Government desires a System Modeling Language (SysML) model and sufficient views to represent the TES-EE concept that captures necessary TES-EE inputs and system responses agnostic to a specific combat system and analyses to quantify expected impacts to self-defense performance and potential confidence bounds associated with EM versus kinetic weapon expenditures.

The TES-EE prototype will demonstrate software algorithms, present EM real-time effectiveness data to the warfighter supporting tactical decision making, provide data and associated analyses demonstrating kinetic weapon expenditure reduction through effective EM weapon employment, a software design model of the prototype TES-EE with traceability to the system model, and a white paper describing the prototype TES-EE’s extensibility to supporting force-level (multiple ships acting in concert) engagements.

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for a TES-EE that meets the objectives stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy's need. Feasibility shall be demonstrated by a combination of analysis, modeling, and simulation as stated in the Description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and demonstrate a prototype TES-EE based on the results of Phase I. Demonstrate the prototype's functionality through software design modeling that provides the warfighter real-time data for tactical weapon employment decisions in a containerized microservices architecture.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The final product will be the set of containerized applications that make up the TES-EE along with the necessary product-level objective quality evidence to support authorization for demonstrations via Mission Readiness Assessments (MRAs) and certification as part of the ICS. Developers for TES-EE are encouraged to leverage the Forge Ecosystem for development and testing to leverage the benefits of the Surface Navy's DevSecOps pipeline for combat systems. Support Level 3-5 combat system test events as necessary.

The TES-EE will provide a critical Decision Support Service as part of the ICS Combat Management System architecture, paving the way for integrated kinetic/EM coordination. The TES-EE will be able to be deployed to USN ships of all classes (DDG, FFG, CVN, L-Class) upgraded with a computing environment that enables independent applications/services to be employed. All ICS platforms will enable independent applications/services within the combat system enclave.
As a standalone application or as a plug in with other decision support applications, there are potential commercial applications in the communications sector assessing or obviating electromagnetic interference in over-the-air communications through frequency agility or bandwidth management methodologies and enhancing site security assessments associated with vehicle disablement options at facility entry points.

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KEYWORDS: Engagement Coordination; Hardkill or Softkill Effectors; Integrated Combat System; Decision Support Services; Softkill Effectiveness; Real-Time Effectiveness Assessment

N241-036 TITLE: Virtual Well Deck Operations Trainer: Line Handling

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

OBJECTIVE: Design and develop a virtual Well Deck Operations Trainer replicating an L-Class ship well deck environment able to support and train various surface craft and shipboard crews on duties and responsibilities associated with embarking, debarking, and emergency procedures of expected connectors (i.e., Landing Craft Air Cushion (LCAC), Ship to Shore Connector (SSC), Landing Craft Utility (LCU), small boats).

DESCRIPTION: There are currently limited training resources that develop individual and collective proficiency for handling craft inside an L-class ship well deck. In a review of data regarding the Well Deck Watch Stations training, it becomes clear that there is a need to standardize and enhance the existing training approach. The current process involves On-the-Job Training (OJT) along with a Personal Qualification Standard (PQS) and Job Qualification Requirements (JQR). However, additional training is sought to maximize effective OJT. The establishment of a training continuum. either virtual or on a scaled temporary on demand basis. that emphasizes performance in a controlled environment is required to support expeditionary readiness.

A Well Deck Line Handler Trainer would be part of a training continuum utilized prior to conducting training/operations aboard Naval shipping at sea, so that time and training value can be maximized. The Well Deck Operations Trainer, either virtual or on a scaled temporary on demand basis, shall provide live form and function capabilities associated with well deck operations to meet individual and collective training standards. The proposed solution should provide line handlers, supervisors, and small craft operators an opportunity to train under realistic conditions in a controlled environment before underway operations on an L-class ship. The well deck, as much as possible, shall replicate the material and working conditions of an L-Class ship to prepare individuals and crews for live shipboard operations. The LPD 17 Class well deck is 188 feet long and approximately 50 feet wide at mid well, increasing to 59 feet at the sill, or stern of the ship. Vertical clearance in the well is 31 feet. The trainer should be able to replicate ballasting requirements for various craft to include maximum 8-10 ft at the sill for LCU operations. To support training requirements, the Well Deck Operations Trainer should provide embark and debark procedures that replicate recovery and emergency procedures for craft expected to conduct wet well operations. The trainer should include a catwalk where line handlers are stationed, as well as replication of day and night operations. Training should be structured to replicate skill components required of the integrated working environment utilizing the building block approach.

The culmination of block training would be conducting line-handling duties aboard L-class shipping under normal operating conditions. The phased approach is a cost-effective solution that maximizes prime time skills development ensuring a high level of competency.

The design, development, and implementation of a Well Deck Trainer will provide a location for teams to train, rehearse, and refine Required Operational Capabilities and Projected Operational Environment (ROC/POE) and Mission Essential Tasks (METs) that directly relate to amphibious requirements.

PHASE I: Develop a conceptual design to meet the requirements in the Description. Through modeling and simulation, or other means, demonstrate the feasibility to develop a concept that meets the needs of the Navy. 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: Based on the results of Phase I efforts and the Phase II Statement of Work (SOW), develop and deliver a prototype. Demonstrate the capability of the prototype to recover and secure an LCU in a controlled environment incorporating line-handling practices. Construct one task trainer prototype for testing. Support the Navy for test and validation in accordance with Navy regulations and requirements. Navy technical leads will validate the prototype to ensure compliance with training certification requirements. Refine the design of the Well Deck Operations Trainer for the training and qualification of line handlers and small craft/boat crews to conduct wet well procedures.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. Following testing and validation, implement the final prototype at multiple sites in Fleet concentration areas.
This technology will help the Navy meet the critical needs of increased warfighting capability for L-Class ships and expand the Amphibious Warfare Mission Area(s). Rescue boat crews from civilian fire and law enforcement rescue units will also benefit from this training.

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2. Naval Education and Training Command, NAVEDTRA 43220-5C Personal Qualification Standard for LPD 17 Deck Operations, 30 Aug 2021. https://www.mnp.navy.mil/documents/7769305/12444240502/43220-5C.pdf/705e1a2d-5d5b-2e0d-9335-69d7056b18e9?t=1630354876925
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KEYWORDS: L-Class Ship; Well Deck; Embark; Debark; Wet Well Operations; Small Craft launch and recovery

N241-037 TITLE: Weapons Scheduling for Uncertain Weapon-Target Assignment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an automated capability for the Ship Self-Defense System (SSDS) that maximizes weapon scheduling effectiveness where explicit weapon-target assignment solutions are not possible.

DESCRIPTION: Current US Naval platforms use a variety of onboard sensors, communications networks, data processing systems, weapons, and other components organized into a combat system to detect, track, and classify inbound targets, determine how to best employ weapons and countermeasures to defeat those targets, and then use those weapons and countermeasures to maximum effect. This involves explicit selection, scheduling, and assignment of self-defense weapons to inbound targets to achieve an optimal defensive solution, often across multiple layers of weapons in range (i.e., “depth of fire”). This process uses a variety of factors to make explicit weapon-target assignments (WTA) and schedule engagements against incoming targets, including but not limited to: assessments of target attributes, the number of detected targets, the number of defensive weapons in inventory, doctrine describing how and when particular weapons are used, and other factors. Furthermore, engagement schedules are “dynamic, changing as new sensor data are provided, additional targets are disclosed, and initially scheduled engagements are executed” [Ref 1]. This is a challenging and complex process.
Due to the ever-shifting landscape posed by our adversaries, future Naval combat systems must be resilient to scenarios in which generating engagement schedules with explicit WTA approaches are not tenable and no current solution is available. The Navy therefore seeks an automated capability that generates engagement schedules enabling incoming target raid annihilation in the face of uncertainty regarding the number of inbound targets, the physical location and position of targets, knowledge of expected inbound target behavior during terminal homing phases, inferred target identity, and other characteristics occurring during off-axis, massed and/or swarm attacks [Refs 2, 3]. Proposals using machine learning approaches will also be considered, but candidate solutions must be capable of generating schedules against completely novel, never-before-seen threats and raid conditions, and in scenarios for which training data for use in ML-focused solutions cannot be provided. Solutions must reside inside and support integration into the SSDS combat management system (CMS) (that is, algorithms should not be targeted for integration into weapons or sensors), but must use data (e.g., radar track and state data, sensor data, and others) that are common to other CMSs. Furthermore, the solution should consider the potential complexities introduced by distinctions between CMS-provided WTA, and WTA approaches decided by defensive interceptors themselves as they near their targets [Ref 4]. Finally, the solution must be compatible with current combat system operational characteristics and constituent components (that is, solutions cannot depend on integrating new weapons and/or sensors into the combat system) [Ref 1]. The solution used to demonstrate proposed methods and/or algorithms for scheduling under WTA uncertainty should be demonstrated under low- to medium-fidelity modeling and simulation approaches. Simulation and analysis results should be presented in the form of scenario descriptions, Red and Blue force asset laydown(s), and engagement timelines using synthetic yet realistic engagement events, parameters, and data. The inner workings of proposed algorithmic approaches must be explainable.

Three SSDS Top Level Requirements (TLRs) would be supported by this investigation. These TLRs will be provided by the government to the awardee. These requirements are:

- The SSDS CS shall determine, recommend and apply weapons tactics to include firing policy, salvo size, and salvo spacing [SSDS_CS_TLR-1571];
- The SSDS CS shall reevaluate and rebuild HK and SK schedules periodically, as well as when certain events occur that can change target and resource status [SSDS_CS_TLR-1674]; and
- The SSDS CS shall consider the effects of multiple targets in the weapon's field of view on weapon performance when building the engagement schedule [SSDS_CS_TLR-1684].

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for a capability to generate SSDS engagement schedules that enables incoming target raid annihilation without using explicit weapon-target assignment approaches. Demonstrate the feasibility of the concept to meet the conditions outlined in the Description section through modeling, simulation, and analysis. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver an engagement scheduling system prototype capable of meeting realistic engagement and operational requirements based on the results of Phase I. Demonstrate at a Government- or company-provided facility that the prototype meets all parameters detailed in the Description. The technology will be assessed by Navy subject matter experts.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The technology will go through system integration and qualification testing for the prototype engagement scheduling approach developed in Phase II. This prototype will be delivered to support the Navy through a critical experiment conducted jointly by the awardee and combat system engineering agent (CSEA). This is expected to take place in a live environment with tactical SSDS CMS software. Integrate the prototype into the SSDS CMS.
Dual use applications to consider include commercial resource management, delivery, and scheduling challenges that are particularly vulnerable to uncertainty that is difficult to deterministically quantify and/or changes over time.

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KEYWORDS: Operational characteristics; WTA uncertainty; weapon-target assignment; schedule optimization; stochastic optimization; weapons and countermeasures

N241-038 TITLE: Runtime Software Verification for Non-Standard Compute Infrastructure

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an automated software runtime verification capability that reveals errors or conditions for combat management systems running on US Navy ship computer hardware.

DESCRIPTION: Current US Naval platform combat management systems are a system-of-systems, operating as a complex collection of computers, controllers, sensors, communications networks, rack-mounted servers and hardware, and other systems required to accomplish the ship’s objectives. These components communicate and interact over local area networks. Safeguards must be taken to identify unexpected errors before they result in potentially catastrophic system failure modes, improving the resilience and reliability of platforms and the safety of embarked personnel. Currently there are no commercial solutions known that apply to the Navy’s need. The Navy seeks an automated software solution, using current development and engineering approaches, that updates both software and computing infrastructure (CI) hardware on faster timescales than current refreshes and overhauls. Improved methods to identify unexpected but potentially catastrophic failure modes while new software is running on new CI would significantly improve the resilience and reliability of the Navy’s future combat management systems. Three Ship Self-Defense System (SSDS) Top Level Requirements (TLRs) would be supported by this investigation. The TLRs will be provided by the government to awardee. These requirements are:

- The SSDS Combat System (CS) shall have the ability to automatically discover, identify, and record security relevant information such as hardware and software attributes [SSDS_CS_TLR-1065];
- The SSDS CS shall periodically validate the integrity of persistent operating system and application software files against a known-good baseline, and log and notify the operator for further analysis [SSDS_CS_TLR-1071]; and
- The SSDS CS shall support modular, extensible, rapid, and transparent introduction and integration of new and updated cybersecurity capabilities to the CS elements [SSDS_CS_TLR- 2162].

The solution must monitor and detect early indicators and warnings (I&W) of combat system software component errors or failures through the application of runtime verification or dynamic software analysis techniques. Critically, this approach must be able to detect these conditions in combinations of software and CI that cannot be anticipated and tested prior to release (i.e., as both hardware and software are upgraded across the lifetime of the ship). An approach should be used that supports displaying detected findings relevant for embarked personnel. It should provide personnel an understanding of the nature of the identified I&W so actionable steps can be taken before catastrophic system failure occurs. Runtime error types relevant to combat management systems include memory leaks and memory management errors, system process concurrency errors, race conditions, livelocks, deadlocks, and unexpected system process executions. Furthermore, while relevant errors can address potential cybersecurity vulnerabilities, solutions are desired that address the above types of runtime errors. Note that potential solutions should be distinct from software verification techniques that can be used during the software engineering process (e.g., static code analysis, fuzzing, testing, and others). Potential solutions should be suitable for the SSDS but also support extensibility to other combat management systems [Ref 1]. Finally, solutions must be flexible enough to support prototype construction and integration into US Navy consoles and display system approaches, as well as perform these tasks agnostic of specific combinations of software and CI hardware.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for performing automated runtime verification of combat management system (CMS) software components. The concept must demonstrate feasibility to detect early indications and warnings (I&W) of potential error modes, as well as an approach to display those errors for relevant embarked personnel according to the parameters of the Description. Demonstrate feasibility through modeling, simulation, analysis, or other formal methods. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype automated runtime verification solution capable of meeting realistic operational requirements for the SSDS based on the results of Phase I. Demonstrate at a Government- or company-provided facility that the prototype meets all parameters detailed in the Description. The government will provide a reference combat management system architecture example and additional information for demonstration development. The technology will be assessed over the course of Phase II by Navy subject matter experts.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The final product will use system integration and qualification testing. This prototype will be delivered to support the Navy through a critical experiment conducted jointly by the company and the combat system engineering agent (CSEA). This is expected to take place in a live environment with tactical SSDS CMS software. Integrate the prototype into the SSDS CMS.
Dual use applications to consider include extension of these technologies and capabilities to any safety-critical system monitoring use cases, including but not limited to: industrial control systems; manufacturing systems; electrical grid or other resource distribution systems; transportation and logistics systems; and others.

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1. Bath, W. G. “Overview of Platforms and Combat Systems.” Johns Hopkins APL Technical Digest, Volume 35, Number 2, 2020. https://www.jhuapl.edu/Content/techdigest/pdf/V35-N02/35-02-Bath.pdf

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KEYWORDS: Runtime verification; software verification; dynamic software analysis; formal methods; system failure modes; combat management systems

N241-039 TITLE: Portable Boats & Small Craft Assembly Kits

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Develop a craft that is easily manufacturable in theatre to allow more assets to arrive at the Expeditionary Advanced Base (EAB) within the same shipping/logistic footprint for forward deployments.

DESCRIPTION: More craft available in theater would support reduction in refuel, rearm, and resupply times allowing on demand supply transport from a capital asset or a supply depot to forward bases. This will enable risk worthy asset support to contested logistics and distributed lethality during littoral operations in a contested environment through manned or unmanned operations. The kit shall be stored within a standard shipping container no larger than 40 foot that may contain other supporting equipment. A form factor similar to the portable rigid inflatable boat is desired. Craft must be recoverable by conventional ship boat handling mechanisms. Maximum craft weight cannot exceed 5,600 pounds fully outfitted. The portable boat & small craft assembly kits need to contain, within shipping containers, all components needed for construction. Forward deployed sailors would then construct the craft, assisted by manufacturing aids. The craft that is manufactured would then need to meet stability and speed requirements in a minimum of sea state 3.

Stage of completion and speed to deployment must be weighed against compactness of shipping. Flexibility to disassemble craft for storage or repurposing is desired. Craft operation should not require more than two boat operators. Expected maximum payload is no more than 925 pounds. Payload includes weapons/ammo (forward M60/M240 machine gun mount), other outfit and personnel.
Autonomous operation is not a requirement but inclusion of the capability to attach a tactical autonomous operation kit is desirable. Number of craft kits per container will be determined by scale of finished craft and volume needed for accessories and payload support systems. Payloads may include offensive or defensive systems and humanitarian support.

PHASE I: Develop a concept for portable boats & small craft assembly kits for an Expeditionary Combatant Craft or relevant vessel. Demonstrate the feasibility of the operational concept via physics-based modeling and simulation. Define the components of the system and hull, mechanical and electrical interfaces as well as additional functional design concepts of the system. Provide a preliminary concept design and an associated component validation plan. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype portable boat & small craft assembly kit capable of being constructed by forward deployed sailors. Evaluate the prototype to determine its capability in meeting the performance goals defined in the Phase II SOW. Demonstrate system performance through prototype evaluation and testing, modeling, and analysis. Evaluate results and accordingly refine the system concept. Ensure that the prototyped hardware clearly shows a path to development of a sea worthy hardened system. The prototype model is to be made available for Government demonstration or testing upon Government request. Prepare a Phase III development plan to transition the technology for Navy use.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the system for Navy use. Support the Navy in transitioning a fully hardened system for sea trials to be demonstrated on a relevant vessel. Ensure that the system passes an underway test to be developed for the defined test platform. Support for participation in fleet demonstration is aimed at transition with the intent to purchase and integrate the system into the US Navy.

Commercial applications include disaster recovery efforts where an abundance of quickly assembled small craft will make significant impact in humanitarian relief efforts in moving people and provisions in ravaged environments brought on by natural disasters or war.

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1. Lacey, Jim, THE “DUMBEST CONCEPT EVER” JUST MIGHT WIN WARS, War on the Rocks 29 July 2019, https://warontherocks.com/2019/07/the-dumbest-concept-ever-just-might-win-wars/
2. Smith, Eric M, Lieutenant General, US Marine Corps, Deputy Commandant for Combat Development and Integration, 'Tentative Manual for Expeditionary Advanced Base Operations", February 2021, https://mca-marines.org/wp-content/uploads/TM-EABO-First-Edition-1.pdf

KEYWORDS: Portable Boats; Assembly Kits; Force Protection Operations; Distributed Maritime Operations; Littoral Operations; Contested Environment

N241-040 TITLE: Additive Manufacturing of Textured Piezoelectric Ceramics

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials; Sustainment

OBJECTIVE: Develop a low-cost, flexible manufacturing technique to produce textured piezoelectric ceramics for undersea sensor applications.

DESCRIPTION: Ceramics with a high degree texturing or grain alignment can exhibit enhanced properties compared to traditionally manufactured ceramics with randomly oriented gains. One such property benefitting from gain alignment is improved piezoelectric performance of ceramics used for sonar sensor applications (early prototypes have shown upwards of 12dB improvement in performance, enabling sensors to detect potential threats much farther out). Current manufacturing techniques to produce highly textured ceramics involve using an expensive and complex tape casting technique to properly align the material seed crystals.

Additive manufacturing (AM) could provide a solution by improving the Manufacturing Readiness Level of these new textured ceramic materials and enabling technology insertion at a scalable, cost-effective rate. Current stereolithography (SLA) and digital light processing (DLP) 3D printers create parts by using a light source to polymerize a liquid photopolymer resin to create a high resolution 3D printed part with minimal need for additional post processing. SLA employs a laser to trace the shape of each layer. DLP, on the other hand, projects a mask of a whole cross-sectional layer at a time. Proposals will be evaluated on the modification to the existing photo-polymerized resin systems used in SLA/DLP 3D printers to be compatible with Navy piezoelectric ceramics. Additionally, there is a need to modify existing 3D printing hardware to incorporate the ability to properly align high aspect ratio seed particles within each print layer to produce grain alignment during sintering of the ceramic. Currently, there are very few commercial solutions that have the ability to align particles or fibers within each layer while printing.
The first objective will be to validate the feasibility to integrate a Navy provided piezoelectric ceramic with a photopolymer resin system. The system must demonstrate the ability to properly polymerize with darker colored ceramic materials. Evaluation criteria will include the ability to polymerize each layer, the layer height that is able to be polymerized, adhesion between layers, percent solids loading of the resin as well as density of final parts.

The secondary objective will be to demonstrate the ability of the 3D printing hardware to properly align high aspect ratio barium titanate platelets during the printing process. These platelets should be dispersed in the piezoelectric ceramic resin and aligned within each print layer. Prototype samples of approximately 1in outer diameter cylinders will need to be produced and undergo binder burn off and sintering. Prototype parts that will be electrically and acoustically tested will be sent to a 3rd party that will apply electrodes and pole the piezoelectric ceramic parts. Prototype parts will be evaluated by Naval Surface Warfare Center Crane Division for density, surface finish, particle/grain alignment, texture fraction as well as electrical and acoustic properties. Textured prototype parts will be electrically tested for resonance frequency, capacitance, dielectric constants, and loss factor and then compared to traditionally manufactured non-textured materials. The company will aim to create a material that exceeds a capacitance of 200pf while minimizing the loss tangent. The company will then revisit particle alignment and binder composition as needed in an attempt to improve acoustic and electrical performance.

PHASE I: Develop a concept that will demonstrate the ability to validate the compatibility of 3D printing resin systems with Navy piezoelectric ceramics and for 3D printing hardware that can align high aspect ratio ceramic platelets within the constraints listed in the description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver prototype hardware based on Phase I work and demonstrate the ability to construct a prototype ceramic that meets the constraints listed in the Description. The prototype hardware will be delivered at the end of Phase II ready to be tested by the government.

PHASE III DUAL USE APPLICATIONS: Focus on transferring the technology and knowledge to the Navy. Scale/volume/speed of production will also be optimized in this phase. Finalize the equipment and consumables needed to produce the parts and make the products available for Crane/Navy to utilize/purchase. This new technology will support the Navy programs/platforms by providing advanced piezoelectric transducers with better performance and capability.

This added technology/capability will also assist in other projects that require advanced, textured ceramics including hypersonic radomes as well as various sensors in the commercial sector and the military. This specific technology could be used in commercial and recreation sonar such as fish finders and navigation devices. It could be used to develop high resolution seafloor mapping devices. There are some possibilities of using this technology for communications/data transfer. This technology is also commonly used in the medical field for imaging devices.

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2. Rueschhoff, Lisa; Costakis, William; Michie, Matthew; Youngblood, Jeffrey and Trice, Rodney. "Additive Manufacturing of Dense Ceramic Parts Via Direct Ink Writing of Aqueous Alumina Suspensions." International Journal of Applied Ceramic Technology 13, no. 5 (2016): 821-830. https://doi.org/10.1111/ijac.12557
3. Walton, Rebecca L.; Kupp, Elizabeth R. and Messing, Gary L. "Additive Manufacturing of Textured Ceramics: A Review." Journal of Materials Research 36 (2021): 3591-3606. https://doi.org/10.1557/s43578-021-00283-6

KEYWORDS: Additive manufacturing; digital light processing; DLP 3D printing; textured ceramics; piezoelectric; undersea sensors; sonar transducer

N241-041 TITLE: High Power Optical Splitter for Laser Weapon Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a capability to efficiently split the power of a high energy laser beam into two outputs.

DESCRIPTION: The Navy is fielding a family of high energy laser (HEL) weapons designed for surface ship self-defense. As the output power of these systems has been steadily evolving, the realities of shipboard implementation are coming to the forefront. This includes issues of cost, size, weight, and power consumption on the one hand, and issues of employment and tactical effectiveness on the other. HEL weapon systems can be divided into two main sub-systems: the sub-system that generates the laser power and forms a high quality output laser beam, and the laser beam director that places and holds the beam on target. Between these two units is an optical path that is essentially lossless.

The laser generation hardware is housed below deck in an environmentally controlled space. The beam director is mounted above deck, preferably as high on the ship’s structure as practical. The complete functional independence of the two units and the lossless path between the two make this possible. It also makes it possible, in theory, to supply multiple beam directors from the same laser power source. Theoretically, this would then provide a cost-effective means for providing full coverage around the perimeter of a vessel without the need for multiple laser power sources. Currently there is no commercial capability that can split a high power laser beam.

The Navy needs a technology for splitting a high power laser beam into two separate channels (optical paths). The splitter is intended to be placed in the optical path between the laser source and beam director(s). An optical splitter that can switch the entire beam between two channels is the minimum requirement. However, a technology that can split the bream fractionally between channels is most attractive. The ratio of power split between the paths can be continuous or fixed to discrete increments but, in addition to complete switching between channels, ratios of 50/50 to 20/80 are desired. True splitting of the continuous wave power provides the greatest flexibility in operation, however, solutions that achieve average power splitting by time division of the full continuous wave beam power are acceptable provided the switching between channels occurs at a rate of at least 500 Hz. As the quality of the transmitted beam is of great importance, acceptable solutions should not degrade the beam quality of the input beam (as measured by M2) by more than 5%.

The solution must be capable of handling a minimum of 300 kW of continuous wave input power at a wavelength of 1.0 micron. As a goal, the beam splitter should have a 98% transmission efficiency (95% is the minimum acceptable). As the technology is intended for eventual deployment aboard Navy vessels, the solution should be fundamentally rugged and require no manned intervention (e.g., periodic calibration, alignment, tuning, etc.) during operation. Note that the Navy does not intend to furnish tactical or otherwise representative laser hardware for this effort. The proposed solution should therefore include the means for test and demonstration on surrogate hardware, provided as part of the solution. To verify power handling, demonstrations using scaled hardware, analysis, and comparison to proven component technologies are acceptable. A prototype (hardware and software) of the technology will be delivered to NSWC Dahlgren Division at the conclusion of Phase II.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for an HEL beam splitter that meets the objectives stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy's need by any combination of analysis, modelling, and simulation. Analyze and predict the splitter performance, including the ability of the splitter to handle the input power required. Include in the proposed concept a means to test the technology. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype HEL beam splitter based on the concept, analysis, preliminary design, and specifications resulting from Phase I. Demonstration of the beam splitter technology shall be accomplished through test of a prototype in a laboratory or controlled outdoor environment utilizing surrogate lasers. At the conclusion of Phase II, prototype hardware and software shall be delivered to NSWC Dahlgren along with complete test data, installation and operation instructions, and any auxiliary software and special hardware necessary to operate the prototype.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Government use. Refine specific hardware, software, and operating instructions for specific Navy HEL weapons. Establish hardware and software configuration baselines, produce support documentation, production processes, and assist the Government in the integration of the beam splitter technology into existing and future HEL weapon systems.

The technology resulting from this effort is anticipated to have broad military application. In addition, there are scientific uses, specifically in high energy physics. Machining, food packaging, and solar energy are a few industries that may benefit from this technology.

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KEYWORDS: Laser System; High Energy Laser; Beam Director; Laser Weapon Systems; Optical Splitter; Beam Splitter

N241-042 TITLE: Compact Rapid Attack Weapon (CRAW) 100HP Electric Powerplant

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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 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 100HP powerplant that fits into a 6.75” Compact Rapid Attack Weapon (CRAW) afterbody form factor while delivering performance similar to that of the existing CRAW propulsion system and integrating with existing interfaces.

DESCRIPTION: The CRAW is a very lightweight multi-mission torpedo with a 6.75” diameter that is launched out of the Virginia Class submarine external countermeasure launchers. CRAW development is ongoing, but leverages several existing technologies to reduce technical risks. As such, the propulsion system remains a cost and maintenance driver, but has shown to provide the performance that CRAW needs to meet its requirements.

A new 100HP electric powerplant that fits into the CRAW afterbody space to replace the existing propulsion system would be beneficial for various reasons, including reducing cost and maintenance complexity. Ideally, a small business industry partner would be capable of utilizing existing electric motor technology or developing new electric motors to fit the CRAW form factor. The CRAW program envisions a future state where electric propulsion could become the preferred method as electric motor performance meets existing propulsion performance requirements. One of the most difficult aspects of developing technologies for CRAW remains the tight 6.75” diameter form factor. The CRAW program anticipates that use of an electric motor could cut maintenance labor by 50%, which could reduce cost significantly. Ultimately, success of the new electric motor design will be measured by its ability to meet or exceed total energy of 2.5 kW/hrs and 100 hp at 7000 rpm.

The powerplant will consist of three components; 1) a primary or secondary battery capable of sourcing over 100 electric HP, 2) an electric motor capable of continuous 100HP for up to 10 minutes and 3) a small form factor motor controller able to control battery input to the electric motor at To Be Determined (TBD) current levels (type of motor selected and chemistry of the battery will determine current capability). The entire power plant system will be contained in a circular tube of the following dimensions; approximately 6” outside diameter (OD) by 38” in length overall. Details on shell components will become available as the proposed design matures.

Voltage requirements for a system of this compact nature should lean toward levels greater than 600Vdc to reduce conductor size for a lightweight and condensed packaging scheme.
In addition to the above, overall system weight is restricted to below 90 pounds counting the aluminum shells the devices are contained in; these are approximately 23 pounds. Details for the overall packaging scheme will be available.

Evaluation criteria for the electric powerplant system consists of battery load testing to determine overall available power, duration of the battery and any relevant US Navy testing for abuse and safety. The electric motor and controller performance will be verified via dynamometer testing to confirm the ability to make the expected 100HP.

PHASE I: Develop a concept for a design of a 100HP electric powerplant that meets the requirements in the Description. Provide all analyses supporting the design's compliance with Navy safety requirements. Establish feasibility through modeling/simulation to meet propulsion performance requirements. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype 100HP electric powerplant system for testing and evaluation based on the results of Phase I. The prototype electric powerplant will be evaluated on its ability to meet propulsion system requirements and its ability to meet or exceed existing propulsion system performance. Likewise, the ability of the 100HP electric powerplant to integrate with the existing CRAW architecture and its set of interfaces will be paramount to the success of the prototype.

PHASE III DUAL USE APPLICATIONS: Assist the Navy to transition to low rate initial production while coordinating with existing CRAW partners. Particularly, Penn State University's Applied Research Lab (PSU/ARL) will require integration support to integrate the 100HP electric powerplant into the electric CRAW variant for full system testing. It is anticipated that this size powerplant could be useful for other 6.75" devices launched out of external countermeasure launchers (e.g., acoustic countermeasures), as well as high powered Unmanned Aerial Vehicles and electric automobile applications.

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KEYWORDS: Very Lightweight Torpedo; Compact Rapid Attack Weapon; Electric Motor; Virginia Class Submarine; External Countermeasure Launchers; High Power Density Battery

N241-043 TITLE: Extended Reality (XR) for Use in Naval Shipyard Industrial Environments

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

OBJECTIVE: Develop extended reality (XR) solutions to combat safety mishaps and, decrease repair/maintenance times, additional travel expenses, re-work, congested areas, and unnecessary breakdowns and repairs in naval shipyards.

DESCRIPTION: The Navy is seeking the use of XR, which encompasses virtual reality (VR), augmented reality (AR), and mixed reality (MR), to cultivate a digital workforce for driving digital transformation of Navy Shipyards (NSYs). The Navy is seeking technology to introduce high velocity learning, first time quality, and better objective quality evidence (OQE) while removing safety hazards, travel expenses, unplanned work, and physical costs associated with waste generation, mock-ups, tear downs, assembly/disassembly. The Navy currently works and trains in harsh high-risk environments, lacks operational efficiencies, requires additional travel for troubleshooting, assistance, and inspections, lacks first time quality (human errors), congested areas with tours and workers, and requires unnecessary disassembly and repairs.

In its current state, shipyards carry out activities by qualified and trained personnel who perform procedures established by technical documentation in its physical form. When working in an industrial environment in which losing a single asset can mean million-dollar losses or those with complex procedures or time-sensitive product timelines, increasing efficiency and eliminating human error whenever possible becomes crucial for the enterprise. Failure of valuable equipment correlates to extra cost required to purchase material and/or extra man-days required to recover and repair. When equipment in one shop or area is down, it has potential to create a ripple effect that halts or diminishes work in other areas, leading to even further costs and delays. These issues are currently resolved by following complex procedures for diagnostics and maintenance, some of which are sparsely or poorly documented or so extensive that it requires additional training or understanding when conveying to maintainers. In some instances, troubleshooting or repair requires an expert to travel and perform the maintenance or repair leading to additional travel costs. Moreover, record keeping in physical formats is becoming obsolete so there exists a need to transfer physical documents such as standard operating procedures (SOPs), records, and reports into a secure digital format.

XR will cultivate the needed workforce by filling in technology gaps and will unlock new opportunities, drive new efficiencies, and inform analytical-based decision making. Public shipyards are currently working to move design, planning, and execution to computers in order to replace the physical formats that are currently used. XR will catalyze the workforce to efficiently move in the direction they are seeking allowing for 2D and 3D interactive digital forms that are easier to understand, work to, and maintain.

The Navy is seeking to develop XR solutions tailored for use in NSY environments to include considerations such as bandwidth availability (e.g., 5G networks), safety effects (e.g., motion sickness), XR interface (e.g., without peripherals such as mouse, keyboard, or touchscreen), 3D model generation, easy content creation, and IT/cyber security zero trust principles and policies for use in arenas such as mockups, training, surveys, hands free step-by-step instructions, reality capture (3D modeling), remote assistance, virtual tours, spacial computing, object recognition, dimensional digital twinning, behavioral digital twinning, remote collaboration, digital retention, and record keeping. XR solutions should allow for long term archival and would not require someone to be physically present for training or assisted applications and should introduce high velocity learning, first time quality, and better objective quality evidence (OQE) while removing safety hazards, travel expenses, unplanned work, and physical costs associated with waste, mock-ups, tear downs, assembly/disassembly. This includes cutting-edge and powerful technologies that provide an engaging environment, leading to useful data capture about the task(s) being performed. Advances in XR in the commercial sector could be adapted for shipyard use.

Augmented Reality (AR):
Problem: Unfamiliar situations or anomalies require expert/experienced personnel or engineering intervention over the phone with word or photo descriptions of the situation during maintenance, inspection, troubleshooting, or any procedural work. The technician or mechanic describes the situation and solution is implemented for remediation. This all happens without the expert seeing the "true" environment the person is trying to explain or support and can delay processes. Step-by-step instructions for complex maintenance or assembly involve steps that can be difficult to remember and are subject to interpretation. Maintainers and operators perform steps by reading from an operating procedure while holding the current step in memory before coming back to the paper copy for further instructions, which can be distracting.
Desired Resolution: The objective is to develop an AR solution to allow for remote assistance and communication in real-time using digital tools. These devices would be the eyes and ears of the expert and the on-site professional can act as the surrogate body to accomplish the work. AR methods would avoid transit and travel costs and time, disseminate knowledge quicker, and less experienced personnel can be accompanied by senior personnel or experts when needed. With AR, users would work on steps, without diverting their eyes or hands from the work being performed. As tasks are completed, there would be visual confirmation and the next step would be presented when the current step is completed safely and with good quality.

Virtual Reality (VR):
Problem: Training is primarily performed in classroom-based sessions, with physical mock-ups, part task trainings, just-in-time trainings, and work familiarization with examinations and evaluations. Mechanics and technicians need a human trainer and rely on rudimentary tools and paper documentation to complete their job functions. Shipyards incur costs associated with providing the right information, by the right people, at the right place, and with the right equipment. Current mock-ups are being physically produced, torn down, and lose historical knowledge overtime, which cost up to millions of dollars depending on the intricacy of the project. Construction requires experts from various organizations and locations to meet for collaboration and usually entails tours of areas where work will be performed, which congest and distract the area. Space at NSYs is at a premium and VR would save space on mock ups, tear downs, and/or storage of mock ups not being utilized, rather than bringing in large bulky machinery and components for training or mock-up or utilizing large spaces for this application, virtual reality allows access to features through a 3D virtual model that can be visualized in its intended space while a 1:1 scale is maintained.
Desired Resolution: The objective is to develop a VR solution to modernize operations and amplify physical mockup training by creating immersive training environments, streamlining the creation and sustainment of technical documents, and enhancing mechanic, technician, and engineering services. VR methods would reduce costs by decreasing the amount of text to be translated; streamlining training processes for operators of complex equipment; training in safe environments that would otherwise be harmful, expensive or dangerous; and providing the opportunity to train on exact configurations rather than "similar" configurations. VR would allow access to features through a 3D virtual model that can be visualized in its intended shop or space while a 1:1 scale is maintained, removing the need to view in a reduced format. Additional text, graphics, and videos should be superimposed along with any manuals, procedures, or documentation. VR solution should allow all parties to collaborate in their current location(s) removing the need for travel expenses. Furthermore, mock-ups and spaces would be viewed digitally and can bring in unlimited number of machinery or equipment of any size, enabling realistic demonstrations similar to physical spaces. This removes the need to physically interrupt locations or to build expensive parts for demonstrations. Mock-ups will have the capability of digitally being placed in

the intended location to capture any potential issues that may arise during installation or use before physical movement takes place.

Mixed Reality (MR):
Problem: Quality assurance and inspection tasks are subject to human error with a potential for negative outcomes such as equipment failure, injury, pollution, damage, and more. Inspectors perform inspections using checklists in order to confirm quality of work, equipment, or structures.
Desired Resolution: The objective is to develop MR to provide enhanced information to the inspector. The user can be taken through the inspection process where settings, states, locations, and parts can be presented to the inspector who can compare expected values and verify with automated visual confirmation and has the ability to alert the user when results are outside expected values. MR methods would reduce inspection errors due to human error, improve reliability of inspection tasks, assist with interactive checks, and automate storage or results for traceability and reproducibility. MR should also provide the value of monitoring student behaviors to ensure proper job execution and increased procedure accuracy. Instructors can adjust training based on student's ergonomics, positioning, and time spent in certain areas to help reduce safety risks and exposure while applying the best ergonomic practices.

PHASE I: Develop a concept to implement XR solutions into secured industrial workspaces by identifying the highest anticipated risks associated with the concept and proposing viable risk mitigation strategies to technological and reliability challenges. Feasibility must be demonstrated through modeling and analysis for a useful product to be used in NSYs including technical feasibility of integrating virtual or augmented visuals into current processes as well as meeting risk management framework guidelines associated with cybersecurity compliance.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop, task, test XR, and deliver a prototype for existing networks utilizing current work processes. Develop hardened system architecture and complete the risk management process for gaining cybersecurity accreditation for system deployment. Develop high fidelity prototype(s) that are acceptable for use within the current NSY infrastructure and demonstrate technological competence through evaluation and modeling over systems and processes that are already available and in place at NSYs. Demonstrate prototype performance in a simulated or realistic/piloted environment. Identify, evaluate, and mitigate risks, roadblocks, and challenges. Create milestones to incorporate this technology into the Phase III development plan.

PHASE III DUAL USE APPLICATIONS: Further refine the prototype(s) and support the Navy in transitioning, testing, validating, and certifying the technology for shipyard use. Introduce training and incorporate the product into NSY processes for sustainment.

Commercial applications may include, but are not limited to, any public industrial environment setting performing common trade work, maintenance, repair, or inspections.

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KEYWORDS: Extended Reality; Augmented Reality; Virtual Reality; Mixed Reality; Remote Assistance; Navy Shipyards

N241-044 TITLE: Rapid Scalable Time Synchronization

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

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 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 rapid time synchronization capability for nodes that use single beam antennas in a Global Positioning System (GPS) denied environment.

DESCRIPTION: As modern networking technology has proliferated, the “Internet of Things” describes the increasing interconnectivity of devices at all layers of modern society. This has enabled sharing of information and coordination of operation in real time across a wide range of applications, in particular allowing for comprehensive control of devices by centralized or distributed command structures. Recent industry gains in this area have provided an opportunity to leverage modern networking technology to reduce communications operations overhead by integrating much more efficient networking methods. Time sync has been identified as a specific area where significant gains can be realized that will make larger fleet operations much more robust and flexible.

The Navy is tasked with connecting, improving, and expanding over-the-air tactical network functionality to support expanded mission areas and new and evolving future warfighting capabilities. Time synchronization is an essential requirement for Navy networked sensor systems to perform their primary mission, which relies on sensor data distributed across the network. The existing time sync methods are laborious and slow, necessitating specific input from operators and disruption to network operations. Incorporation of modern, Transportation Control Protocols / Internet Protocols (TCP/IP) time sync methodologies, specifically the methodologies utilized in wireless fidelity (Wi-Fi) switches and routers, into the larger communications system would reduce this operational overhead. This has great value as networks increase in node size consistent with integrated Naval operations currently being developed. The Navy network is a C-Band, maritime, half-duplex, line of sight network of mobile nodes including both ships and aircraft. This networking capability needs to be as agile as possible to enable utmost flexibility for the warfighter. A time sync capability with the desired performance will enable large networks to form more rapidly, as time sync is the first step in network formation. It will also enable new nodes to enter an existing network in much less time. This will enable the warfighter to respond more rapidly to changing battle space conditions.

The Navy needs a rapid time sync capability for nodes that use single beam antennas in a GPS denied environment for nodes in a large, directional, half duplex, C-band, microwave, maritime, mobile network that uses single beam antennas, but can be extended to multi-beam capability. There is currently no commercial capability known that can do this. The capability should optimize transmit power and minimize total power required given an available Effective Isotropic Radiated Power (EIRP) of approximately 50 decibel-Watt (dbW).

The solution must leverage protocols from technologies developed for, and used in, 5G and other modern communications networks, such as Precise Timing Protocol (PTP) and Network Time Protocol (NTP), while maintaining sub-microsecond (i.e., current state of the art with PTP for wired networks) accuracy within a mobile, wireless network. A key improvement sought is minimizing prime power required from the supporting platforms. This will enable application to a larger number of smaller platforms. The goal is to use no more power than required in the mobile maritime environment. The protocol should adaptively determine what is required. The maximum available EIRP is 52.2 dBW. The threshold requirement for time accuracy is sub-microsecond with an objective of 100 nanoseconds. The time sync protocol should meet its performance requirements without GPS but should be able to use it when available. It shall adapt to varying radiated power limits placed on the network, with the capability to provide accurate solutions even when operating at reduced power. It shall be scalable to many moving platforms with a threshold of dozens of nodes to an objective of 100 nodes, accomplishing time sync for this network within 2 minutes or less. It shall not require prior knowledge of node locations. It may use directional or Omni antennas or both. Finally, it must do all of this in a contested, congested, and constrained Naval electromagnetic and electronic warfare environment as described in the 2020 Department of Defense Electromagnetic Spectrum Superiority Strategy and MIL-STD-461G requirements.

Classified legacy time sync requirements in Navy network system specifications shall provide a baseline against which the prototype will be compared.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for a rapid time sync capability for a network of mobile maritime nodes using a line of sight C-band microwave link. Demonstrate the concept can feasibly meet the Navy requirements as provided in the Description. Establish feasibility by a combination of analysis and modeling. The modeling should include maritime ducting conditions resulting in signal degradation [Ref 4]. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype rapid time sync capability based on the results of Phase I. Demonstrate that the prototype meets the performance parameters outlined in the Description. Testing, evaluation, and demonstration are the responsibility of the awardee but government subject matter experts will validate the improvements achieved by the prototype.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. Further refine the prototype for evaluation to determine its effectiveness and reliability in an operationally relevant environment. Support the Navy in the system integration and qualification testing for the technology through platform integration and test events to transition the technology into Navy applications for simultaneous communications links to improve and expand tactical network functionality. A substantial amount of this Phase's effort will be in integrating the new time sync protocol with the pre-existing networking code.

High-performance time sync protocols will have direct application to private sector industries that involve mobile microwave networks. These applications include transportation and communication industries.

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KEYWORDS: Time synchronization; over-the-air tactical network; precise timing protocol; Effective Isotropic Radiated Power; scalable to many moving platforms; Global Positioning System (GPS) denied.

N241-045 TITLE: Composite Launch Tube (LT) for the Compact Rapid Attack Weapon (CRAW)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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(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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a composite launch tube that will be used as part of 6.75-inch diameter Compact Rapid Attack Weapon (CRAW) Launcher Assemblies.

DESCRIPTION: The CRAW is a very lightweight multi-mission torpedo with a 6.75-inch diameter that will be launched out of the Virginia Class submarine External Countermeasure Launcher (ECL) system. The CRAW is contained within a Launcher Assembly (LA). The Launch Tube (LT) is a major component of the LA and is capped on one end with a muzzle cap/nose assembly and sealed to sea pressure on the breech end by the Mk 77 Gas Generator (impulse system). The CRAW and ancillary hardware such as a pressure plate, ram plate, drag fin assembly reside within the LT between the muzzle face of the Mk 77 Gas Generator and the muzzle cap/nose assembly. The LT is designed to meet Grade A shock requirements (i.e., heavyweight, high-impact, air-backed, wetted-surface environment), implosion, hydrostatic, hydrodynamic and Mk 77 impulse/launch loads. The current stainless steel LT represents nearly 50% of the total projected weight of the overall CRAW LA weight. Furthermore, there is little to no ability to achieve weight savings in any of the other LA hardware, including the CRAW itself. Additional service life/environmental factors include, but are not limited to, Hazards of Electromagnetic Radiation to Ordnance (HERO), Grade A shock qualification (i.e., heavyweight, high-impact, air-backed, wetted-surface environment), shipboard vibration, corrosion preventions/life, and contributions to CRAW and Mk 77 Gas Generator Insensitive Munitions qualification.

The Navy seeks a new composite LT that would replace the existing stainless steel in the CRAW LA, which would be beneficial for various reasons, including reducing cost, weight, and manufacturing complexity. Ideally, a small business industry partner would be capable of utilizing existing commercial composite material technology or developing new composite materials that can be shaped to house a 6.75-inch CRAW device form factor along with the Mk 77 Gas Generator and CRAW launcher ancillary hardware. The CRAW program envisions a future state where composite launch tubes could become the preferred manufacturing method as material properties could meet existing launch tube requirements. One of the most difficult aspects of developing launch tube technologies for CRAW remains the tight 6.75-inch diameter form factor, combined with the stringent requirements to meet the aforementioned operational and environmental loads, and the machinability of the launch tube internally and externally along its entire length. Ultimately, success of the composite launch tube will be measured by its ability to meet existing CRAW launch tube requirements.

Requirements and performance characteristics for a composite CRAW LT are (but are not limited to):

- Maintains existing shipboard interfaces per CRAW LT drawing (to be provided) – same form factor as existing LT tube design
- Maintains existing interface (internal to LT) with Mk 77 Mod 0/1 gas generator (drawing to be provided)

• Meets or exceeds existing LT service life (2 years deployed with minor maintenance (paint and anode replacements, 4 years to full maintenance cycle)
• Reusable: Threshold – unlaunched condition; Objective – launched condition
• Meets requirement for Grade A shock qualification under MIL-DTL-901E
• Maintains Hazards of Electromagnetic Radiation to Ordnance (HERO) safe designation of current system
• Adheres to MIL-STD-464 – latest rev
• Adheres to MIL-STD-461 – latest rev
• Adheres to MIL-STD-167 – latest rev
• Adheres to NAVSEA Temporary Alteration (TEMPALT) Manual - NAVSEA S9070-AA-MME-010/SSN/SSBN, 3rd Revision, ACN-5
• No impact on corrosion susceptibility and life of surrounding hardware/structure
• No hazardous material generation or addition to post-launch combustion by-products effluent from exposure to launch process and/or seawater
• Adheres to NAVSEA Implosion requirements for VIRGINIA and COLUMBIA Class
• Compatible with existing Weight Handling Equipment (WHE), Ordnance Handling Equipment (OHE), and Weapon Handling Equipment (WHE)
• Minimum weight reduction, compared to the current LT: Threshold – 150 lbm; Objective – 175 lbm

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Complete a robust conceptual design for the composite LT and provide all critical analyses supporting the design’s compliance with Navy safety, performance, and operational requirements. Support the feasibility of meeting propulsion performance requirements through modeling/simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design, develop, and deliver a prototype composite LT for testing and evaluation based on the results of Phase I. The prototype composite LT will be evaluated on its ability to meet LT requirements, and its ability to meet or exceed existing LT system performance as identified in the Description section. Likewise, the ability of the composite LT to integrate as part of the existing CRAW Launcher Assembly along with its set of interfaces will be paramount to the success of the prototype.

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

PHASE III DUAL USE APPLICATIONS: Assist the Navy to transition to low rate initial production which will occur while coordinating with existing CRAW partners. Particularly, Penn State University's Applied Research Lab (PSU/ARL) and Navy Warfare Centers will require integration support to integrate the composite LT into the CRAW Launcher Assembly for full system testing. Testing at this point would include MIL-STD-2105 (Insensitive Munitions), Implosion, Hydrostatic, Explosive Shock qualification, and other shipboard integration and ordnance qualification tests, as required.
It is anticipated that this composite launch tube could be useful for other 6.25-inch and 6.75-inch devices launched out of external countermeasure launchers (e.g., acoustic countermeasures). Outside industries such as the commercial Unmanned Undersea Vehicle (UUV) designers, offshore energy industries, and other marine or industrial applications where a high-strength, lightweight pressure vessel or piping would be of interest.

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KEYWORDS: Very Lightweight Torpedo; Compact Rapid Attack Weapon; Virginia Class Submarine; External Countermeasure Launcher; Composite Materials for Tubes; Torpedo launch sequence

N241-046 TITLE: Micro Inertial Measurement Unit for Maritime Navigation

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 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 highly accurate 6-axis Inertial Measurement Unit (IMU) that is low-cost and lightweight for future U.S. Navy surface and subsurface platforms.

DESCRIPTION: The success of U.S. Navy missions depends on personnel and platforms having access to accurate and reliable position, velocity, attitude, and time information. Maritime platforms specifically need this information continuously to support safety of ship, weapons deployment, and network communications. They rely on inertial navigation systems to provide continuous position and velocity information for accurate navigation. However, current inertial navigation systems are large and expensive to build and maintain. Small-scale factor IMUs, such as Micro-Electro-Mechanical (MEMS)-based sensors, micro-Hemispherical Resonating Gyro (HRG)-based sensors, and other micro-Machined Vibrating Gyroscope (MVG)-based IMUs, offer the advantage of lower production costs through batch processing and fabrication. Some MEMS and HRG devices have also proven superior survivability to environmental shock and vibrations, which makes them ideal for military applications, given their potential for low cost and small size.

In the commercial sector, long-term accuracy has been a challenge for MEMS gyros with gyro-bias stability and Angular Random Walk (ARW) performance metrics not yet meeting navigation-grade standards, though bias-stability in MEMS accelerometers has been demonstrated to near-strategic-grade standards. Achieving the long-term accuracy desired for Naval maritime applications (going from hours to days), requires further reductions in gyro bias drift. Some factors shown to impede gyro performance include temperature drift error, mechanical imperfections, imbalances, and misalignments in the fabrication process. These can be resolved by effective vacuum packaging for environmental-resistant MEMS and/or effective temperature compensation by control circuitry, quadrature compensation, laser trimming, and circuit compensation.

Low-cost production has been a challenge in commercial HRG technology because early designs of macro-HRGs have focused on the higher performance, and higher cost, space application market. As a result, there are a limited number of HRG manufacturers, which has driven up production costs. However, new fabrication techniques, such as glassblowing and glass molding, have been developed to fabricate 3D-MEMS, or micro-HRG, devices that show the same promise of lower fabrication costs with batch production.

These existing and emerging technologies are applicable in meeting the future needs of the Navy to develop a lower cost, lightweight, and highly accurate 6-axis IMU that can be integrated into future U.S. Navy platforms. While both technology areas present challenges, fabrication and manufacturing techniques have developed significantly in MEMS wafer-scale etch processing and micro-machine fabrication techniques used to produce micro-HRGs and other MVG-based sensors in recent years.

To meet mission requirements of future deployed surface and subsurface vessels, the Navy needs a low Size, Weight, Power, and Cost (SWaP-C) 6-axis (3-axis accelerometer and 3-axis gyroscope) IMU with performance equivalent to or better than the existing Ring Laser Gyro (RLG) navigator in use in the Fleet today. Government subject matter experts will guide development for these specifications.

Achieving the desired accuracy in position, velocity, and attitude will require gyro bias stability to be demonstrated at or better than 0.005 degrees/hour (1 sigma) and ARW < 0.0005 degree/root-hour (1 sigma). Accelerometer bias stability must be demonstrated at or better than 5ug. Contributions of other error sources (that is, scale factor, misalignment, etc.) should be balanced to meet the overall error budget of the IMU. SWaP-C must meet IMU performance requirements in the range shown below:

- Size: < 5 Liter
- Weight: < 10 Kg
- Power: < 25 W
- Cost: < $100,000

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept that characterizes inertial measurement sensors that meet the target metrics in the Description. Establish feasibility of an approach through analysis, modeling, and simulation to show the concept will meet the required parameters in the Description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Design and deliver a prototype of the system described in Phase I. The prototype will undergo an independent evaluation at a government provided facility based on its ability to satisfy the parameters in the Description and its functionality in a maritime environment.

NOTE: It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology to Navy use. The final product will be a 6-axis inertial measurement unit and will be tested on a maritime platform to demonstrate performance. Ultimately, it will be validated, tested, qualified, and certified for Navy use. The technology will be highly valuable in any at-sea situations where GPS is not always available and high accuracy is a requirement.

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3. Zotov, S. et. al. “Compact In-Run Navigation Grade IMU Based on Quartz MEMS.” IEEE, 2020. https://ieeexplore.ieee.org/document/9109851
4. Johnson, B. et. al. “Development of a Navigation-Grade MEMS IMU.” IEEE, 2021. https://ieeexplore.ieee.org/abstract/document/9430466
5. Meyer, A.D.; Rozelle, D.M.; Trusov, A.A. and Sakaida, D.K. “milli-HRG Inertial Sensor Assembly – A Reality.,” IEEE, 2018. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8373359

KEYWORDS: Inertial Navigation System; Micro-Electro-Mechanical; Hemispherical Resonating Gyroscopes; Inertial Measurement Unit; Micro-machined Vibrating Gyroscope; Navigation

N241-047 TITLE: [DON has removed topic N241-047 from the 24.1 SBIR BAA]

N241-048 TITLE: Virtualized Naval Tactical Data System Interfaces over Ethernet

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a capability for Ethernet-based Naval Tactical Data System (NTDS) interfaces to allow hardware abstraction of Interface Processor Computer Programs (IPCPs) to virtual machines.

DESCRIPTION: Currently AN/SQQ-89 infrastructure uses legacy hardware interfaces to connect. The Navy is seeking innovative solutions to replacing legacy hardware used in tactical systems with software defined solutions supported in an Infrastructure as a Service (IaaS) architecture. The IaaS architecture uses the latest release of VMWare / ESXi hypervisors with virtual machines running Red Hat Enterprise Linux (RHEL) operating system (RHEL7 or later). Hardware abstraction in software will address the growing problem of hardware obsolescence and lowering installation, maintenance, training, and logistics costs.

AN/SQQ-89 is currently transitioning to an IaaS architecture that supports hardware abstraction (i.e., virtual machines (VM)) to improve fault tolerance, improve resiliency, and lower operational risk due to hardware obsolescence. The Navy is looking for innovative solutions as alternatives to legacy interfaces that can transition to an IaaS architecture. In the IaaS architecture, a VM can run anywhere in a cluster of compute nodes within the architecture. Legacy NTDS applications between Aegis Weapon System (AWS) elements on US Surface Ship combatants require specialized NTDS hardware that was designed in the 1950’s. The linkages between applications are point-to-point (i.e., NTDS cable between two NTDS devices). NTDS MIL-SPEC interfaces and NTDS interface hardware are becoming increasingly harder to manufacture and to maintain. MIL-SPEC NTDS connectors and cables are very expensive. The cost of a typical NTDS cable may be more than $3K per cable.

Research and development (R&D) is in-progress to transition an NTDS interface application to a VM and evaluate the use of a special-purpose Ethernet-to-NTDS device (i.e., an IXI PowerNet device) to demonstrate the feasibility of VM technology for these interfaces.

The Navy is seeking innovative solutions to replace legacy hardware used in tactical systems with software defined solutions supported in an IaaS architecture. Hardware abstraction in software addresses the growing problem of hardware obsolescence and, lowers installation, maintenance, training, and logistics costs. The goal is to eliminate physical NTDS interfaces in favor of software-only, Ethernet based communications between NTDS applications.

The solution will provide software drivers that can be added to tactical operating systems such that no software changes are needed for the legacy NTDS application to work with the new drivers.

Solutions with enhanced CYBER-secure features are preferred. The ability to abstract NTDS interface applications to VMs reduces risk with hardware obsolescence and components that are in limited supply and increasingly difficult to manufacture. This solution will reduce development, logistic, and maintenance costs by eliminating physical NTDS hardware and cabling, thus saving tens of thousands of dollars per installation.

Commercial application for this technology will be limited as this interface protocol is used exclusively for DOD (NTDS - Navy Tactical Data System); however, the concept of developing Ethernet-based drivers to replace physical hardware can be extended to commercial use.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for NTDS over Ethernet designs. Demonstrate the concept meets the parameters in the Description and show the feasibility of NTDS interface communications between two servers.

Feasibility will be shown through analysis and modeling. The concept shall support as a minimum RHEL 7 operating system. The government will provide specific details describing changes that will be required to support the NTDS-over-Ethernet with connections to legacy servers. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype NTDS over Ethernet solution for testing and evaluation based on the results of Phase I. Demonstrate the prototype meets requirements and parameters in the Description. The prototype will be assessed by the government subject matter experts. Develop procedures for installation and integration.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The final product will be the VM-based NTDS over Ethernet that can be extended to support all AEGIS combat system elements on all surface ship combatants. The design of VM-based NTDS applications shall be adapted to current and future AN/SQQ-89A(V) ACB and AEGIS baselines. Future NTDS development efforts will be software development specific as the need for physical NTDS hardware for NTDS interface applications transitions to NTDS-over-Ethernet. Validation and testing will be performed with AN/SQQ-89 integration team and various AEGIS certification authorities.

The potential for dual-use with other Navy developers involved with NTDS interface application development is tremendous. Virtually all Navy systems include NTDS interface hardware. The transition to Ethernet-based NTDS will slowly eliminate the need for these devices. Innovations and development of drivers for transition from physical hardware to Ethernet-based communications may be applied to other communications protocols. Commercial industries that can use this technology include computer and network system builders and any company that has integrated legacy hardware in their networks infrastructure.

REFERENCES:

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2. “PowerNet™ NTDS to Ethernet Converter.” https://ixitech.com/product/ntds-ethernet-converter/
3. “Navy Fact File: AN/SQQ-89(V) Undersea Warfare / Anti-Submarine Warfare Combat System.” https://www.navy.mil/Resources/Fact-Files/Display-FactFiles/Article/2166784/ansqq-89v-undersea-warfare-anti-submarine-warfare-combat-system/

KEYWORDS: Naval Tactical Data System (NTDS); AN/SQQ-89 infrastructure; hardware obsolescence; Infrastructure as a Service (IaaS); Cyber-secure; NTDS connectors and cables

N241-049 TITLE: Shipboard Proof Testing Apparatus for Field-Expedient Parts

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Develop testing equipment for the shipboard environment to enable proof testing of field-expedient parts fabricated in the shipboard environment.

DESCRIPTION: Navy ship platforms are currently outfitted with varying capability for on-board machining, repairs, and fabrication, to include additive manufacturing (AM). With the deployment of AM expanding to the shipboard environment, the manufacturing capability of more complex items are becoming more readily available to the Fleet. With this addition in capability, there is an increased risk of potential inadequate parts being installed in ship systems. There is a need to be able to reduce the risk of installing field-expedient parts designed by the Fleet. Part of this risk reduction can be achieved through proof testing of the designed parts at the point-of-need. This capability would allow shipboard leadership to make a more informed, rapid risk assessment of part viability based on empirical test data from the desired solution.

There are increased needs for AM afloat as it is explicitly identified in the COMNAVSEA Campaign Plan 3.0 as a technology focus area. The Navy directly supports efforts to integrate AM into the Fleet and support a more self-sufficient ship. The Navy seeks to maximize its use of AM to fabricate "hard to source" or obsolete parts, reduce cost, field more effective systems, and reduce reliance on vulnerable supply chains through production at the point of need.

The goal of this project will be to develop a modular proof testing apparatus for locally manufactured components in the shipboard environment. The solution must include the ability to test non-uniform objects, tools, and parts which should be able to be mounted and tested within the same test unit. In addition, different loading conditions and scenarios must be able to be applied to the test part within this apparatus. Example loading scenarios include, but are not limited to: tensile, compression, torque and pressure. The operational conditions within these expeditionary settings include ship motion, ship vibration, shock, ventilation, and electromagnetic interference (EMI). In order to successfully install the test rig and enable adequate operation of the equipment, the machine must not experience severely degraded performance under these conditions. All processing must be completed on the system and must operate in a non-networked environment. Sensor packages supporting tracking of system operation and performance, as well as machinery health monitoring, should be included in the design.

Current test apparatuses of this nature are specialized laboratory equipment that is not designed for use in the dynamic shipboard environment. In addition, current commercial tensile, compression, torsion, and pressure testing systems require a degree of training for interpretation of data that is not feasible for the typical Navy operator. There exist no commercial solutions that can provide easy-to-assess part test responses that allow for rapid risk reduction. Furthermore, simplistic design and usability will be beneficial since most Fleet personnel will not have an engineering or science background. This should include ease of use from a test setup and operation standpoint, but also clear, definitive, and easy to understand results display and interpretation. The designed solution should have on board processing capability, with full traceability and logs available. These systems must include a modular test fixture and load application design to be able to accommodate the variability in types of parts being 3D printed. In addition, since both metal and polymer solutions are being deployed, the solution should be able to accommodate forces necessary for both material types, including, but not limited to, carbon fiber reinforced nylon and 316L stainless steel. The solution should be able to test parts that fit within a 20” Wide x 12” Deep x 12” High volume. The system itself should be hatchable, and take special consideration to minimize footprint of the design. The aforementioned design considerations to overcome the technological gap is paramount as a risk reduction method to enable the Fleet to safely install AM solutions shipboard.

The product will be assessed against the MIL-STDs listed below:

1. MIL-S-901D, Amended with Interim Change #2, Shock Test, H.I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for
2. MIL-STD-167-1, Mechanical Vibration for Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
3. MIL-STD-461F, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
4. MIL-STD-740-2, Structure-borne Vibration Acceleration Measurements and Acceptance Criteria of Shipboard Equipment

PHASE I: Develop a conceptual design of a modular proof testing apparatus that can test shipboard manufactured parts, including Additively Manufactured items as described in the Description section. Demonstrate the feasibility of the conceptual design through detailed modelling, simulation, and analysis for the proposed solution. For example, 3D models, simulations, and/or design documentation to illustrate the work holding/fixturing modularity option to accommodate the various types of applications and loading scenarios. The conceptual design feasibility analyses should also indicate how the apparatus will be hardened for the shipboard environment to be able to accurately apply loads, but also handle the dynamic shipboard environment. Include, in the conceptual design applicable sensors and details on how the machine will be optimized for Fleet use, to include, but not be limited to, operation, maintenance, and results display. The design details should include the on-board processing setup and the proposed results reporting display.

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: Build and deliver a prototype system that can apply proof testing loads to sample parts that can be operated in the shipboard environment by shipboard personnel. Demonstrate how shipboard environmental mitigation will be applied to account for incoming vibration and shock, and uncontrolled temperature and humidity. Subsequent testing of these mitigation protocols will be needed to evaluate shipboard viability and should be included. Examples of the simplified setup and results should be included in the prototype, with processing occurring local to the proposed solution. The prototype is expected to be installed either shipboard or at a Navy facility for continuation testing and evaluation.

PHASE III DUAL USE APPLICATIONS: Assist the Navy to transition a production ready proof testing machinery optimized for Navy expeditionary environments with modular options for tensile, compression, torque, and mechanical pressure loading applications. The equipment must be able to operate in the shipboard environment (machine shop or welding spaces) and be able to accurately apply loading conditions for various, non-uniform applications of multiple material types including, but not limited to, chopped carbon fiber filled Nylon and 316L Stainless Steel. The solution must be able to simply interpret results to inform a risk-based decision-making analysis for Fleet personnel. All processing must be completed on board the system and must operate in a non-networked environment. The applicability of such a design could be implemented in environments beyond just the shipboard community, to include the local maintenance activities and Shipyards. In addition, commercial applications of the solution for the shipping or oil and gas industry and other Military forward operating bases may be available.

REFERENCES:

1. Amend, JR, Jr., & Lipson, H. "FreeLoader: An Open Source Universal Testing Machine for High-Throughput Experimentation." Proceedings of the ASME 2011 International Design Engineering Technical Conferences and Computers and Information in Engineering
2. United States, Congress, Office of the Under Secretary of Defense for Research and Engineering. DOD Additive Manufacturing Strategy, January 2021.https://www.cto.mil/wp-content/uploads/2021/01/dod-additive-manufacturing-strategy.pdf

KEYWORDS: Metal additive manufacturing; 3D printing; Shipboard Additive Manufacturing; Proof testing; Shipboard Validation Testing; Testing of AM manufactured parts; Mechanical part testing

N241-050 TITLE: Forces Afloat Man Overboard Persons in the Water (PIWs) Recovery

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 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 deliver a prototype technology that leverages existing technologies and improves identification, location and tracking of all persons in the water (PIWs) from afloat assets operating up to sea state five (5) and distances up to ten nautical miles. Later stages of development could seek to integrate the improved performance with other means to support staging and recovery operations.

DESCRIPTION: The proposed technology must be able to work with current systems for recovering PIW on all active afloat assets and be capable of operating with modern Global Positioning System (GPS) technology. It should be able to discriminate individual PIWs but also able to provide continuous accountability for up to five (5) PIWs. The ability to provide uninterrupted live audio/video communication or any display methods such as infrared, thermal, opacity or others in real-time between the afloat asset and PIWs throughout recovery operations would be favorably evaluated.

The current Navy system for Man Overboard / PIWs responds to these incidents that occur when afloat assets with personnel onboard operate at sea is referred to as Man Over-Board Indicator (MOBI) system. MOBI uses a transmitter attached to personal flotation devices (PFDs) that transmit a signal to the MOBI antenna on the afloat asset. The current MOBI system sounds an alarm on the bridge for the PIWs within three (3) seconds of activation and continues alerting for up to one (1) nautical mile (NM), and provides bearing(s) for PIWs for up to five (5) NM or greater depending on the height of the receiving antenna. A secondary indicator for PIWs is a strobe light illuminating from the PFD in the water. The recovery time for PIWs varies as a function of many factors such as maneuverability of afloat asset type, sea state, visibility and skill of the rescue operators executing the recovery mission. The current recovery procedures for PIWs are resource intensive and pose additional risk to rescue personnel. The objective of this topic is to increase probability of detection and maintain situational awareness of PIWs through recovery, with long term objective of increasing safety and effectiveness to PIWs, equipment, and rescue personnel.

Improvements are needed to increase the survivability of PIWs and enhance rescue operations. The objective alert time for PIWs should remain at three (3) seconds with threshold of not more than five (5) seconds. The objective is to maintain positive identification of PIWs at a threshold of (1) NM and objective of (10) NM. The PIWs' location bearing updates must be continuous in order to maintain an accurate track. Other methods of data collection to improve future location accuracy would also receive favorable evaluation.

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept to improve the survivability of PIWs with enhanced information and accuracy of location to provide continuous and as near real-time detail as modern technology would enable. The signaling device(s) should have the capability to monitor up to five (5) PIWs in proximal succession, regardless of whether they are outfit with wearable locator technology, at the discretion of rescue operators' to preserve safety of life at sea to the maximum extent possible. Capabilities must demonstrate at least threshold functions up to sea state five (5) and in zero visibility by natural human sight. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be developed into a useful product for the Navy as well as other seafaring vessels. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype and demonstrate that it can meet the needs of the Navy. Initial testing of the system can be on subscale demonstrators progressing to a full-scale model. The location of and facility for testing will be determined during this Phase. Testing must demonstrate performance, environmental robustness, shipboard shock, vibration, sea-state survivability, and maintainability. Product performance will be demonstrated through prototype evaluation, modeling, and demonstration over the required range of parameters. An extended test in the maritime environment will be used to refine the prototype into a design that will meet Navy requirements. Prepare a Phase III manufacturing and development plan to transition the product for Navy use.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the new system with operational support systems (hardware and software) to Navy use. Manufacture and install on a candidate Nimitz Class / Gerald R. Ford aircraft carrier or other suitable and available afloat asset for in-situ test and evaluation. Plan to produce units to outfit all naval aircraft carriers initially but should be scalable for commercially-viable military adaptation on any Navy sea platform.

Commercial markets with adjacent technology would be any vendor or technology developer focusing on communication systems and at sea lifesaving equipment or similar related industries that support these.

REFERENCES:
1. Schuldt, Dieter and Kurucar, Joel. "Maritime Search and Rescue via Multiple Coordinated UAS." MIT Lincoln Laboratory, June 12, 2017. https://apps.dtic.mil/sti/pdfs/AD1035043.pdf
2. Giammarco, Kristin; Hunt, Spencer and Whitcomb, Clifford. "An Instructional Design Reference Mission for Search and Rescue Operations." Naval Postgraduate School, September 2015. https://apps.dtic.mil/sti/pdfs/AD1060267.pdf
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KEYWORDS: Man-Over Board; Person in the water; Water Recovery

N241-051 TITLE: Enhanced Radome Design

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): FutureG; Integrated Network Systems-of-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 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 radome capability for providing greater filtering and aid in beam shaping.

DESCRIPTION: Radomes have been used for decades to protect an antenna from the environment and conceal the antenna. The Navy operates in harsh environments where rain, hail, salt, fog, and other natural conditions would harm sensitive electrons like an Actively Electronically Scanned Array (AESA) antenna. So, to protect those AESA antennas, the Navy uses a radome as cover to protect from environmental conditions. Because the radome covers the antenna, it must also allow it to function with minimal impacts when transmitting and receiving radio frequency signals over the frequency band of operation. Since an AESA antenna can scan over a large angle, the radome needs to minimize the distortion of the transmitting and receiving radio frequency signals over the angler range of operation. This is all typical and can be accomplished with ridge low loss dielectric materials.

More complex radomes now have Frequency Selective Surfaces (FSS) worked into the design. As the name implies, these surfaces help to filter out undesirable frequencies by allowing only selected frequencies pass through. Thus, the radome can act as a filter and aid in the reduction of electromagnetic interference.

With the advances in surfaces, the Navy is seeking to improve current radome capabilities to help beam shaping and sidelobe reduction on the edges beyond the field of view. Currently there is no commercial solution. A new capability could be designed into a radome in a passive manner by structuring the FSS or could be an active design where some sort of bias is applied that activates an adaptive surface. Also, a reactive surface could be designed to limit the amount of power that is passed through the radome, thus avoiding saturation of the electronics. This design would be non-reciprocal, in that the transmit power would be allowed to pass through the surface but the receive power would be limited. In terms of a traditional circuit approach this could be thought of as a switch or circulator with a limiter.

The material also must be capable of meeting environmental requirements, quasi planner (can allow for minor curvature,) and meet government objectives for bandwidth, one way roll-off greater than 20 dB, and low losses operating approximately 4 GHz to 6 GHz.

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for a radome capability that provides greater filtering and aid in beam shaping. Demonstrate that the concept meets the parameters in the Description. Feasibility will be demonstrated through analysis, modelling, and simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype radome capability that provides greater filtering and aide in beam shaping based on the results of Phase I. Demonstrate the prototype meets the parameters described in the Description through testing in a laboratory environment. The laboratory environment will be provided by the awardee. At the completion of Phase II, a minimum of six sample articles will be delivered for performance testing purposes.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the radome capability to Navy use. The enhanced radome capability will replace the existing radome on the ASEA. The company will work with the program of record prime contractor for integration onto the ASEA housing.
This technology will also benefit many other Navy and commercial antennas (industries such as telecommunication, aviation, satellite communications, etc.) by providing improved antenna performance and a means to reduce out-of-band rejection of unwanted or interfering incident RF energy increasing system sensitivity of desired signals of interest.

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2. de Lustrac, André; Ratni, Badreddine; Piau, Gérard-Pascal; Duval, Yohann and Nawaz Burokur, Shah. “Tri-state Metasurface-Based Electromagnetic Screen with Switchable Reflection, Transmission, and Absorption Functionalities.” ACS Applied Electronic Materials 3 (3), 2021, pp. 1184-1190 DOI: 10.1021/acsaelm.0c01038. https://pubs.acs.org/doi/abs/10.1021/acsaelm.0c01038
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KEYWORDS: Radome; Filtering; Radio Frequency Beam Shaping; Actively Electronically Scanned Array; Dielectric Materials; Interference with radio frequencies; Reactive Surface of Radomes

N241-052 TITLE: Energy Harvesting for Underwater Persistent Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Renewable Energy Generation and Storage

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop innovative power generation or energy harvesting technologies to extend the life of underwater electrical systems.

DESCRIPTION: Underwater persistent systems are often significantly limited by the availability of onboard energy. The issue of energy limitation becomes more critical for continuously submerged persistent systems due to difficulties of deploying and retrieving systems for maintenance.
The Navy seeks a solution to extend system endurance without mission interruption or manned support. Available underwater persistent system capabilities would be significantly enhanced by innovative approaches to energy extraction in the underwater environment. In particular, underwater in-situ energy harvesting and storage could realize increased system endurance and reduced cost. The Navy is seeking an innovative way of powering underwater persistent systems by energy extraction from the seabed or underwater environment with power level sufficient for continuous reliable operations. The use of energy harvesting eliminates potential operational impacts associated with large, unique, specialized energy storage.

The desired technology centers on harvesting energy from the undersea environment for a long duration, maintenance free power source to fit in a compact form factor without a presence on the ocean's surface. Long duration mission profile should maximize the continuous available energy as measured in watt hours. This energy requirement could therefore rely on novel methods for continuous energy harvesting to power onboard systems. All other approaches will be considered. The challenge of miniaturizing and incorporating these technologies into the volume constraint and successfully deploying this system in the field remains the dominant technical issue associated with this technology. Currently, no commercial system exists that meets the requirements.

The proposed power source must have a minimum storage shelf life under controlled conditions of six years without maintenance prior to deployment. The system should be autonomous and require no maintenance in while deployed. The desired form factor should be no greater than 1,000 cubic inches.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security

Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for an innovative small scale energy harvesting system from the environment that meets the requirements described above. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be feasibly developed into a useful product for the Navy. Feasibility will be established by testing and analytical modeling.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype for evaluation as appropriate. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II SOW and the Navy requirements for the small scale energy harvesting System. Demonstrate performance with a detailed analysis, and live demonstration in a test environment as part of the evaluation. Provide detailed technical documentation of the design, including an interface control drawing and interface specification, to allow successful transition of the product. Prepare a Phase III development plan to transition the technology to Navy use. The company will prepare a Phase III development plan to transition the technology to Navy use.

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

PHASE III DUAL USE APPLICATIONS: Provide technical support for the incorporation of the solution into Navy program(s). Depending on the particular program, support for additional testing may be needed. Explore the potential to transfer the system or technology to other military and commercial systems, including the scientific community.

Technology developed under this effort is applicable to any domain that requires subsea platform autonomy such as subsea oil and gas pipeline inspection.

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KEYWORDS: Extended Life; Underwater Electrical Battery Powered Systems; Energy Harvesting from the Ocean; Waste Energy; Underwater Persistent Systems; Decreasing Energy Consumption

N241-053 TITLE: Additively Manufactured Polymer Tooling for Rubber Compression Molding

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Develop an additive manufacturing (AM) technology to rapidly create high strength, high temperature, and low-cost polymer tooling for use in rubber compression molding applications.

DESCRIPTION: Compression molding is a common manufacturing process for making rubber products. During this process, uncured rubber stock is placed within a heated mold before the mold is closed. The rubber cures and conforms to the mold cavity before the mold is opened and the finished part is removed. Within the Navy, numerous undersea sensor components, such as cable plugs and connectors, are fabricated using rubber compression molding. The molding process typically uses tooling made from steel due to the high temperatures and pressures required. However, steel tooling can have high costs and lead times. Advances in AM (also known as 3D printing) and new high-temperature polymers may allow these steel molds to be replaced with AM polymer molds, which could significantly reduce costs and lead times and open up new workload capabilities.

Limited research has been done to adapt AM technology and polymer materials to rubber compression molding. Some commercial AM systems have the capability to print room-temperature silicone molds or low-volume injection mold inserts, but the materials used in these systems do not translate well to the high continuous use temperature of the compression molding environment. The Navy is seeking the development of an additive manufacturing process that can rapidly create high strength, high temperature, and low-cost polymer tooling for use in rubber compression molding applications.

Polymer AM was chosen as the preferred process due to its speed, low cost, easy implementation within existing spaces, geometry flexibility, and safety. Metal AM processes will not be considered due to relatively high investment and post-processing costs. Several challenges exist for bringing polymer tools close to parity with traditional steel tools. Surface roughness, dimensional accuracy and precision, durability, and longevity are key focus areas to consider. Surface treatments, coatings, machining, and other post processing techniques may be used, but should be minimized to reduce overall costs. Polymer materials may be thermoplastics, thermosets, composite reinforced, photopolymer, or other novel material and must be non-hazardous. Companies may develop a new material, machine, or process; or adapt a commercial material, machine, or process to meet the Navy's needs. All printed inserts will be used in a metal master unit die (MUD) frame.

The new AM solution will be utilized in a production setting to enable the rapid turnaround time for time- or cost- sensitive tasking, reduce project costs, and develop new products. Proposed concepts should meet the following thresholds:

1. Process:
    - a. Process: additively manufactured
    - b. Material: Polymer or composite; surface coatings, treatments, or other post-processing permissible but should be minimized; non-hazardous
    - c. Build size: 6 in x 3 in x 3 in Threshold, 12 in x 12 in x 6 in Objective
2. Tool:
    - a. Inserts will sit in metal MUD frame
    - b. Continuous use temperature: 300°F
    - c. Typical clamping force: 15 tons
    - d. Duty cycle: 1 hour minimum cycle time under required temperature and pressure
    - e. Reusability: 100x minimum, molded part must meet requirements
    - f. Mating face flatness: 0.010 in Threshold, 0.005 in Objective
    - g. Chemical resistance: no special considerations

3. Molded part:
   a. Dimensional tolerance: 0.010 in Threshold, 0.005 in Objective; or 0.05 in/in Threshold, 0.002 in/in Objective; whichever is greater
   b. Surface Roughness: 250 microinch Threshold, 125 microinch Objective
   c. No physical defects, bumps, or voids > 0.030 in

PHASE I: Develop a concept for an AM process to create rapid, low-cost polymer tooling for use in rubber compression molding as detailed in the Description. The concept shall include proposed material(s), machine(s), and post-processing technique(s) needed to meet the Navy's requirements and how they address the challenges of high temperature, high pressure, surface finish, dimensional accuracy, and durability. Demonstrate the feasibility through modeling, simulation, analysis, or other formal methods. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop, demonstrate, and deliver an AM prototype to create mold inserts that meet the Navy's requirements. The proposed material(s), machine(s), and post-processing technique(s) will be evaluated to determine their capability and feasibility. Perform detailed testing and analysis addressing required performance. Deliver a minimum of five prototype mold inserts for rubber parts chosen by the Navy for evaluation and demonstrate the flexibility of their concept to apply to various rubber part shapes and sizes.

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II to further develop a complete turnkey AM system capable of producing polymer inserts suitable for rubber compression molding and assist the Navy in transitioning the technology for use. The AM system may include commercial-off-the-shelf (COTS) parts or equipment, and need not include equipment for typical or readily available post-processing steps such as machining. Support the Navy in implementation of the system within Navy production spaces and qualifying the system for production use. The complete AM solution will be used to support production of undersea sensors components aboard various surface ships and submarines.

Explore the potential to apply the solution to other military or commercial rubber molding shops or do further research to apply advancements to similar molding applications, such as injection or composite layup molding.

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KEYWORDS: Additive manufacturing; rubber compression molding; high temperature polymers; composite reinforced plastics; master unit die; undersea sensors.

N241-054 TITLE: Probabilistic Forecasts of High Impact Weather on Medium Range to Subseasonal Timescales using Artificial Intelligence

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Develop a robust artificial intelligence/machine learning (AI/ML) based numerical weather prediction (NWP) system capable of generating skillful high resolution forecasts globally at the medium range (5-14 days) and subseasonal (14-90 days) timescales. System should meet or exceed conventional NWP metrics for skill and computational expense, especially for high impact weather events and high error scenarios.

DESCRIPTION: Rapid progress has been made in the past few years in the development and application of AI/ML meteorological models, especially with respect to mirroring capabilities of state of the art dynamical NWP models. There is recent evidence that AI/ML models can be as skillful as state-of-the-art NWP using standard metrics (e.g., anomaly correlations, root-mean-square errors, etc. – see Weyn et al. 2020, 2021; Lam et al. 2022; Bi et al. 2022, 2023; Zhang et al. 2023). However, it remains unclear how well these models perform using more complete metrics that incorporate high-impact weather events (e.g., rainfall, peak winds, etc.), smaller scale atmospheric features, and high sigma (i.e., uncommon) weather pattern scenarios. Furthermore, many of these AI/ML models are trained with relatively coarse resolution reanalysis data. A challenge remains how to better use volume of data (including from commercial sources) for better initial conditions and forecasts. While certain aspects of traditional NWP infrastructure may be difficult to change (such as data assimilation and model analysis states), other aspects such as parameterized physics, construction and diversity of ensembles toward probabilistic forecasts, and identification of forecast uncertainty are ripe for improvement by AI/ML methods. This topic aims to bolster strong development of AI/ML NWP techniques by soliciting targeted research and development to robustly improve skill and resolution of weather forecasts. Specifically, we seek to improve scientific understanding and forecast capability at the medium range (5-14 days) and subseasonal (14-90 days) timescales for both state variables and derived metrics (e.g., clouds, precipitation, etc.). While it is anticipated that weather feature fidelity will be achieved via large ensemble development, use of downscaling towards high resolution techniques would also be considered. Robust methods to resolve high impact cases and development of verification statistics that do not smooth/average out those signals will be necessary. Finally, a significant component of this effort involves development of understandable (explainable) AI/ML infrastructure and techniques that support refined physics improvements and the ability to substitute newer methods as routines evolve.

PHASE I: Perform a comprehensive feasibility study on the proposed end-to-end software architecture as well as demonstrations of AI/ML technique effectiveness to address this problem. Study should include a comprehensive literature review including the state of the science and trajectory, an analysis of alternatives on different AI/ML methods and their strengths and weaknesses, and a discussion on the most challenging research and development parts of the problem (focusing on physics representation, skill challenges with lead-time, and representativeness of weather features at different resolutions). Analysis must include potential for large ensemble and probabilistic approaches and/or high resolution and downscaling techniques and the potential need to use coupled earth system models (that include atmosphere, ocean, land and/or ice) to foster longer range skill. Requirements on computational architecture/software/data should be outlined, as well as proposed metrics to improve beyond point-based averaged metrics towards emphasizing high impact weather events, skill dropouts, and bifurcating scenarios.

PHASE II: A prototype system capable of running real-time forecasts comparable with state of the art dynamical weather prediction systems shall be delivered at the end of Phase II. Development of this capability includes building out the appropriate data ingest, physics representation, forecast propagation, and data output. Architecture components must conform to leveraging processes available to traditional dynamical modeling platforms. Throughout this development, computational efficiency benchmarks should be provided to assess acquisition hardware needs. For more mature efforts, there should be a strong focus on developing very large ensembles and/or high resolution and/or other proposed novel/innovative use of NWP, data assimilation and initial condition sensitivity to demonstrate fidelity for high impact events on 5-90 day time scales. Software must incorporate potential to train/retrain model or model elements. Verification and validation (V&V) will be emphasized throughout the Phase II, with multiple retrospective and real-time V&V development check points. System should be flexible enough to have iterations of skill improvement, validated using impact-based probabilistic metrics with concurrent ONR field campaigns (that may include one or more of analysis of tropical cyclones, atmospheric rivers, boundary layer, and air-sea interaction). There will be particular interest in comparison of skill with other NWP models and analysis of high error/dropout events when AI/ML technique is superior to the traditional NWP model (and vice versa). Sensitivity to grid resolution, initial conditions, and training versus validation datasets (seasons, years, models) will need to be tested and reported.

PHASE III DUAL USE APPLICATIONS: Primary Naval transition opportunity would be to the Fleet Numerical Meteorology and Oceanography Center as an operational weather forecast model run in real-time production. Phase III efforts toward this goal would entail building out the software infrastructure needed to run on local compute, dedicated HPC, and/or government cloud compute solutions. Careful consideration would be needed to develop an environment conducive to upgrades, such as from new data sources, retrained AI/ML equations, and application to varied use cases (such as regional domains, output variables, verification statistics, etc.). Phase III, or alternate projects, would also coordinate with partner Air Force and Army numerical weather prediction programs for other DoD use cases and spin-off efforts. There will also be opportunity and potential to partner with other government agencies outside of the DoD, such as NOAA, NASA, and DoE for their weather modeling use cases. Commercialization beyond government services would support a growing industry with varied needs for computationally efficient and highly specialized meteorological forecasts, including demonstration of commercial weather data services, tailored platforms spanning multiple industries (e.g., agriculture, insurance, aviation, etc.), and general public interests.

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KEYWORDS: Numerical Weather Prediction; Machine Learning; Artificial Intelligence; Subseasonal to Seasonal; Forecasting; Reanalysis; Mesoscale; Meteorology; Oceanography; Earth System Modeling

N241-055 TITLE: Generative Text Engine for Form Completion

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Human-Machine Interfaces; Trusted AI and Autonomy

OBJECTIVE: This SBIR topic is soliciting tools and techniques to facilitate generating semi-structured text reports with free-form text. There is a research interest in exploring the application of Generative Text artificial intelligence (AI) (such as Chat GPT, GPT3/4, etc.) to facilitate the filling in of text-based data collection forms; however, other tools and approaches will be considered if it is explained how they would contribute to the requested capability. The data generated by this general purpose form completion engine will lead to reduced data curation for subsequent analytics. The desired solution will:

(1) generate a general-purpose curation/creation text engine that facilitates completing a variety of text-based forms.

(2) describe a mechanism for incorporating technical terminology & phrasing appropriate for a specific usage domains (potentially including sensitive or classified terminology and phrases) along with a general baseline generative text engine.

(3) be designed to be useful with minimal compute, and without immediate or sustained connection to cloud-based processing resources. Cloud-based Processing intense resources may be used in developing the general-purpose engine and achieving threshold performance, but the proposal must describe how the initial capability will be refined to be useful with minimal computer and storage footprint. Further, the proposal must state the size and capabilities for processing that shall be required to achieve with threshold and objective (final) performance in the desired system.

(4) describe any key technologies being used in creating the capability, and clearly characterize the data usage rights associated with those capabilities.

The concept being proposed in this SBIR topic shall demonstrate the use generative text algorithms to curate the text entries as they are being created. The desired solutions should:

(1) focus on a workflow / process for a prompting dialog between the generative text engine and the user vice developing large language models. It is expected that some tuning of large language models may be required to address a specific technical domain, but that should be as constrained as possible to focus on the process whereby users interact with the models to facilitate form completion.

(2) be easily adapted for incorporating technical jargon and domain specific phrases for different usage domains. The technique(s) for incorporating specialized technical language into the application must be described.

(3) address anticipated prompt tuning techniques to adapt to specific technical domains enabling techniques for one-shot or few-shot learning.

(4) generate appropriate phrases/descriptions (an understanding of what is being described) in different task domains that are correctly structured and generate consistent and appropriate technical descriptions.

(5) be scalable for use from PCs/Tablets/Phones with limited connectivity to a local server and be cloud- connected, not cloud-dependent.

(6) provide for the use of instructions + answers as a sustainable workflow for maintaining / utilizing the authoring / curation engine.

DESCRIPTION: This effort is aimed at enabling the creation of text-based forms with consistent terminology and phrasing by applying generative text artificial intelligence (AI) technology during the authoring of form content. The desired technology will assist content creators by offering interactive curation during the content authoring. The application of the developed technology will result in more consistent form content that is amenable to automated analytics on the generated text and will therefore accelerate and improve accuracy of ship maintenance reporting.

New advances in integrating Large Language Models (LLMs) in application pipelines have demonstrated the potential to support a wide range of technical reporting domains; however, there are significant challenges in generating text with relevant content and terminology when completing maintenance reports. While LLMs show impressive performance in general knowledge and reasoning capabilities, they have inherent limitations and lack capabilities required for broad language understanding and use in the real world (e.g., specialized or proprietary knowledge of terms, facts and concepts). Fine tuning, parameterizing, and combining LLMs with external tools should produce capabilities that enable LLMs to be more useful in real world settings, such as that of facilitating completing form-based descriptions of technical problems and their impacts. The desired applications will provide customized content to support maintenance reporting workflows and answer technical questions across a variety of maintenance reporting use cases.

PHASE I: Conduct research in open source LLMs with commercially permissive license (e.g., Apache 2.0, MIT) to identify, select, and track appropriate models that have the potential to perform well for the Navy domain and desired downstream tasks. Selected models must be usable in both research and commercial settings. The solution will need to work on resource constrained devices (e.g., tablets, laptops), which may be disconnected from the Internet and cloud-based resources during form authoring. To improve the performance of models in deployment environments, different techniques (e.g., distillation, supervised fine-tuning, parameterization) should be identified, explored, and evaluated to ensure correct information is generated for the defined downstream tasks. Define the task and data sources that will be used to act as a suitable proxy for ship maintenance reporting, which involves consistently generating text necessary to fill-in ship maintenance forms. The longer-term technical objective is a general-purpose form-completion engine that can be readily adapted to various technical domains and terminologies and utilize alternative technical jargon and phraseology. The selected LLM and a systems-based approach will minimize model behaviors that generate incorrect content for the selected domains and defined tasks. It is assumed that the task being performed will require new knowledge that was not part of the pre-training data of a general large language model. Successful approaches will securely combine new private data into the workflow and customize the LLM for a target domain and authoring task. Phase I should result in proof of concept demonstrations of key capabilities so as to show how a prototype tool will be built and demonstrated during Phase II. The primary metrics for Phase I success will be quality of proposed workflows for user interaction and a demonstrated use case to show how forms would be completed using a representative large language model.

PHASE II: Build on the tools and results of Phase I to create a viable prototype tool for form completion. Utilize real world forms completion tasks. Ideally the problems and real-world data sources would relate to Navy ship maintenance reporting and ship material readiness, although use cases for other transition customers would be acceptable. A prototype tool will be built and tested to demonstrate a proof of concept involving a user interacting with the system to produce a complete and accurate report. The Ship's Maintenance Action Form (OPNAV 4790 or two-kilo) is an example of a primary maintenance data system (MDS) form that would be of interest, which is used to report both deferred and completed maintenance actions. The mission-degrading casualty report (CASREP), is another example that is used to report an equipment degradation to the operational commander which impacts mission readiness. Automated tools will (1) generate text and fill in these semi-structured forms with free-form text fields, (2) reduce data curation requirements, and (3) enable analytics on the curated data.

For Naval applications, the contractor will need to be able to process Controlled Unclassified Information (CUI) and/or classified data sources up to the Secret level. The government team will provide contractor access to historical reports to support development and evaluation of the proposed techniques, automated tools, and analytics (e.g., text generators, classifiers). The historical text was often written inconsistently and therefore making it challenging to automate analytics across this data. Address inconsistencies and unique language in the various text reporting workflows and describe how the proposed capabilities will support generation of high-quality data for reporting. Describe and demonstrate analytics/metrics on the text data generated to assess the quality of the text being generated. Assess how the tool will run on resource constrained hardware (e.g., tablets, laptops) with reasonable compute capabilities and document its ability to run on-line and off-line (i.e., that the developed technology would be suitable for shipboard/at sea use with limited access to cloud/remote computing capabilities). The tool will provide a tailorable vocabulary database suitable for use across different technical reporting domains (e.g., electrical systems, distillation systems, turbine mechanics, etc.). The workflow and user interface will be fully described and demonstrated as appropriate. The workflow shall be demonstrably easy to use and will demonstrate valid, predictive results. Technical evaluations, capability demonstrations, and metrics will focus on the quality of the human machine interaction (HMI), completeness / correctness of reports, and generalizability of approach across technical reporting domains shall be addressed at the completion of Phase II.

PHASE III DUAL USE APPLICATIONS: Integrate and transition the developed tools for support of the NAVSEA SEA21 Ship Maintenance Data Improvement Initiative (SMDII) Program of Record (POR) to support automated text processing requirements for Navy ship maintenance reporting and ship material readiness. The tools being developed are expected to be applicable to a broad range of form completion applications, including for medical, maintenance, and other domains reliant on text-based data entry.

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KEYWORDS: Automated Text Curation, Large Language Models (LLM), 2-Kilos, CASREP, Casualty Report, Form authoring, Artificial Intelligence, AI

N241-056 TITLE: Autonomous, Mission-based Traffic Engineering

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; Trusted AI and Autonomy

OBJECTIVE: Develop autonomous, mission-based traffic prioritization mechanisms/techniques and orchestration to ensure network priorities are aligned with the Commander's Intent – especially during contested operations when there will not be sufficient network resources to satisfy all of the operational needs.

DESCRIPTION: Tactical networks typically contain an admixture of critical, essential, and non-essential traffic. Criticality of the traffic depends on the types of missions that are currently being executed, mission phase, etc. and is, consequently, highly dynamic. Reference (1) outlines command and control (C2) constructs for the U.S. Navy and Army. These constructs have different warfare commanders, functional commanders, and coordinators – with different network applications / priorities – that must be synchronized to achieve operational objectives. The Navy seeks technical solutions for (1) identifying different types of traffic, (2) associating each traffic type with specific platforms as well as functions/missions, (3) enabling the Commander to prioritize these functions/missions, and (4) translating the Commander's prioritization into network policies that can be implemented across the network to ensure, to the extent possible, end-to-end delivery of mission-critical traffic.

There are two main technical challenges that must be solved:
(1). Reliable mapping of Commander's intent and mission objectives into structured data forms that can be combined with policy representations and reasoned with by machines. Supervised Natural Language Processing (NLP) training requires more exemplars than may be available given the highly dynamic nature of Commander's intent or mission objectives. Machine representations need to precisely capture the original human meaning within the intent as well. Reference 2 provides an overview of the application of artificial intelligence in different areas of the private sector.
(2). How to combine machine representations of policies? Ontologies can be used to capture schema but live tactical feeds for situation awareness, which may be ad hoc, are also critical.

PHASE I: Develop a framework/approach to address the challenges outlined above. Prepare a report documenting the proposed framework/approach along with any preliminary results or data that help demonstrate the viability of the proposed approach. Include in the report a proposed set of benchmarks for assessing performance of the framework and a clear articulation on how the framework is viable with incomplete training data sets. The latter is important because warfare commanders are individuals who have different preferences for receiving and displaying information to support a decision.

PHASE II: Implement the proposed framework using representative data sets for different functions or missions. Demonstrate how the framework correctly interprets intent and then translates that intent into traffic engineering policies. Show how this intent is met both with dynamic network demand and changing circumstances (e.g., priorities change due to a triggering event). Prepare a report documenting the framework implemented, how it was tested, the resulting performance, and recommendations or lessons learned for future implementations.

PHASE III DUAL USE APPLICATIONS: Integration and transition into ADNS is the objective of Phase III. The commercial sector has historically relied on fixed, terrestrial networks and can either easily procure more bandwidth to alleviate congestion or add redundancy. For truly mission critical traffic, the commercial sector builds dedicated networks with dedicated resources to guarantee performance. However, the push towards 5G deployment and increasing need for real-time control systems for autonomous vehicles, automated manufacturing, smart city concepts, etc. are pushing the commercial sector to develop prioritization mechanisms and how to orchestrate their employment across the network to ensure end-to-end delivery of mission-critical traffic. A potential commercial transition option that can be explored is to integrate the algorithms developed into the zero-touch network management solutions developed for 4G/5G mobile services by ZTouch.

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KEYWORDS: Command, Control, Network, Prioritization, Mission, Automated, Dynamic, artificial intelligence/machine learning, AI/ML

N241-057 TITLE: Networking Platform for Real-time Communication of Personnel Health Status and Location during Shipboard Emergencies

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials; Human-Machine Interfaces; Integrated Sensing and Cyber

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 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 prototype networking platform capable of relaying real-time information on personnel health status and location during shipboard damage control activities. This platform should be fully capable of pushing continuous data steams through shipboard spaces to Surface Forces supported wireless systems, such as ship's Wi-Fi, land mobile radio (LMR) leaky coax antenna system, or the Command Readiness, Endurance and Watchstanding (CREW) platform hardware and integrating data into a flexible graphical user interface (GUI) positioned at command and control nodes throughout a ship and robust data management and analytic capabilities for post-event assessments (e.g., mishap investigations).

DESCRIPTION: Due to new enemy weapon systems (e.g., hypersonic missiles) and the heightened risk for engagement at-sea with near-peer adversaries, shipboard combat-related emergencies and subsequent damage control response capabilities will be a defining feature of future US Navy operations [Refs 5, 6, 7]. Damage control (DC) activities involve containment of shipboard damage; managing consequences; recovery capabilities; and sustaining the ship's combat effort [Refs 1-4]. DC activities include firefighting; flood control; structural support/repairs; combat system repair; ordnance clearance; and causality care [Refs 1-4]. These activities are largely performed by Sailors trained in various DC functions and conducted in the extremely hazardous conditions present in damaged shipboard compartments [Refs 1-4]. Hazards may include exposure to extreme heat (> 1500 °F at point of fire), burns, and inhalation of smoke and/or toxic compounds [Refs 1-4]. DC crew casualties may prevent efficient or complete damage containment and repair which may lead to loss of ship and high casualty rates among the ship's crew during combat operations. The goal of this SBIR topic is to optimize DC responses and mitigate crew casualties by developing a capability to automatically relay DC responder health/equipment stati and movement/location data within shipboard spaces and provide real-time actionable data streams to shipboard emergency response command nodes, such as DC Central and/or the bridge. Such capabilities are required to enable more efficient utilization of personnel resources during DC operations; more efficient containment/repair of combat damage to ships; and reduced casualty rates among shipboard personnel.

Current systems utilized aboard US Navy ships for communication between DC teams and command nodes consist primarily of verbal communications and sound power telephone circuits augmented by short-range radios and ship's intercoms [Refs 3, 4]. Tracking of damage, personnel movements, and damage containment/repair progress is currently conducted by command node personnel via hand annotation of whiteboard schematics of shipboard spaces in response to input through standard communication circuits and ship-integrated environmental sensing systems [Refs 3, 4]. Currently no automated real-time system for comprehensively tracking DC responses on Navy ships exists [Ref 6]. This recognized capability gap prompted Naval Surface Warfare Center – Philadelphia Division to develop the prototype Advanced Damage Control System (ADCS) designed to track shipboard damage and containment/repair progress with inputs from environmental sensors and DC crew annotation of a portable tablet-based interface positioned at damage scenes that is designed to exploit the Wi-Fi capabilities of next generation combat ships [Ref 6]. However, the ADCS has not been designed to directly or automatically provide real-time tracking of DC crew health status and location/movement during DC operations.

Technical challenges/requirements:
1) The essential requirement for successful responses to this topic call will be development of a prototype networking platform capable of real-time relay of DC crew health status and location/movement during DC activities and communication of actionable data streams to shipboard command nodes.
2) A major limitation encountered by platforms designed to transmit data from handheld or wearable devices onboard ships is the difficulty with radio transmission through metal bulkheads, aka the 'metal box problem' [Refs 1, 3, 6]. Communication security concerns also restrict decentralized data transmission tolerance aboard ships [Refs 1, 3]. Thus, the prototype platform must be capable of integrating into modern shipboard wireless communication systems and may require innovative approaches to meet all general DoD and US Navy afloat-specific cybersecurity requirements. Ship Wi-Fi or systems, such as CREW, which utilizes networks of centralized hubs placed strategically throughout ships, are capable of receiving inputs from wearable monitoring devices and pushing aggregate data to GUI dashboards for command view. Though not necessarily designed to collect data from personnel in every shipboard space, such systems represent a potential relay point for DC-specific tools to move data streams from wearable sensors on DC personnel out of shipboard spaces to command nodes. Successful respondents to this topic will develop a prototype platform that networks with established wireless systems through portable or wearable hardware that does not require structural modification to shipboard spaces; develop all software required to integrate data from prototype hardware to established systems allowing for continuous data processing; and develop all software required to display real-time summary data of DC crew health status and location/movement on dashboard type interface.
3) Further, due to the unique suite of environmental and procedural factors inherent to shipboard DC, identifying key biometric factors that are most relevant to shipboard DC crew performance decrement and safety, and thus summary 'health status', remains an active area of research. As such, the resulting prototype platform does not require unique sensor development and must be functionally agnostic to biometric sensor choice and amenable to post-development selection/substitution of sensors.

PHASE I: Demonstrate feasibility of a proof-of-concept networking platform that is capable of real-time relay of DC crew health status and location/movement during DC activities and communication of actionable data streams to shipboard command nodes through limited laboratory testing/demonstrations. The resulting platform should be capable of pushing and relaying data streams within and through bulkheads of modern US Navy ship compartments to established wireless systems, and may consist of portable or wearable pucks carried to damage sites by DC crew or other innovative solutions. Further the platform should be fully functional in ambient temperatures up to 150 °F. Provide cost-effective design and reliability estimates, to include lifetime cost estimate and service life expectancy. Phase I deliverables in addition to standard Phase I deliverables outlined in the BAA, will include: 1) design plans for the prototype platform based on the Phase I proof-of-concept design; 2) an RDT&E plan to develop and validate the final platform in Phases II-III; and 3) a preliminary prototype (physical or virtual) that is capable of demonstrating feasibility of the Phase I proof-of-concept design.

PHASE II: Develop, demonstrate, and validate the prototype networking platform based on the Phase I proof-of-concept design. The resulting platform should be able to perform collection and analysis of data under the relevant environmental conditions (as cited in the Description and Phase I sections). The platform should be capable of processing data continuously for 48 hours or longer utilizing on-device processing, and include all software required to integrate data from prototype hardware to established wireless systems. Platform outputs must be integrated into flexible GUI dashboard-type displays that can be positioned throughout ships for command monitoring of DC crews. Resulting prototype platforms will be tested on human participants at US Navy DC training centers or other acceptable fire training facilities which may include civilian firefighter training centers. The Phase II platform design may be intended for experimental or training use and need not be fully adapted and ruggedized for operational use. Phase II deliverables will include: 1) at least 2 prototype units; and 2) detailed design specifications and technical data package drawings that ensure IP protection.

PHASE III DUAL USE APPLICATIONS: ONR will support the small business with transition of a resulting successful prototype platform for additional development to the Naval Advanced Medical Development and/or the Naval Sea Systems Command 05P5 DC/PPE Tech Warrant Holder, which maintains DC equipment authorized for Naval use. Discussions with corresponding POCs at these offices have been initiated and are ongoing. Operationally relevant conditions will likely necessitate additional development and testing of the platform, which may require greater temperature tolerances, extended data collection, and/or enhanced security capabilities. A successful respondent to this topic call shall support the US Navy in developing the resulting technology for use across the full spectrum of operationally-relevant conditions/environments and account for applicable ship-class specific variations that might impact functionality (e.g., in-hull designs and metallurgy). The small business shall also develop a plan to commercialize, mass produce, and deploy the technology and its associated operating procedures.

REFERENCES:

1. NAVSEA Technical Bulletin, Industrial Ship Safety Manual for Fire Prevention & Response
2. NAVSEA Campaign Plan to Expand the Advantage 3.0
3. Major Fires Review, Executive Summary, Commander U.S. Fleet Forces Command, Commander, U.S. Pacific Fleet, July 15 2021\
4. United States Government Accountability Office, Report to Congressional Requestors, NAVY SHIP FIRES: Ongoing Efforts to Improve Safety Should be Enhanced, April 2023.

KEYWORDS: Damage control; shipboard firefighting; flood mitigation; wearable monitoring device; personnel protection equipment; wireless shipboard communications

N241-058 TITLE: Multi-Sensor Prototype for Non-Destructive Corrosion Evaluation and Characterization

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Develop a multi-sensor unmanned aerial vehicle (UAV) system that can assess the condition of a guy wire in situ (in place/position) and identify degradation and potential areas of repair needs before major damage has occurred.

DESCRIPTION: Current UAVs include visual cameras, making visual inspection easily attainable, but cannot view below the surface. Ultrasonic inspection of corrosion on cables requires direct contact with the surface along with the application of a water-based gel, neither of which are easily adapted into a UAV for cable inspection [Refs 1, 2]. Infrared (IR) thermography cannot view more than a few centimeters below the surface and may require high temperatures to provide useful data [Ref 3]. X-ray fluorescence requires extra safety considerations given the outdoor environment. Eddy current testing requires direct contact or near direct contact [Ref 4]. Magnetic flux analysis may require large magnetic fields to provide useful results.

The desire is for a mobile platform that combines multiple sensors and measurement/analysis technologies to provide subsurface corrosion detection along with surface corrosion characterization up to hundreds of feet away from the operator. Basic requirements:
• Travel height above ground: 1000ft (T), 1500ft (O)
• Travel length in one direction: 1500ft (T), 2300ft (O)

PHASE I: Develop a concept for a UAV system with a multiple Nondestructive Evaluation (NDE) sensor configuration to characterize corrosion and identify areas of further interest. Demonstrate the feasibility of the concept. Prepare a report to ONR / NIWC Pacific on system concept design(s) and sensor output modeling and prepare a Phase II production and testing plan.

PHASE II: Construct a prototype UAV system and assess the accuracy of the corrosion characterization. Provide a report that documents the design options for a prototype system that includes results of operations and type/level/fidelity of corrosion inspection performance. Provide a Phase III plan to ONR 35 / NIWC Pacific for prototype evaluation. Produce a prototype system for NIWC Pacific evaluations.

PHASE III DUAL USE APPLICATIONS: Refine the UAV system and demonstrate corrosion identification, characterization, and analysis. Deliver a UAV system to NIWC Pacific and provide a report containing designs and test data to ONR / NIWC Pacific. The development of a more available option for UAV corrosion assessment would enable remote inspections for a variety of commercial infrastructure applications. Current commercial infrastructure (wind turbine blades, ship hulls, etc.) makes use of a variety of sensor outfitted unmanned systems (UxS); however, none are currently optimized for stand-off, large scale corrosion inspection to the best of our knowledge. Most of the existing commercial options are predominantly fee for service options, vice a complete, off-the-shelf hardware/software asset that is available for procurement.

REFERENCES:
1. Zhang, D.; Watson, R.; Dobie, G.; MacLeod, C. and Pierce, G. “Autonomous Ultrasonic Inspection Using Unmanned Aerial Vehicle.” 2018 IEEE International Ultrasonics Symposium, pp. 1-4. 10.1109/ULTSYM.2018.8579727
2. Hernandez-Salazar, C.D.; Baltazar, A. and Aranda-Sanchez, J.I. “Damage Detection in Multi-wire Cables Using Continuous Wavelet Transform Analysis of Ultrasonic Guided Waves.” 2009

IEEE Electronics, Robotics, and Automotive Mechanics Conference, pp. 250-255. 10.1109/CERMA.2009.65

3. Kerdoncuff, H.; Lin, W-I. and Wacker, L.J. "Spectroscopic techniques for corrosion detection using drones." Danish National Metrology Institute, Report DFM-2017-R005, Ver. 1.01, 2017.
4. Mathey, R. and Clifton, J. "Review of Nondestructive Evaluation Methods Applicable to Construction Materials and Structures." National Bureau of Standards Technical Note 1247, 1988.

KEYWORDS: Corrosion identification; unmanned aerial vehicle; UAV; infrared imaging; eddy currents; magnetic flux; ultrasonic testing; non-destructive materials

N241-059 TITLE: Wideband Interference Suppression

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Microelectronics

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 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: Define, develop, and demonstrate a microelectronics made interference suppression system for use in a single antenna system that can operate simultaneously over a wide spectral bandwidth that contains multiple independent and uncooperative loud signals as well as many small signals which are both of significant interest (SOI) and of low interest (NSOI) categories.

DESCRIPTION: The radio frequency spectrum has become increasingly crowded due to the rapid expansion of wireless networks and growth of the expectation, even in the military, that discussion of alternative response behaviors will occur during decision making. The proximity and overlapping frequency allocations of multiple wireless systems inevitably lead to communication interference. Military environments, both on land and at sea, face additional challenges with constantly shifting transmitters that change location, transmission direction, and frequency. The move toward every platform doing many operations simultaneously drives up the number of functionalities each platform engages in and each has its own transmitter. The resulting electromagnetic environment is complex and carries a significant risk of unintentional interference, especially given the likelihood of signal reflections from neighboring platforms within the battle group. Design and placement of antennas alone cannot sufficiently address the issue.

While digital signal processing techniques have made great advances in enhancing modern electronic warfare, communications, and radar systems, the most efficient approach to interference mitigation is to protect the receiver from exposure to interferers. This requires hardware that can suppress interference as close to the receive antenna as possible, typically at the front end. And as future receivers aim to eliminate analog down-conversion stages and ingest wider bandwidths for direct digitization, the demand for front-end filtering becomes even more critical. Meanwhile the pace of battle has accelerated and the sheer bulk of signals needing attention drives the priority of shrinking the time it takes to respond to any one scenario. Speed of adaptation becomes a critical system parameter.

One possible solution is provision of a number of fast tuning, analog filters. Individually they need to possess steep band edges, highly attenuating stop bands, and low insertion loss. All proposals should quantify their expectations regarding these parameters. Static filters are a well-established and reliable technology. They would be sufficient if the interferers' frequency, spectral width, and power were known and consistent, which unfortunately is no longer the case. Effectively addressing the challenges posed by today's electromagnetic environments demands the use of multiple fast tuning or self-generated notch filters. These filters should be generated independently (in linear fashion) and adjusted in terms of center frequency. A mechanism should be defined to control the bandwidth and depth, which may be interdependent parameters. If active control is required, the same control parameters must produce the same response independent of the previous control settings (i.e., no history effects). The time between the arrival of a new interfering signal and the beginning of its suppression within the total signal needs to be less than a microsecond and ideally less than 1 nanosecond. Additionally, the passband of the total filter should exhibit transmission losses of << 1dB when on and less when parked/inactive/off. The technology selected for demonstrations should imply the net total device insertion loss upon signal Input/Output (I/O) should not dominate the system behavior. Furthermore, the filters need to demonstrate characteristics such as reliability, environmental temperature stability, and resistance to mechanical vibration. To succeed as a product, a high level of as fabricated device-to-device repeatability is needed, or testing and calibration costs can balloon.

Both innovation of the proposed notch filtering mechanism and a lack of distortion of acceptable amplitude signals are sought. Device concepts requiring a reference signal for the signal to be removed must describe how to obtain same for uncooperative transmitters. Systems requiring signals analysis to determine the frequencies at which filters should be tuned need to include that processing time in their turn on/off time estimates. The production of out of signal band interference is not an acceptable byproduct.

The solutions proposed will also be judged on the processing latency they introduce and their design complexity and Size, Weight and Power (SwaP) when the functional instantaneous bandwidth (IBW) contains hundreds of simultaneous signals of interest and there is only one antenna available. The ultimate IBW will exceed 20 GHz. Photonic approaches are acceptable but not required. Such proposals should indicate the expected required optical power of the photonic carrier. All proposals should be careful to define the acceptable range of Radio Frequency (RF) carrier frequencies, estimate wall plug power costs of implementation, describe all during operation circuit trimming required, and provide a discussion of the individual contributions to the system's overall noise figure in a technical risks section.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: In the base, develop the approach, as outlined in the Description, toward the ultimate demonstration for more than two interferers of different bandwidths, including spread spectrum noise like signals, and both narrow and wide band desired signals spread over the entire proposed input IBW simultaneously. The initial demonstration of a multi-notch filtering system should focus on the 3 MHz to 6 GHz communications dominated band, and provide up to 10 independent notches, tunable across the entire band with > 40 dB stop-band rejection and 3-dB bandwidth of < 1 MHz per notch, self or externally adjustable up to > 20 MHz. The Phase I base period should include sufficient performance measurements to allow estimation of the performance expected if the Phase II preliminary plan is accepted. In the Phase I option period, if exercised, further optimize the circuit design and test the prototype more completely with all kinds of signals of interest and interferers.

PHASE II: Review whether the Phase I choices of materials and approach is optimal for wide band ingest performance. If not, consult with the government sponsor whether a change in materials is warranted and if yes, develop a new brass board demonstrator. If not, proceed toward a full IBW demonstration aiming for minimum size, weight and power while including additional C(G)OTS components to be named by government. If the Phase II Option is exercised, continue progress toward integrating this circuit with other required parts in a system.

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

PHASE III DUAL USE APPLICATIONS: The successful result of this SBIR topic will be an enabling technology. Interference suppression is necessitated by the common issue of co-site interference when many transmit antennas are closely collocated with receive antennas without sufficient free space isolation for Simultaneous Transmit And Receive (STAR) to be possible. Moreover, many commercial base-stations have the antennas of many vendors collocated on the same tower and are increasingly bothered by co-site interference.

REFERENCES:

1. Interference Suppression - an overview | ScienceDirect Topics https://www.sciencedirect.com/topics/computer-science/interference-suppression
2. Poor, H.V. “Adaptive Interference Suppression for Wireless Multiple-Access Communication Systems.”Circuits and Systems for Wireless Communications In: Helfenstein, M., Moschytz, G.S. (eds). Springer, Boston, MA, 2002. https://doi.org/10.1007/0-306-47303-8_27

KEYWORDS: Co-site interference; photonic interference cancellation; actively tuned filters; RF isolation; ultra-wide instantaneous bandwidth reception; spurs; intermodulation distortion

N241-060 TITLE: Ultra-High Reliable and Efficient Unmanned Surface Vessel (USV) Modular Generator System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Renewable Energy Generation and Storage; Sustainment

OBJECTIVE: Develop and demonstrate a megawatt (MW) scale, ultra-high reliable and efficient Unmanned Surface Vessel (USV) modular generator concept configured with smaller KiloWatt (kW) scale building block power units in a high-density package to achieve a 4,000 hour no touch maintenance periodicity for continuous operation in a naval environment.

DESCRIPTION: Unmanned surface platforms are expected to become an indispensable part of Naval operations, yet current power system technology does not satisfy future long-duration USV mission needs. Current power generation system technology for USVs supports missions on the order of days to weeks, but many future missions will be measured in months.

One of the most critical enabling capabilities for USVs is reliability of the Hull, Mechanical, and Electrical (HM&E) systems. A significant part of HM&E systems is power generation, which is presently leveraged from manned platforms. These power generation systems, primarily diesels, are not specifically designed for high reliability and maintainability without human intervention.

Modular generators are functionally equivalent to single engine based shipboard diesel or gas turbine generators. The modular configuration enables a common flexible design approach to meet USV cross platform needs, both large and small, to be scalable to total power needs; enables graceful degradation of the system rather than a complete system shutdown in the event of a component failure; and can also be configured as needed to adapt to available platform space.

Innovation is sought to configure and optimize smaller kW scale power units to achieve the following:
• Modular Generator Total Power Output: 1 MW or greater
• Fuel: Navy Logistics Fuel including NATO F76
• Building Block Power Unit Scale and Type: 10's-100's kW High Density Diesels, Stirling Generators, Fuel Cells, Gas Turbine Generators. Note that innovation will be sought on how to configure installation of multiple power units to allow for easy access for maintenance, quick removal and replacement as well as optimize operating life via controls.
• Maintenance Interval: 2000 hrs
• MTBF: 4000 hrs
• Modular Generator Electrical Output: 800-1000VDC
• Operate in a marine environment conditions such as salt air ingestion, ships motion in high sea states, shock, vibration, etc.
• Modular generator volumetric and gravimetric density will be equal to or greater than equivalent power level marine diesel generator sets. Note that innovation will be sought on how to configure installation of multiple power units to maximize density as much as possible.
• Modular single point connections for power, fuel, cooling, exhaust, and controls. Note that innovation will be sought on how to best optimize design to combine multiple power unit connections to a single ship interface.

PHASE I: Develop a Modular Generator conceptual design accounting for innovations and requirements stated in the Description with a defined building block power unit.

PHASE II: Develop a Modular Generator package. Demonstrate innovations identified in the Description. Further demonstrate high risk marine environment conditions as required.

PHASE III DUAL USE APPLICATIONS: Build a MW scale Navy modular generator incorporating innovations identified in the Description. Perform land based testing to prove operational capability with potential for subsequent at sea demonstration. Dual use application includes commercial marine and land-based generators.

REFERENCES:

1. Congressional Research Service. “Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress Updated August 25, 2023.” https://fas.org/sgp/crs/weapons/R45757.pdf
2. “Naval Research and Development Framework.” https://media.defense.gov/2020/May/18/2002302044/-1/-1/1/NRE-ADDENDUM-TO-THE-R-AND-D-FRAMEWORK_070617.PDF

KEYWORDS: Modular Generator; High Density Diesel; Stirling; Fuel Cell; Gas Turbine Generator; USV

N241-061 TITLE: Multi-variable Unmanned Anti-Submarine Warfare (ASW) system assessment and optimization toolkit

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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OBJECTIVE: Develop an analytical toolkit that allows identification, examination, and optimization of tradeoffs of proposed unmanned Anti-Submarine Warfare (ASW)platforms (and their hosted systems), enables comparison of their performance to that of existing manned counterparts, and provides performance metrics for various combinations of unmanned and manned assets in conducting selected theater ASW missions.

DESCRIPTION: The toolkit will enable analysis of the performance of potential unmanned ASW platforms, balancing their unique capabilities and constraints (e.g., self-noise, endurance, operating speed, payload capacity, etc.) with different sensors/sensor configurations, different numbers of platforms, viability of various acoustic and RF communications paths, and performance against selected real-world targets in relevant operating environments. The tool will allow examination of search area, coverage rate, probability of detection vs probability of false alarm, cost per unit area covered, etc. The tool will account for the inherent mobility of unmanned maritime vehicles to optimize area coverage, based on vehicle capabilities and sensor payload selections.

The toolkit will be applicable to all potential phases of ASW operations, including barrier search, wide area open ocean search, classification, localization, and engagement. Environmental variability will be taken into account to provide sensor coverage estimates for various theater ASW scenarios. Based on environmental variables and constraints and expected target detection and classification parameters, the tool will assess sensors of differing modalities and optimize sensor selection and asset allocation. The tool will account for both acoustic and non-acoustic means to detect, classify, and localize targets. Inputs from oceanographic field forecasts will be used to optimize ASW laydowns of assets, manned and unmanned. The tool will enable direct comparison of performance to manned counterparts but will also analyze performance of unmanned systems working in conjunction with manned platforms to enhance theater ASW. The tool will allow an operator to simultaneously examine the performance of multiple platforms (manned and unmanned) and explore different deployment options (i.e., different force laydown/formations) against a number of threat options. The system will determine optimal placement of these assets and associated sensors, and be used to inform development of critical technologies. For scenarios involving multiple unmanned surface and undersea vehicles, the toolkit will consider track synchronization requirements across multiple platforms, defining communication paths required to achieve contact correlation and coherent target track formation. Track synchronization shall be timely, robust, and accurate enough to support automated contact correlation. The toolkit will be able to take into account cases where one or more unmanned platforms or sensors fail or are unable to communicate during mission execution, resulting in the need to reallocate and redistribute assets to provide the best area coverage for the scenario. Shifts from a benign communications environment to a degraded communications environment will be considered and taken into account. Toolkit assessments and theater-level allocation recommendations will be able to be dispersed across Commands via assured server to server communication.

The toolkit will provide information via a map-based graphical display that is intuitive and easily understood by a trained operator. The toolset will provide waterspace management capability for manned and unmanned platforms, allocating undersea assets by depth in addition to latitude and longitude position. The toolkit will provide graphical means to display analysis products for areas of interest (two dimensions) or for volumetric water spaces (three dimensions). The toolset will have the ability to easily update ASW target characteristics in order to predict ASW performance of selected platforms and sensors. Although not the focus of this SBIR topic, the basic technology will be extensible to Anti-Surface Warfare (ASUW) and Anti-Air Warfare (AAW) targets and scenarios.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop the algorithmic baseline that will underlie the analysis toolkit, showing that the algorithms work for a small number of variables (on the order of ten distributed vehicles, either surface or undersea in nature, working with one or more manned platforms). Demonstrate that the system is capable of learning or accepting performance data for each variable. Demonstrate the optimization of the variables against a pertinent ASW mission scenario in a realistic acoustic environment. Algorithms can be in Matlab or other code development tools for this demonstration.

PHASE II: Develop a software system that can handle thousands of variables. Key types of variables including but not limited to platforms, sensors, communication, costs, environment, and targets. Each type of variable will have performance metrics associated with the system. The final system should be a graphics-based input output with touch screen capability. The system will allow the operator to enter the ASW platforms, unmanned vehicles, and the sensors available to them. The system will allow ingestion of environmental modeling data necessary to develop realistic coverage estimates for all sensors against the range of targets in the data base. The system will then compute the optimal placement of platforms against metrics such as probability of detection, probability of classification, probability of false alarm, area coverage, and weapons engagement capability.

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

PHASE III DUAL USE APPLICATIONS: The transition project would be to a mission planning system for use by the ONR 321 ASW team for analyzing new technology development potentials.

REFERENCES:

1. EFFECTIVENESS OF UNMANNED SURFACE VEHICLES IN ANTI-SUBMARINE WARFARE WITH THE GOAL OF PROTECTING A HIGH VALUE UNIT, Naval Postgraduate School
2. STUDY OF INTEGRATED USV/UUV OBSERVATION SYSTEM PERFORMANCE IN MONTEREY BAY, Naval Postgraduate School

KEYWORDS: Operations analysis; anti-submarine warfare; multi-variable optimization; multi-sensor; unmanned system; unmanned surface vessel (USV)

N241-062 TITLE: Innovative Low Profile, Foldable, High Power Microwave Antenna

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials; Directed Energy (DE)

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 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, affordable, foldable/stowable, frequency-scalable, gain/aperture scalable, steerable, low-profile antenna design to improve the performance of High Power Microwave (HPM) weapons. The threshold Radio Frequency (RF) range of interest is 1-to-20-GHz. The antenna system must be capable of High Power use = 100 MW peak power, and waveguide fed.

DESCRIPTION: Components for HPM weapons often work well in the laboratory, but fail in the tactical environment (e.g., dirt, shock and vibration, extreme temperature, exposure to salt water). The objective of HPM weapons is generally achieved by maximizing the Radio Frequency (RF) power density (PD) (PD in units of W/m^2) at the target. PD on target depends on power handling capabilities and gain of the antenna system. A limitation on HPM weapons is achieving appropriate even gain across a large enough bandwidth while maintaining high peak power handling capabilities. The current systems, which couple to HPM antennas, utilize a waveguide output and a wide variety of high-power mode converters already exist, thus any waveguide input can be considered but fundamental modes are encouraged.

While high power antennas exist, most have not been designed with harsh military environments or lightweight steerable mounts in mind. Considerations such as materials that support lighter weights while maintaining mechanical strength to combat wind and water loads (i.e., watertight, wave slap, salt fog, etc.), foldability for storage when not in use, and precise steering to quickly engage multiple targets. Producing high RF power density at the HPM source (in order to produce high PD at the target) will require a multi-disciplinary investigation. Electrical engineering and physics will be required to achieve the objective for high electric field (E) in the antenna input as well as the mechanical requirements needed to survive the harsh military environments. The high power and pulse repetition rate present potential for electrical breakdown in the antenna systems. The pulse duration and maximum size of the aperture can lead to reduced aperture efficiency due to pulse traversal time across the aperture. Current designs feature vacuum-insulated overmoded waveguide feeding a reflector-type antenna. Of course, innovative designs must not introduce unwanted effects; for instance, a voltage standing wave ratio (VSWR) sufficient to damage the source. An innovative design must be able to handle the stress environment of tactical employment, including reducing side lobes to minimize potential Electromagnetic Interference (EMI) to nearby assets and systems, manufacture, transport, storage, launch and operation. The evaluation of the stress environment should include, but is not limited to, shock, vibration, fatigue, water tight, wind loads, corrosion, etc.

KEY ANTENNA PARAMETERS
Will be negotiated with each proposal depending on submitted design. After award a more specific design case may be provided.

- Operating frequency in the range of interest between 1-20 GHz.
- Reliable, operating at peak power levels = 100 MW.
- Maximum possible gains for specific use cases.

• Aperture Area: 10m^2 or greater but scalable and foldable (collapsible) for stowage and transportation when not in use.
• No electrical breakdown inside the antenna, especially at or near the source.
• Waveguide fed and steerable in azimuth and elevation.
• Radome structure to account for sea-state loading, green water load, and sea spray or salt fog corrosion, water tight, etc.
• Radome structure properties specifically beneficial to SOW-negotiated frequencies.
• Compact or low profile design, to-be-determined in SOW negotiation.
• Sufficiently low side and back lobes to permit operation within and near the desired platforms or systems. This will vary but a reasonable expectation may be -30 dB from the well-defined main beam.
• Unique radome designs to reduce side-lobes to ease EMI challenges with platform integration.

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PHASE I: Consult with ONR to identify a nominal, perhaps-hypothetical, platform-payload configuration with operational parameters, to include SWAP-C, Effective Radiated Power (ERP), parameters for pulsed RF power, mechanical stress objectives and environmental considerations.
Consult with ONR to identify potential front-end HPM source systems (e.g., including pulsed power) that shall be configured to work with the innovative antenna subsystem.
Develop design strategies, Modeling and Simulation (M&S) and experimental validation for:
• Mechanical Stress analysis
• Mechanical concept design to include steering capabilities and limitations
• Weight analysis, environmental considerations, and transportability
• High power handling capabilities
• Low probability of electric breakdown with respect to previously stated considerations
• Innovative structural design and validation without unacceptable effects such as high VSWR
• Dielectric insulation choices
• Polarization choices, including but not limited to linear polarization (horizontal or vertical) or circular-elliptical polarization
• Feed network, mode converter
Conduct initial iterations of design, M&S and experimental validation.
Provide a convincing way forward for a Phase II effort.

PHASE II: Design, build and test (at low power) the innovative antenna subsystem. Provide low-power characterization to include sidelobe characterization and steering in azimuth and elevation. Perform the preliminary work necessary to prepare for high-power testing and characterization in Phase III.

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

PHASE III DUAL USE APPLICATIONS: Support ONR to configure the antenna subsystem with a high-power HPM source. Test and characterize at high power. ONR may also dictate the location and government assets used to verify the test and characterization.

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KEYWORDS: High Power Microwave (HPM) weapons, High Power Wideband Antenna, Electric Field Breakdown in an RF environment, Mechanical Structure Tolerance, Shock, Vibration and Fatigue Testing, Modeling and Simulation (M&S), Electric Polarization, Antenna Mount, Fold

N241-063 TITLE: Naval Shipboard Embedded Battery Containment System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE); Renewable Energy Generation and Storage

OBJECTIVE: Develop shipboard containment for embedded lithium batteries in standard containment dimensions, to support the integration of large batteries that scale up to the megawatt (MW), and up to MW-hour (MWh) scales. The batteries have interfaces up to 1000VDC, and containment must account for protection from shock, vibration, internal/external fire, overpressure, managing battery gas release, kinetic effects, etc. The containment system should provide a modular construct to enable a level of isolation between battery modules of different form factors, inside of the container so that propagation potential is minimized.

DESCRIPTION: Energy storage systems, comprised of high power and energy-density batteries, offer the potential for numerous benefits as applied to power systems of different types. However, high density storage systems, which may present electrical, chemical, and flammability/explosive hazards, must be able to be simply and effectively installed in locations which can be populated by personnel and sensitive equipment. Because of this, robust and rugged enclosures must be designed that are capable of overcoming effects related to temperature, pressure and internal/external effects, at the same time. Battery systems will need to be enclosed in containment structures that protect from internal (e.g., other failing modules) and external (e.g., fires, weapons effects, moisture) threats. Containment should not be tied to a specific cell size or chemistry, nor to a specific battery module design or form factor, as it is likely that battery technology approaches and designs will change in time. Thus, containment approaches that are universally useful (e.g., standard containment rack widths or designs that can intrinsically be adapted to various battery designs) are recommended. However, the approaches must provide substantial innovation because the effects upon size and weight due the enclosure and containment cannot substantially adversely affect the power and energy density of the storage systems. Innovative R & D to support the creation of compact, lightweight, and high performance enclosure structures should support the evaluation of means of enclosing and isolating energy storage systems from the surrounding environment.

The overall structural approaches should be amenable to large shipboard-embedded systems. Approaches must be considerate of the conditions of release, including MW thermal flux from failed components, overpressures, and flame effects. The system should include a directed ventilation approach to allow gasses generated to escape into a specific, acceptable location or direction. The enclosure shall not require substantial volume above that already taken by the storage system itself, thus an enclosure system will not expand the volume by more than 10% of the racked storage components. Ultimately the design should ensure strength of the shelving and resilience to shock, vibration and environmental effects as defined in the MIL specifications provided in the References. Any design should be able to support devices enclosed with voltages up to 1000VDC (including arcs and plasmas) and power capabilities up to 1MW, and provide penetrations to allow cabling sufficient for moving energy in and out of the enclosure. Cooling may also be assumed to be available, but no colder than 40 degrees Celsius at a flow rate proportional to the volume of the box. It should not be assumed that copious quantities of cooling liquid are available to cool the enclosure itself, but rather the items placed inside. However, small amounts could be utilized by the enclosure itself to support internal environmental characteristics. Aspects of packaging of components internal to the enclosure could be manipulated to support the overall requirements of the enclosure system; however, the design must be flexible and adaptable to specific components or combinations of components inside.

PHASE I: Perform advanced modeling and analysis to define the energetic characteristics of cascading battery failure conditions, where it is assumed that a device fails on the order of one per minute continuously. The basis of the analysis will utilize the thermal and inertial effects from released gas and ejecta from cells. The evaluations will be utilized to determine the requirements for scalable architectures which create minimal impact on device density. Utilizing this information, a conceptual design will be provided with traceable simulation basis to demonstrate performance. If possible, validation of simulated performance parameters will be provided prior to the Option phase. This work will be used to help define a containment volume of sufficient dimensions to be considered a standard rack, with dimensions of ca. 25"W x 48"D x 72"H.

PHASE II: Scale any conceptual enclosure design artifacts and material selections produced under Phase I and its Option period, if exercised, to relevant size, which provides dense rack-mount capability and serviceability aspects. All input and output interface points will be defined and performance simulations evaluated with a greater level of detail. An interface Control Document (ICD) will be created to define clearly all connection points, types, dimensions, model numbers, etc. The complete containment equipment will be built to the designs produced, and validation of the performance aspects (inertial, mechanical, thermal, chemical resilience) will be demonstrated via failure of Li-ion batteries.

PHASE III DUAL USE APPLICATIONS: Design and build full-scale flexible rack-mount enclosures for a particular military application, with the internal modular structure built to a specific battery. The containment will be designed to the intent of meeting appropriate MIL-SPEC operational requirements, and a combination of detailed analytical evaluations and specific test events will be performed.
A scalable, cost-effective enclosure scheme that provides local isolation from energetic release will enable lighter, more compact energy storage to be implemented onto a greater number of platforms and operational equipment.

Dual use applications are anticipated for commercial marine large scale battery applications.

REFERENCES:
1. "Maritime Risk Focus: Lithium-ion batteries fire risks and loss prevention measures in shipping", 3/21/2023, https://maritimecyprus.com/2023/03/21/maritime-risk-focus-lithium-ion-batteries-fire-risks-and-loss-prevention-measures-in-shipping/
2. NAVSEA S9310-AQ-SAF-010, Technical Manual for Batteries, Navy Lithium Safety Program Responsibilities and Procedures, http://everyspec.com/USN/NAVSEA/NAVSEA_S9310-AQ-SAF-010_4137/

KEYWORDS: Battery, Thermal Runaway, Containment, Enclosure, Fire

N241-064 TITLE: Advanced Wearable Integration and Synchronization Hub (AWISH)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces; Integrated Network Systems-of-Systems

OBJECTIVE: Develop a hub system that optimizes data capture, synchronization times, and integrates data collected from physiological wearable devices.

DESCRIPTION: It is well known that insufficient sleep quality and quantity lead to health and performance decrements – which can be catastrophic in military settings. In response to the Government Accountability Office recommendations to Congress on fatigue in the Navy (GAO-21-366), the Command Readiness, Endurance, and Watchstanding (CREW) program is advancing a fatigue monitoring and mitigation solution for the Navy. An initial prototype of a wearable-based infrastructure has been developed and tested with several ships (e.g., USS San Diego, USS Montgomery). However, technical improvements are required to move this product from a research and development phase to a pre-commercialization phase to support at scale deployment.

The objective of this SBIR topic is to develop a standalone hub system capable of capturing data off physiological wearable devices (e.g., Oura ring, Polar Grit X Pro, PowerWatch, etc.) and then to push the data to the backend data infrastructure. These data captured shall provide an early indicator for fatigue and sleep deficiency for which mitigation strategies may be implemented. The hub system should reduce active human interactions which in turn will reduce human error; as well as optimize sync transfer times between wearables and the hub, increase data throughput, extend bluetooth range for Pi devices evaluate (and/or identify alternative device to use), and create a system dashboard U/I that provides real time stats and allows ease of access/control over the networked system (primary/lead hub and subordinate hubs) to push time updates, monitoring system a stand-alone light weight server. The hub should create a solution for message queuing and automated pushing of files upon restoration of network connectivity following lost network access. The hub should improve or replace automated method for wearable device pairing. The awardee will deliver complete technical documentation and a complete user manual for both the primary and secondary hubs.

PHASE I: Define and develop a concept for a hub that can meet the hardware and software performance constraints listed in the Description. The hub concept should develop means and methods that advance the current mechanisms for data capture and transfer from wearable physiological devices. The hub concept should be backend architecture agnostic, meaning that it should be able to push to a multitude of data management architectures. The Phase I option, if exercised, would include the initial layout and capabilities description to build the hub in Phase II.

PHASE II: Develop a prototype hub based on Phase I work for demonstration and validation. The prototype hub should be delivered at the end of Phase II, ready to be fielded by the Government.

PHASE III DUAL USE APPLICATIONS: Integrate the Phase II developed hub prototype into deployed Naval vessels and transition finalized product to Naval Surface Force (SURFOR). The Phase III hub should integrate with the CREW data infrastructure used by the Navy. Dual uses in the commercial sector include sporting teams and emergency services (e.g., Fire, EMS).

REFERENCES:

1. Chinoy, E. D., et.al “Performance of seven consumer sleep-tracking devices compared with polysomnography.” Sleep, Vol. 44, Issue 5, 2020. Oxford University Press (OUP). https://doi.org/10.1093/sleep/zsaa291

2. Reifman, J., Ramakrishnan, S., Liu, J., Kapela, A., Doty, T. J., Balkin, T. J., Kumar, K., & Khitrov, M. Y. " 2B•]Alert App: A mobile application for real•]time individualized prediction of alertness." Journal of Sleep Research, Vol. 28, Issue 2, 2018. Wiley. https://doi.org/10.1111/jsr.12725
3. Stamatakis, K. A., & Punjabi, N. M. "Effects of Sleep Fragmentation on Glucose Metabolism in Normal Subjects." Chest. Vol. 137, Issue 1, 2010, pp. 95.101. Elsevier BV. https://doi.org/10.1378/chest.09-0791
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KEYWORDS: Physiological monitoring, sleep, fatigue, wearables, human performance, data integration

N241-065 TITLE: Advanced Nondestructive Inspection System for Detection and Characterization of Corrosion under Thick Coatings

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials; Sustainment

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 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 Nondestructive Inspection (NDI) system capable of: (1) detecting decohesion of a thick coating from its substrate and (2) characterizing the presence of corrosion under very thick polymer coating sections. The system will be used to inspect the entire immersed portion of a ship hull autonomously (either tethered or autonomously) and map the location and extent of corrosion without damaging the coating.

DESCRIPTION: Some situations exist where the condition of the substrate needs to be assessed in situ under thick polymeric coatings. This assessment includes the degree of adhesion of the coating to the substrate and the condition of the substrate from a corrosion perspective. There are several potential non-destructive technologies that may be able to “see” through thick coatings. The SBIR topic includes assessment of select non-destructive technologies to monitor interfacial coating/substrate phenomena and substrate corrosion as a function of coating thickness. The accuracy and reliability should also be addressed. The system will be used to inspect the entire immersed portion of a ship hull autonomously (either tethered or autonomously) and map the location and extent of corrosion without damaging the coating.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Explore the various non-destructive technologies through a literature search and downselect to the two or three most promising Non-destructive evaluation (NDE) options or propose a new inspection methodology. Selection will be based on the potential of the NDE processes to penetrate coatings thicknesses to evaluation coating adhesion, substrate conditions, and coating defects over various conditions of surface roughness. The proposed methods should be validated via modeling and simulation or experimentally by fabricating and testing of simple coupons. For validation purposes, coatings of various thicknesses will be applied to steel plates using a specified standard. The coupons should have at least one surface defect region with a diameter no larger than half the coating thickness, but smaller size defects would be preferable. The NDE methods should be assessed as to the quality and accuracy of the objective measurements. There should be minimal loss of signal responses as a function of coating thickness. The speed at which the requisite information can be obtained (ft2/minute) will also be an evaluation parameter. Offerors must show at least one NDE technology that can reliably characterize the quality of the adhesive interface layer as a function of coating thickness, assess the spatial resolution of the technique, and assess the substrate surface conditions such as corrosion including at site with significant surface roughness.

During the Phase I Option period, if exercised, identify key areas of the proposed solution that need further improvement or development, and depending on the availability of funds, validate the modifications. Evaluate possible methods to autonomously inspect the entire submersed portion of the platform. Plan for Phase II.

PHASE II: The NDE technology(ies) selected in Phase I should be further tested using larger coated coupons of the size necessary to better gauge what the speed (ft2/minute) of detection of decohesive sites, coating defects, and substrate corrosion, if present. Work with a Navy laboratory for collaborations in assisting the offeror in maturing and transitioning the NDE technologies. Further modeling validation will be required and further testing to assert the reliability and sensitivity of the NDE technology will be needed. Other acceptance testing as dictated by the Navy Laboratory should also be done.

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

PHASE III DUAL USE APPLICATIONS: The ability of some NDE methods to penetrate most non-metallic materials allows non-contact examination of materials that are opaque in the visible range such as concrete, insulating foam, and alloy surfaces. The properties of interest across the industries may be broadly categorized into three areas—layer thickness, defects and contamination, and material characterization. Although the key parameters of interest are application-specific, the advantage of some NDE methods over other mature technologies is in providing new information. There may be commercial applications for the technology developed during Phase II, depending on the type of information obtained by employing this NDE technology. The possible use will depend on the degree of attenuation through an alternative medium. Potential uses could be the condition of rebar (degree of corrosion, if any through concrete pillars for a bridge).

REFERENCES:
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KEYWORDS: Non-destructive evaluation; corrosion; decohesion; coatings; welding; sensors

N241-066 TITLE: Laser Magazine

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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 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, battery powered, uncooled, tens of kilowatt (tens of kW), one micron wavelength, high energy laser (HEL) integrated solid state laser (SSL) subsystem utilizing concepts such as a reloadable magazine “clip”, or “replaceable” rechargeable, man serviceable, cooling and battery magazines. These “replacement” magazines offer an opportunity to forgo “near infinite life” requirements and examine the potential benefits of limited life (tens to hundreds of shots) and potentially expendable, quickly replaceable munition type power and cooling sub-assemblies.

DESCRIPTION: For the Navy and Marine Corps, the demand on “infinite duty cycle” cooling by water chillers deteriorates causing limited operational employment. Relieving the design and alignment constraints of separating the systems and examining “rechargeable magazines” for cooling and electrical power in the deployment of such kW-class HEL systems may have benefits on small platforms (ground or airborne, including unmanned weapon platforms) and offers some unique research opportunities. The Navy seeks development of a solid state laser that is compact, battery powered, uncooled and on the order of tens of kilowatts (kW) operating at one micron wavelength, and able to produce continuous wave high energy laser (HEL) energy as an integrated subsystem.

Currently, prototype HEL systems are being deployed in a variety of platforms as laser weapons; prototype systems have been deployed by the Navy platforms as laser weapons to destroy targets and threats. These are each separately developed subsystems (power, cooling, laser) – but the interest is a combined small size, weight, and integrated power with cooling (SWaP-C) for tens of kilowatt class HEL systems limit utility from those combined systems. Use of systems that are “direct diode” or “pixel/vixel” based are of primary interest, possibly using coherent, spectral, or incoherent power beam combination techniques due to their inherent high efficiency, whereas fiber or other gain amplification systems are seen as less efficient and require higher levels of optical integration risk.

For the Navy and Marine Corps, the demand on “infinite duty cycle” cooling by water chillers deteriorates causing limited operational employment. Relieving the design and alignment constraints of separating the systems and examining “rechargeable magazines” for cooling and electrical power in the deployment of such kW-class HEL systems may have benefits on small platforms (ground or airborne, including unmanned weapon platforms) and offers some unique research opportunities.

Using the same concept as a reloadable magazine “clip”, this SBIR topic seeks innovation in “replaceable” rechargeable, man serviceable, cooling and battery magazines. These “replacement” magazines offer an opportunity to forgo “near infinite life” requirements and examine the potential benefits of limited life (tens to hundreds of shots) and potentially expendable, quickly replaceable munition type power and cooling sub-assemblies. The Navy seeks a compact battery powered, uncooled, tens of kilowatt (10’s of kW), one micron wavelength, HEL integrated solid state laser (SSL) subsystem. High cooling capacity and thermal requirements have driven HELs to focus on water chilled systems that are heavy and operate within tight tolerances for temperatures. The potential to dissipate the heat generated by the laser amplifier medium and externally pump, or exhaust, the resulting heat from the sources of heat - to areas or materials that dissipate the heat, have only been explored to a limited extent. Similarly, the potential to "dump" heat (for example, by exhaust or release of superheated water vapor) are seldom contemplated. However, in some circumstances, this may be a preferable and acceptable trade for the purposes of reducing subsystem weight.

The DoD has a great demand for compact and robust unmanned weapon platforms. Therefore, DoD has a resulting great demand for more compact and robust uncooled kilowatt - class laser systems for a variety of short time use cases and applications, if temperature tolerant designs for one micron wavelength lasers can be found. Industry will benefit as class laser system for a variety of short duty cycle power and thermal applications, as well from the reduced well SWaP-C requirements for technology in applications where lasers are used to cut, weld, or ablate and clean substrates with limited surface areas. At present, an air cooled, compact battery power kW class HEL system is not a known commercially available item used with laser subsystems.

KEY PARAMETERS – Laser Magazine
Power Threshold: 10 kW (Objective: 20 kW); ability to focus light at a range of kilometers with minimal atmospheric turbulence (Cn2
HEL wavelength: one (1) Micron (1020-1095 um)
Technology: Solid State Laser (Preference for high efficiency laser semiconductor based diodes or similar pixel LED emitters)
Laser beam output quality (M2): Threshold: 2, (Objective < 1.4, vertical & horizontal, Gaussian or top hat.)
Laser Weight: Threshold: 120 lbs (Objective 20 lbs)
Volume: Threshold: 50 cubic inches (Objective < 20 cubic inches);
Air cooled compact HEL prototyped system with input air 60°C and 90% humidity
Audible Noise: under 60 dB
Operating Temperature: Threshold: 15°C to 30°C, Objective 10°C to 70°C

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

PHASE I: Develop a concept for an innovative laser magazine. Validate the product-market fit between the proposed solution and with the Navy stakeholder define a clear plan for trial and/or test with the proposed solution and the focus area.

The proposed solution should directly address:

1. Identify the components and likely configuration and explore the extents of the benefit area(s) compared to identified objectives, which are to be addressed by the proposed solution(s),
2. Define clear objectives and measurable figures of merit for the proposed solution(s) – specifically how the proposed solution(s) will be developed into a compact subassembly or "laser magazine,"
3. Define any inherent risks to achieving objectives and measurable figures of merit for the proposed solution(s) as well as potential risk mitigation strategies,
4. Describe the cost and feasibility of integration with current mission-specific subsystems,
5. Describe how the component or solution(s) can be used by other government customers, both DoD and non-DoD, and the impacts of "expendable" solutions, and
6. Describe technology related development that is required to successfully field the proposed solution(s) with a preliminary set of incremental - steps or milestones over subsequent phases of the effort.

PHASE II: Develop, integrate, and demonstrate a prototypical laser magazine (unit) in a laboratory environment, as determined to be the most feasible solution during the Phase I period. The demonstration should focus on:
1. Evaluating the proposed solution against the operational system requirements, objectives and measurable results as defined in Phase I
2. Describing in detail how the solution can be scaled to be adopted widely
3. A clear transition path for the proposed solution that takes into account input from stakeholders
4. Specific details on how the proposed solution can be integrated and how it will be supported/sustained
5. Laboratory experimentation, with incremental and final technical reports.

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

PHASE III DUAL USE APPLICATIONS: Make additional improvements in manufacturing and development of a compact size demonstrator at a scale showing laser performance with focus on manufacturing methods to continue to improve component packaging, yield, production time, and individual component contributions to size, performance, and cost. Criterion for the laser performance in Phase III is dependent on the progress made in Phase II. New criterion for Phase III includes the time and cost to produce small quantities (100), and individual first unit components.

Small, miniature laser magazines offer potential in multiple commercial applications including remote sensing, metal fabrication/cutting, and for long range telecommunications or remote powering. There is some potential for some solid-state lasers developed to be used in a next generation laser weapon system, which have less dependency on physical and environmental challenges seen with current systems.

REFERENCES:
1. Rothenberg, J. "Limits of Power Scaling by fiber based optical amplifiers, fiber laser combination" Optical Fiber Communications (OFC), 2009 high power fiber laser workshop, 23 March 2009
2. Denker, B. and Shklovsky, E. (eds.) "Handbook of Solid-State Lasers: Materials, Systems and Applications." Woodhead Publishing, 2013
3. Bowman, S.R.; Jenking; N.W.; O'Connor, S.R.; and Feldman, B.J. "Sensitivity and stability of a radiation-balanced laser system," IEEE Journal of Quantum Electronics, Volume 38, Issue 10, October 2002, pp, 1339 – 1348. DOI: 10.1109 / JQE.2002.802950
4. Bahari, Babak; Vallini, Felipe; El Amili, Abdelkrim and Kante, Boubacar. "Nonreciprocal lasing in topological cavities of arbitrary geometries." SCIENCE Vol. 358, No. 6363, p. 636. DOI: 10.1126
5. Bao, L.; Bai, et al. "Reliability of High Power/Brightness Diode Lasers Emitting from 790 nm to 980 nm." Proc. of SPIE 8605, 860523 (2013).

6. Chow, W.W. and Koch, S.W. “Semiconductor-Laser Fundamentals Physics of the Gain Materials.” Springer, Berlin, 1999.
7. Coldren, L.A. and Corzine, S.W. “Diode Lasers and Photonic Integrated Circuits.” John Wiley & Sons, New York, 1995.

KEYWORDS: Laser, photon, light, battery, cooling

N241-067 TITLE: Common Software Platform for Learning-based Robots

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Trusted AI and Autonomy

OBJECTIVE: Develop an open-source common software platform that is independent of robotics hardware and can be widely used to incorporate artificial intelligence (AI) skills, such as perception and manipulation, for robots that learn to facilitate transfer of research in robotics into application products in a short time.

DESCRIPTION: In recent years, significant advances in AI have been made from image recognition to generation, from large-scale language models to dialogues, and from locomotion to diverse manipulation. A key feature of this advancement has been the rapid transfer of technology—transition time from fundamental research to deployment is unusually short, typically taking only a couple of months. Examples include Jasper AI (for fast content generation), Stability AI (image generation), Photoshop, Hugging Face (natural language understanding), and others. Interestingly, while advances in computer vision (CV) and natural language processing (NLP) have shown this rapid deployment, AI research in robotics has seen little transition to application products and across a very narrow segment of table-top grasping. Most other robotic products, either for defense or consumer, service or industry domain, still exploit and rely on classical control-theoretic and optimization-based approaches and have difficulty with machine learning (ML) and generalization. In learning-based control, assessing safety and performance limits are still challenging. A common software platform will enable expedited research in these issues. The absence of a common software platform has created an increasing gap between robot learning research and deployment. One of the key reasons is the lack of infrastructure and software platforms for reproducibility and fast transfer of robot learning technology. Robotics hardware vary across tasks in their capabilities and do not enjoy independence in hardware variability, unlike CV or NLP. Hence, as a result, it has become a standard practice in robotics companies to proceed full stack from hardware to software. This not only lengthens the development cycle, but also results in most robotics companies needing to develop their own AI infrastructure and expertise, which makes it difficult to keep up with cutting-edge advances in research.

The above issue has created a unique opportunity. ONR is seeking development of a common software platform for the rapid technology transfer of data-driven robotic algorithms. Such a software platform would go beyond current platforms such as the Robot Operating System (ROS) framework, which focuses on resource scheduling and communication but does not focus on AI capabilities, or Mission Oriented Operating Suite Interval Programming (MOOS-IvP) with similar capabilities. The proposed software platform would build a mid-level AI layer with state-of-the-art perception, locomotion, and manipulation skills. The goal is to abstract low-level robotic skills so that the developers do not need robotics expertise and can focus on the creative applications of the robots. Ideally, this platform could be shared by different robotics companies allowing them to focus better on their application vertical with faster iteration cycles while having a way to easily incorporate the latest algorithmic developments in robot learning. Selected references related to certain skills such as manipulation and locomotion are included below.

PHASE I: Design and demonstrate the feasibility of a shared platform for efficient transfer and implementations of data-driven robotic algorithms. Validate the platform's ability to meet key parameters on a custom reference hardware which is to be scaled to multiple platforms in Phase II. The key parameters to be met in Phase I: 90% success rate on simple terrain locomotion, 80% on complex rough terrain locomotion, 85% success rate for point to point navigation for both legged and wheeled robots, 70% grasping rate for at least a selection of 50 everyday objects. Produce detailed design specifications and capabilities descriptions for Phase II prototype development.

PHASE II: Develop and deliver a deployable prototype of the platform, including perception and action capabilities such as locomotion, navigation, and targeted class-conditioned manipulation. Validate the prototype's ability to run on multiple hardware configurations such as Franka robotic arm, UR5 arm, X-arm as well as legged robot with arms and wheeled robot with arms in home and warehouse settings. The key parameters to be met at this stage are: work on multiple hardware including a total of at least 5 different commercial hardware platforms across tasks, more than 98% success rate on simple terrain locomotion, more than 95% success rate on rough terrain locomotion, 95% accuracy of point to point navigation, 75% grasping rate for at least a selection of 100 everyday objects. In parallel, produce a detailed Phase III plan for partnering for commercial as well as DoD applications.

PHASE III DUAL USE APPLICATIONS: Perform additional experiments in a variety of situations and environments. Begin testing with external partners.

This technology could be used in commercial sectors such as medical robotics, warehousing, and delivery, for developing versatile robots capable of performing maintenance, service robots at home or work places, and other tasks.

REFERENCES:

1. https://www.ros.org
2. https://oceanai.mit.edu/moos-ivp/pmwiki/pmwiki.php
3. A. Agarwal, et al. Legged Locomotion in Challenging Terrains using Egocentric Vision. CoRL 2022.
4. Z. Cao, et al. Reconstructing hand-object interactions in the wild. ICCV 2021.
5. T. Chen, et al. Visual dexterity: In-hand dexterous manipulation from depth. ICML Workshop 2023.
6. S. Pandian, et al. Dexterous Imitation Made Easy: A Learning-Based Framework for Efficient Dexterous Manipulation. ICRA 2023.
7. L. Pinto and A. Gupta. Supersizing Self-supervision: Learning to Grasp from 50K Tries and 700 Robot Hours. ICRA 2016.
8. A. Simeonov, et al. Neural descriptor fields: Se (3)-equivariant object representations for manipulation. ICRA 2022.

KEYWORDS: Software platform, robot manipulation, robot perception, robot Artificial Intelligence skills, learning robots

N241-068 TITLE: Fast Micro-Electromechanical Systems (MEMS) Shutters for Stellar Sensing Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Nuclear; Space Technology

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 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 fast (< 0.1s) global optical imager micro shutter (minimum size 0.5 x 0.5 cm2) capable of operating in high radiation, strategic environments over 30-year mission timelines. Control of individual shutter elements or in groups is desirable, but not required.

DESCRIPTION: Star trackers are in use on strategic systems, which must survive and operate in harsh radiation environments. Calibration via a closed shutter allows for the direct characterization of radiation induced detector noise apart from the target star. The development of this technology will help enable more capable star trackers to operate with increased reliably in higher radiation environments than currently capable.

Existing Micro-Electromechanical Systems (MEMS) shutters have been demonstrated to be reliable in a variety of environments, including space-borne missions such as the James Webb Space Telescope (JWST) [Ref 3]. The existing technology has been improved with a shift from magnetic to electrostatic operation [Ref 1]. Additional micro-mechanical geared shutters have been developed by industry for applications from TVs to imagers [Ref 2].

The objective of this SBIR topic is to develop MEMs shutters that can eventually be utilized to provide live calibration functionality to in-flight calibration sensors in hostile environments. Live calibration data provides options for making strategic missions less sensitive to radiation and allowing them to perform in increasingly hostile environments, with increased precision. The lack of advancement will come at a direct cost to the performance of the strategic systems in terms of performance and concepts of operations with regard to stellar sighting.

PHASE I: Develop a design for a fast (< 0.1s) global optical imager micro shutter (minimum size 0.5 x 0.5 cm2) capable of operating in high radiation, strategic environments over 30-year mission timelines. Control of individual shutter elements or in groups is desirable, but not required. Include in the design the plans/methodologies for microfabrication and testing to demonstrate the capabilities desired in 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: Based on the Phase I design and execution plan, fabricate and characterize a small lot (up to Qty: 5 wafers) of global optical image micro-shutters. This characterization may include a dynamic/force assessment [Ref 4] and thermal/radiative sensitivity for sample MEMS devices. The prototypes, test samples, and characterization results should be delivered by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Based on the prototypes developed in Phase II, continuing development leads to productization of the MEMs micro-shutter device. While this technology is aimed at military/strategic applications, micro-shutters are used more broadly in the space-based astronomy industry. The devices incorporating the MEMS micro-shutters may be subject to several common test environments for strategic sensors, including radiation and vibration environments.

REFERENCES:

1. M. -P. Chang et al., "Development of the Next Generation Microshutter Arrays for Space Telescope Applications," 2020 IEEE 15th International Conference on Nano/Micro Engineered and Molecular System (NEMS), San Diego, CA, USA, 2020, pp. 89-92, doi: 10.1109/NEMS50311.2020.9265604
2. J. J. Sniegowski and E. J. Garcia, Surface Micromachined Gear Trains Driven by an On-Chip Electrostatic Microengine, IEEE Electron Device Letters, Vol. 17, No. 7, 366, July 1996.
3. “About Webb Innovations: Microshutters” James Webb Space Telescope NASA. https://webb.nasa.gov/content/about/innovations/microshutters.html
4. Kyowon Kim, et al. “Characterizations of Optimized Microshutter Arrays for Space Borne Observatory Applications.” 2022 35th International Conference on Micro Electro Mechanical Systems, Tokyo, Japan, (9-13 Jan 2022)

KEYWORDS: Micro-Electromechanical Systems; MEMs; Microshutter Arrays; Space Telescopes; Star Trackers

N241-069 TITLE: Deterministic Precision Machining of Miniature Optics in Hard Ceramics

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Nuclear; Space Technology

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 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 the manufacturing capability to fabricate miniature, high-precision, high-numerical aperture optical components in hard ceramic materials.

DESCRIPTION: The Navy requires enhanced capabilities for precision machining of hard ceramic optical mirror surfaces with high numerical aperture (NA). In spite of fabrication challenges, hard ceramics such as silicon carbide are seeing increasing adoption as substrate materials for optical mirrors due to their high thermo-mechanical stability and high stiffness. These products find use in applications such as space-based telescope primary mirrors, for instance. Grinding and polishing are traditional methods of achieving final surface form and are well-suited to a broad range of materials, including hard ceramics. Traditional grinding methods, however, are limited to relatively low-NA optical surfaces. For soft metals, single point diamond turning (SPDT) can produce a wide range of surface forms, including high-NA and aspheric surfaces, while achieving extraordinarily precise surface form tolerances [Ref 1]. SPDT has also recently shown promise as a method for machining certain hard ceramics, although further research may be required to optimize cutting parameters [Ref 2]. Techniques such as ion etching and magnetorheological finishing (MRF) may also be used to produce arbitrarily precise surface forms in a variety of materials [Ref 3], although they are slow and labor-intensive. The Navy has an interest in developing a deterministic and cost-effective fabrication capability for high-NA optical surfaces in hard ceramics (such as silicon carbide, silicon nitride, or similar) with optically precise surface form tolerances. In addition to the machining challenge, high-NA surfaces add challenges to the process of validating the achieved surface form (interferometry and profilometry are common methods) which must also be overcome. The capability will be demonstrated by the production of small (sub-centimeter-scale) convex and concave hemispherical mirror substrate test articles to be delivered at the conclusion of Phase II.

PHASE I: Develop methods for producing hemispherical mirror substrates in hard ceramic materials. Perform a feasibility study for achieving the target surface form and radius of curvature thresholds listed below for two types of mirror substrates: a concave hemispherical mirror (substrate A) and a convex hemispherical mirror (substrate B). Assess the scalability of the proposed approach in terms of per unit labor hours and throughput. Material and threshold mirror surface specifications for test articles to be produced in Phase II include:
• Material: Hard, non-porous ceramic (such as silicon carbide, silicon nitride, or material of similar hardness)
• Radius of curvature (both convex and concave): 3 mm +/- 500 nm
• Nominal outer diameter (OD) of mirror surface: 3mm
• Spherical surface irregularity may not exceed 500 nm
• Surface roughness may not exceed 30 nm RMS • Mirror substrates shall be uncoated
• Localized surface imperfections (scratch and dig): Best effort (Goal is 10-5 per mil spec MIL-PRF-13830)

Methods that provide a path toward deterministic production of aspheric surfaces are of interest, but not strictly required. Methods of metrology for validating the final surface form must also be proposed and assessed for scalability for arbitrary surface forms and numerical aperture. A detailed risk assessment of the proposed fabrication and metrology methods should be provided.

PHASE II: Implement the methods proposed in Phase I for the production of a set of test articles for delivery to the Navy by the conclusion of Phase II. These deliverables consist of five (5) prototypes of substrate A and five (5) prototypes of substrate B with key specifications listed in Phase I above. Parts will be evaluated based on the form of the primary hemispherical surface; other dimensions and surfaces are not critical. Each prototype must be delivered with metrology data indicating the achieved surface form.

PHASE III DUAL USE APPLICATIONS: The machining capabilities demonstrated in Phase II advance the state of the art for optical component fabrication in durable materials. Support the Navy in transitioning the technology to Navy use. The prototypes will be evaluated for compatibility with existing and planned strategic system component designs. The technology will be used in Phase III to develop components according to specific design requirements for strategic sensors. The end product technology is applicable to a range of dual use applications that benefit from the stiffness and thermal stability properties of hard ceramics. These include space-based and airborne optical systems and high power laser applications.

REFERENCES:
1. 1. Higginbottom, D. B.; Campbell, G. T.; Araneda, G.; Fang, F.; Colombe, Y.; Buchler, B. C. and Lam, P. K. “Fabrication of ultrahigh-precision hemispherical mirrors for quantum-optics applications.” Scientific Reports, 2018, 8, 221. https://doi.org/10.1038/s41598-017-18637-8
2. Goel, S. “The current understanding on the diamond machining of silicon carbide.” Journal of Physics D: Applied Physics, IOP Publishing, 2014, 47, 243001. https://dx.doi.org/10.1088/0022-3727/47/24/243001
3. Golini, D.; Kordonski, W. I.; Dumas, P. and Hogan, S. J. “Magnetorheological finishing (MRF) in commercial precision optics manufacturing.” Optical Manufacturing and Testing III, SPIE, 1999, 3782, 80 – 91. https://doi.org/10.1117/12.369174

KEYWORDS: Non-porous Ceramic; Silicon Carbide; Silicon Nitride; High-precision Machining; Precision Optics, High numerical aperture

DEPARTMENT OF THE NAVY (DON)
24.1 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 topic only:**
  - **N241-D01 through N241-D03**

- Submitting small business concerns are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic changes.
  - The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Select the tab for the appropriate BAA cycle.
  - Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

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

- Proposing small business concerns 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 proposing small business concerns are detailed in the section titled ADDITIONAL SUBMISSION CONSIDERATIONS.

- A DP2 Phase I Feasibility proposal template (for Volume 2), unique to DP2 topics, and a Supporting Documents template (Volume 5) are available at https://www.navysbir.com/links_forms.htm.

- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.

- This BAA is issued under regulations set forth in Federal Acquisition Regulation (FAR) 35.016 and awards will be made under "other competitive procedures". The policies and procedures of FAR Subpart 15.3 shall not apply to this BAA, except as specifically referenced in it. All procedures are at the sole discretion of the Government as set forth in this BAA. Submission of a proposal in response to this BAA constitutes the express acknowledgement to that effect by the proposing small business concern.

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information on DON's mission can be found on the DON website at www.navy.mil.

The Department of Defense (DoD), including the Department of the Navy (DON), may issue an SBIR award to a small business concern under Phase II , without regard to whether the small business concern 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 small business concern 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 proposing small business concerns 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.

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	DON SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil or appropriate Program Manager listed in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DSIP Support via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	DON SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil

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

Topic Numbers	Point of Contact	SYSCOM	Email
N241-D01 to N241-D02	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N241-D03	Mr. Jon M. Aspinwall III (Acting)	Strategic Systems Programs (SSP)	ssp.sbir@ssp.navy.mil

Each DON SBIR DP2 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 proposing small business concern 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 proposing small business concern 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 small business concerns to submit a Full DP2 Proposal. Demonstrating proof of feasibility is a requirement for a DP2 award. The small business concern 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 small business concern 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. Proposing small business concerns must read the topic requirements carefully. The Government is not responsible for expenditures by the proposing small business concern prior to award of a contract. For 24.1 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following section details requirements for submitting a compliant DON SBIR DP2 Proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposing small business concerns 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.)

DoD SBIR/STTR Innovation Portal (DSIP). Proposing small business concerns are required to submit proposals via the DoD SBIR/STTR Innovation Portal (DSIP); follow proposal submission instructions in the DoD SBIR/STTR Program BAA on the DSIP at https://www.dodsbirsttr.mil/submissions. Proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through DSIP for the first time will be asked to register. It is recommended that proposing small business concerns 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 electronically in DSIP by the Corporate Official prior to BAA Close will NOT be considered submitted and will not be evaluated by DON. Proposals that are encrypted, password protected, or otherwise locked in any portion of the submission will be REJECTED unless specifically directed within the text of the topic to which you are submitting. Please refer to the DoD SBIR/STTR Program BAA for further information.

Eligibility. Each proposing small business concern 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 the Proposal Fundamentals section 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 small business concern 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 small business concern
- Register in the System for Award Management (SAM) as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA. To register, visit https://sam.gov/

Proposal Volumes. The following six volumes are required.

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

- **Technical Volume (Volume 2).**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
    - 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

  - Additional information:
    - It is highly recommended that proposing small business concerns use the DP2 Phase I Feasibility proposal template at https://navysbir.com/links_forms.htm to meet DP2 Technical Volume (Volume 2) requirements.
    - A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, proposing small business concerns are cautioned that if the text is too small to be legible it will not be evaluated.

- **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, proposing small business concerns DO NOT need to download and complete the separate cost volume template when submitting the DON SBIR Phase I Feasibility Proposal. Proposing small business concerns are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Snapshot of Proposed Phase II Effort portion of 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		Total (NTE)
	Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
N241-D01 and N241-D02	$1,000,000	30 mos.	$300,000	12 mos.	$1,300,000
N241-D03	$900,000	18 mos.	$300,000	6 mos.	$1,200,000

- Additional information:
  - For Phase II a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator. **NOTE:** G&A, if proposed, will only be attributed to the proposing small business concern.
  - 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.
  - Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.
  - The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3.

- **Company Commercialization Report (Volume 4)**. DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award.

All proposing small business concerns must review and submit the following items, as applicable:

- **Telecommunications Equipment Certification.** Required for all proposing small business concerns. 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 proposing small business concerns must include as a part of their submission a written certification in response to the clauses (DFAR clauses 252.204-7016, 252.204-7018, and subpart 204.21). 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 the instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.
- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries.** Each proposing small business concern is required to complete Attachment 2 of this BAA, "Disclosures of Foreign Affiliations or Relationships to Foreign Countries" and upload the form to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
  - Program Description
  - Proposal Fundamentals
  - Phase I Proposal
  - Attachment 2
- **Certification Regarding Disclosure of Funding Sources.** Each proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. The disclosure and certification must be made by completing Attachment 4, Disclosure of Funding Sources, and uploading to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
  - Phase I Proposal
  - Attachment 4
- **Majority Ownership in Part.** Proposing small business concerns 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. Complete certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

- Additional information:
  - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at https://navysbir.com/links_forms.htm to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
    - Additional Cost Information to support the Cost Volume (Volume 3)
    - SBIR/STTR Funding Agreement Certification
    - Data Rights Assertion
    - 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
- Do not include documents or information to substantiate the Technical Volume (Volume 2) (e.g., resumes, test data, technical reports, or publications). Such documents or information will not be considered.
- A font size smaller than 10-point is allowable for documents in Volume 5; however, proposing small business concerns are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

DP2 EVALUATION AND SELECTION

The following section details how the DON SBIR/STTR Programs will evaluate Phase I Feasibility proposals.

Proposals meeting DSIP submission requirements will be forwarded to the DON SBIR/STTR Programs. Prior to evaluation, all proposals will undergo a compliance review to verify compliance with DoD and DON SBIR/STTR proposal eligibility requirements. Proposals not meeting submission requirements will be REJECTED and not evaluated.

- **Proposal Cover Sheet (Volume 1).** The Proposal Cover Sheet (Volume 1) will undergo a compliance review to verify the proposing small business concern has met eligibility requirements and followed the instructions for Proposal Cover Sheet as specified in the DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).** The DON will evaluate and select Phase I Feasibility proposals using the evaluation criteria specified in the Phase I Proposal Evaluation Criteria section of the DoD SBIR/STTR Program BAA, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. The information considered for this decision will come from Volume 2. This is not a FAR Part 15 evaluation and proposals will not be compared to one another. Cost is not an evaluation criteria and will not be considered during the evaluation process; the DON will only do a compliance review of Volume 3. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

  The Technical Volume (Volume 2) will undergo a compliance review (prior to evaluation) to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
  - 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, except as permitted in the instructions above.

- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will undergo a compliance review to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
    - Must not exceed values for the Base and Option (refer to Table 3).
    - Must meet minimum percentage of work; a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs.

- **Company Commercialization Report (Volume 4).** The CCR (Volume 4) will not be evaluated by the Navy nor will it be considered in the Navy's award decision. However, all proposing small business concerns must refer to the DoD SBIR/STTR Program BAA to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Supporting Documents (Volume 5) will not be considered in the selection process and will only undergo a compliance review to ensure the proposing small business concern has included items in accordance with the DP2 SUBMISSION INSTRUCTIONS section above.

- **Fraud, Waste, and Abuse Training Certificate (Volume 6).** Not evaluated.

ADDITIONAL SUBMISSION CONSIDERATIONS

This section details additional items for proposing small business concerns to consider during proposal preparation and submission process.

Due Diligence Program to Assess Security Risks. The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally funded award. Please review the Program Description section of the DoD SBIR/STTR Program BAA for details on how DoD will assess security risks presented by small business concerns. The Due Diligence Program to Assess Security Risks will be implemented for all Phases.

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. Proposing small business concerns may request, in their Cost Volume (Volume 3), 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 $1,800,000 or lower limit specified by the SYSCOM). The amount proposed for TABA cannot include any profit/fee by the proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. 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.

Request for TABA funding will be reviewed 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 (to include the purpose and objective of the assistance)
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any indirect costs, profit, or fee by the SBIR proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern 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 in the proposal as follows:

- Phase II:
  - DON Phase II Cost Volume (provided by the DON SYSCOM) - the value of the TABA request.
  - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as “TABA” in the section titled Additional Cost Information when using the DON Supporting Documents template.

Proposed values for TABA must NOT exceed:

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

If a proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must participate in the virtual Navy STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

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 award, the proposing small business concern 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 (defined by National Security Decision Directive 189). A small business concern whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DON Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DON Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the government Contracting Officer, noted in the contract.

Majority Ownership in Part. Proposing small business concerns 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 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 proposing small business concerns 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, proposing small business concerns must register with the SBA Company Registry Database.
b. The proposing small business concern 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 5).
c. Should a proposing small business concern become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposing small business concern 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 proposing small business concerns register in SAM, https:// 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, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal. A small business concern selected for an award MUST have an active SAM registration at the time of award or they will be considered ineligible.

Notice of NIST SP 800-171 Assessment Database Requirement. The purpose of the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 is to protect Controlled Unclassified Information (CUI) in Nonfederal Systems and Organizations. As prescribed by DFARS 252.204-7019, in order to be considered for award, a small business concern is required to implement NIST SP 800-171 and shall have a current assessment uploaded to the Supplier Performance Risk System (SPRS) which provides storage and retrieval capabilities for this assessment. The platform Procurement Integrated Enterprise Environment (PIEE) will be used for secure login and verification to access SPRS. For brief instructions on NIST SP 800-171 assessment, SPRS, and PIEE please visit https://www.sprs.csd.disa.mil/nistsp.htm. For in-depth tutorials on these items please visit https://www.sprs.csd.disa.mil/webtrain.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: https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

SELECTION, AWARD, AND POST-AWARD INFORMATION

Notifications. Email notifications for proposal receipt (approximately one week after the Phase I BAA Close) and selection are sent based on the information received on the proposal Cover Sheet (Volume 1). Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Debriefs. 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 proposal of the proposing small business concerns 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. Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of the BAA must be served to: osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil. A copy of a pre-award Government Accountability Office (GAO) protest must also be filed with the aforementioned email address within one day of filing with the GAO.

Protests related to a selection or award decision should be filed with the appropriate Contracting Officer for an Agency Level Protest or with the GAO. Contracting Officer contact information for specific DON Topics may be obtained from the DON SYSCOM Program Managers listed in Table 2 above. For protests filed with the GAO, a copy of the protest must be submitted to the appropriate DON SYSCOM Program Manager and the appropriate Contracting Officer within one day of filing with the GAO.

Awards. Due to limited funding, the DON reserves the right to limit the number of awards under any topic. Any notification received from the DON that indicates the proposal has been selected does not ultimately guarantee an award will be made. This notification indicates that the proposal has been selected in accordance with the evaluation criteria and has been sent to the Contracting Officer to conduct cost analysis, confirm eligibility of the proposing small business concern, and to take other relevant steps necessary prior to making an award.

Contract Types. In addition to the negotiated contract award types listed in the section of the DoD SBIR/STTR Program BAA titled Proposal Fundamentals, 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.

Contract Deliverables. Contract deliverables are typically progress reports and final reports. Required contract deliverables must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

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.

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. Consequently, DON will assign SBIR/STTR Data Rights to any noncommercial technical data and noncommercial computer software delivered in Phase III that were developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and 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 Direct to Phase II SBIR 24.1 Topic Index

N241-D01 TITLE: DIRECT TO PHASE II: Ultrahigh-Dynamic Range Photonic-Assisted Direct Digitization Receiver

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; Microelectronics; Sustainment

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 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 photonic-enabled receiver that can directly digitize radio frequencies up to 4 GHz without desensitizing or compressing in the presence of strong interference.

DESCRIPTION: The benefits of direct digitization receivers are well known and include (1) software-defined signal processing over the entire operating frequency range, and (2) lower size, weight, and cost in comparison with superheterodyne receiver chains. Despite these advantages, two key limitations prohibit their use in certain demanding applications: (a) strong interference either desensitizes or compresses the entire spectrum, and (b) radio frequency (RF) sampling analog-to-digital converters (ADCs) consume large amounts of electrical power, which can be difficult to manage in certain harsh environments where antennas are deployed.

Microwave photonic signal processors and analog fiber-optic links are well suited to overcome these fundamental limitations.(3,4) In particular, wideband analog photonic phase modulation enables designers to encode analog signals in the optical domain without any small signal approximations, enabling the use of sensitive coherent receiver photonics to sample in-phase and quadrature components and decode phase information in the digital domain directly [Ref 1]. The benefits of analog signal transport over fiber are also well known, enabling coherent sampling multichannel receivers and power-hungry ADCs to be integrated in more amenable locations with access to power, cooling, and maintenance.

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 32 U.S.C. § 2004.20 *et seq*., National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq*. (1993). https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004

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. It must have developed a concept for a workable

prototype or design to address at a minimum the basic requirements of the stated objective. The below actions would be required in order to successfully satisfy the requirements of Phase I:
Demonstrate the feasibility of a design of a photonic-assisted direct digitization receiver with a 3MHz–4 GHz target, 3MHz-2GHz threshold instantaneous bandwidth (IBW), an effective noise figure (NF) of < 8 dB target, < 13 dB threshold, and an input-referred full-scale power greater than 26 dBm target and 15dBm threshold from 3MHz-2GHz, and 15 dBm target -10 dBm threshold from 2 GHz–4 GHz. The direct digitization receiver should not desensitize or compress with spurious above ADC spurs over the entire input power range. With a noise figure (NF) less than 8 dB and an assumed SNR > 6 dB, the receiver should also be able to receive signals (1 MHz analysis bandwidth) down to < -100 dBm target, < -88 dBm threshold, even in the presence of in-band interference up to the aforementioned levels. The demonstration shall include prototype plans to be developed under Phase II.

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 NOT 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 offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 24.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Create and test a functioning prototype exceeding the threshold performance objectives. Demonstrate a packaged design and real-time digital signal processing.

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

PHASE III DUAL USE APPLICATIONS: Support the DoD in transitioning the proposed receiver to include working with a Program Office to develop a final packaging design that meets platform's Size, Weight, and Power (SWaP) and environmental requirements, and developing systems specifications for the associated analog photonic links. Development of this receiver has widespread commercial applications for commercial radar and 5G/6G receivers.

REFERENCES:

1. Clark, T. R., O'Connor, S. R., & Dennis, M. L. (2010). A phase-modulation I/Q-demodulation microwave-to-digital photonic link. IEEE Transactions on Microwave Theory and Techniques, 58(11), 3039-3058. https://doi.org/10.1109/TMTT.2010.2076971
1. Urick, V. J., Jr., Williams, K. J., & McKinney, J. D. (2015, February 6). Fundamentals of microwave photonics. John Wiley & Sons. https://doi.org/10.1002/9781119029816
2. Devgan, P. S. (2018). Applications of Modern RF Photonics. Artech House. https://www.worldcat.org/title/applications-of-modern-rf-photonics/oclc/1029482016
3. Yegnanarayanan, S., Kharas, D., Plant, J. J., Ricci, M., Ghosh, S., Sorace-Agaskar, C., & Juodawlkis, P. W. (2021, August). Integrated Microwave Photonic Subsystems. In 2021 IEEE Research and Applications of Photonics in Defense Conference (RAPID) (pp. 1-2). IEEE. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9521455

KEYWORDS: Digitization; Electronic Warfare; EW; Receiver; Photonic; Radio Frequency; RF; Fiber

N241-D02 TITLE: DIRECT TO PHASE II: Safeguarding Warfighter Medical Data: Secure Encrypted Transmission of Physiologic Monitoring (PhysMon) Data

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Design and manufacture a more secure method of transmitting physiology endpoint data from wearable aircrew physiologic monitoring (PhysMon) devices.

DESCRIPTION: In 2010, the number of hazard reports from military aircrews related to physiological episodes (PEs) increased compared to previous years and have continued to rise sharply each year since 2012. An attributable cause to the increase in reported PE can be an increased awareness regarding the phenomenon; however, a single root cause has not been identified. PEs, as experienced by flight crews, have consisted of multiple symptoms, including cognitive impairment, numbness, tingling, lightheadedness, behavioral changes, and fatigue. These reports have been connected to several Class A mishaps, leading to a growing awareness across all aircraft activities on the recognition of inflight human symptomology. While reported PEs peaked in FY15–16, in recent years there has been a marked decline; however, they still occur, and between FY18 to FY23 there have been reports of 934 PEs, some resulting in significant medical complications. Most of the reported PEs have been in the F/A-18 community including legacy (F/A-18C) and super hornets (-E, -F, and -G); however, PEs are also reported in the T-46, T-6, and F-35 communities.

Since 2010, the U.S. Navy (USN) and U.S. Air Force (USAF) have been working diligently to determine the cause (or causes) of PEs. While several vulnerabilities have been identified and corrected, reports of PEs still persist (934 between FY18-23) and have shown to be difficult to diagnose with causal factors remaining elusive. Mitigating the risk of PE has proven to be complex and not rooted in one single cause. Additionally, it is critically important to note that this is not a U.S. Navy-exclusive problem. It is a joint issue affecting aviators and aircrew across the Department of Defense (DoD) component services, including the USAF, U.S. Army (USA), and our International partners. The USN stood up two root cause and corrective action (RCCA) teams for both the F/A-18 and the T-45 with the mission to investigate PE for both platforms. Among the 564 recommendations between the two teams, the RCCA recommended that the USN take actions to research aircraft components and physiological monitors for aircrew members; maintain, upgrade, and test aircraft components; as well as train aircrew members on gear fit and potential PE symptoms to reduce PEs.

In recent years, the DoD has invested a significant amount of funding and resources into the investigation of unexplained PEs within the flight environment. As part of this effort, devices to monitor the physiological state of aircrew have been proposed, prototyped, developed, and tested in a variety of environments, including in-flight. These devices range from forehead patches to measure near-infrared spectroscopy (NIRS, functional or cerebral), compression garments with integrated heart rate and respiratory sensors, eye trackers within helmets or simulated cockpits, pulse oximetry (SpO2), instrumented orinasal masks, and electroencephalography to measure neural activity during environmental exposures. Aircrew physiological monitoring during flight operations to identify signs and symptoms associated with PE end states could help better identify causal factors, improve treatments and outcomes, and return aircrew to operational duty sooner. Combined with the fact that PEs still occur, the requirement for aircrew PhysMon remains a top capability gap and a top safety issue across the DoD and component services.

The commercial medical instrument industry is well established in the manufacture of devices designed to monitor various physiological endpoints. The military leverages these commercially available devices as starting points to adapt, optimize, and ruggedize for operation in a dynamic aircraft environment and hostile military environments. The common feature between those commercial medical devices and those specially augmented for the military is their means of connecting to IT devices to transmit their data. Bluetooth is a short-range wireless technology used for exchanging data between fixed and mobile devices over short distances. Medical monitoring devices universally employ this technology standard to transmit physiologic data. Additional benefits include reduced device bulk and no wires. Both are unwelcome snag hazards to worn flight gear and equipment/hardware inside the cabin/cockpit. Snag hazards are not only detrimental to crew resource management (CRM) for normal and combat operations, but can constitute a substantial impediment in the event aircrew are required to ditch from the aircraft. As a result, the PhysMon devices currently evaluated by the USN and USAF for use in operational flight environments also use Bluetooth.

Unfortunately, Bluetooth is not secure and is vulnerable to a variety of hacking and tracking methods. While its short range provides some measure of protection, the technology has continued to improve over time, and in the case of active U.S. military operations and Private Health Information (PHI), this is insufficient. Bluesnarfing (information theft), bluejacking (spam, phishing, malware), bluebugging (backdoor access to spy), bluesmacking (denial of service), and car whispering (eavesdropping on communications) make continued use of Bluetooth in deployed, wearable PhysMon devices an unacceptable risk.

The Navy requires a more secure method for transmitting data from wearable PhysMon devices and replace the universally used Bluetooth. While military versions will likely require additional security measures subject to the area of operations (AO) or area of responsibility (AOR), commercial development of a more secure method of transmission for wearable PhysMon devices would be positively received and relevant. Methods can include, but are not limited to, magnetic secure transmission. Important considerations are Size, Weight, and Power (SWaP) requirements, wireless capability, no interference with worn gear, and battery endurance.

While PhysMon devices are mature technologies and available commercially in various forms, operation in conjunction with aircrew flight/safety gear or within the unique confines of an aircraft cabin (hypobaric pressure, oxygen-enriched, temperature) was not a primary factor in their design. The USN and DoD have been developing a number of devices in response to PE that are optimized for military environments, but like their commercially available counterparts, these military-specific devices use Bluetooth for data transfer. The increased computerization of today’s military and evolving cyber threats necessitate a more secure way for transmitting physiological data.

Advanced, innovative solutions for secure, encrypted transmission of data from wearable PhysMon devices are sought. Design can include, but is not limited to, Magnetic Secure Transmission (MST) technology, commercial encrypted wireless links (CEWL) or miniature encrypted wireless links (MEWL) and/or Ultra Wide Band (UWB) Radio Frequency Identification (RFID) and Wireless Intercom System (WICS).

The candidate technology will demonstrate the ability to securely transmit medical endpoint data from an existing wearable PhysMon device. The technology developed will eventually be required to be adapted to a flight environment on military aircraft with special emphasis on naval environments featuring moisture and salt. Highly desirable criteria include minimal size profile, low power requirements, long battery life, minimum weight and bulk, wireless, and no interference with flight/safety gear. In order to have a common reviewing process for all potential applicants, it is requested that all submitting performers, at a minimum, employ heartrate as the physiologic endpoint of the wearable monitoring device. 1. Threshold: The method of recording heartrate should be—at a minimum—similar to fitness trackers, Photoplethysmography (PPG). 2. Objective: Full wave 60Hz electrocardiogram (ECG).

Other important considerations include: 1. The device should provide secure transmission to both storage and real-time display of monitored physiologic endpoint data. 2. There are many existing commercial and military-optimized wearable PhysMon devices currently available. The ability to convert these existing devices for secure transmission of data is a desirable objective. 3. For existing wearable monitors, designs may not allow easy access into device housing for reasonable modification of machinery. An attachable dongle to these existing devices overriding the stock Bluetooth in favor of the secure method is a desirable objective. 4. This technology should be able to transmit data across a distance of at least 240 m (This is the range of Bluetooth 5.0. Bluetooth 4.0 is 60 m).

Note: NAVAIR will provide Phase I performers with the appropriate guidance required for human research protocols so 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: 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. It must have developed a concept for a workable prototype or design to address at a minimum the basic requirements of the stated objective. The below actions would be required in order to successfully satisfy the requirements of Phase I: the candidate technology will demonstrate the ability to securely transmit medical endpoint data from an existing wearable PhysMon device. The technology developed will eventually be required to be adapted to a flight environment on military aircraft with special emphasis on naval environments featuring moisture and salt. Highly desirable criteria include minimal size profile, low power requirements, long battery life, minimum weight and bulk, wireless, and not interfere with flight/safety gear. In order to have a common reviewing process for all potential applicants, it is requested that all submitting performers—at a minimum—employ heartrate as the physiologic endpoint of the wearable monitoring device.
1. Threshold: The method of recording heartrate should be—at a minimum—similar to fitness trackers, Photoplethysmography (PPG).
2. Objective: Full wave 60Hz electrocardiogram (ECG).

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 NOT 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 offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 24.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE II: Develop a working prototype that securely transmits medical endpoint data from an existing wearable PhysMon device and is suitable for use in the flight environment and during operations. Ensure that the prototype meets the requirements listed below. Begin to validate the use of the prototype with human participants. Through this testing and evaluation process make iterative refinements to the prototype. Required Phase II deliverables will include a working prototype, and a report about the overall project progress.

It is important to note that the goal of this SBIR topic is to develop a more secure method to transmit physiologic monitoring data from wearables rather than developing a new wearable device for monitoring. As such, this SBIR topic is open to applications proposing a new secure wearable monitor or modification of existing wearable monitor incorporating secure transmission methods of physiologic endpoint data. Additional endpoints such as respiration rate, pulse oximetry, and so forth are welcome. However, all performers must propose a device that measures heartrate.

Other important considerations include:

1. The device should provide secure transmission to both storage and real-time display of monitored physiologic endpoint data.
2. There are many existing commercial and military-optimized wearable PhysMon devices currently available. The ability to convert existing devices for secure transmission of data (desirable objective).
3. For existing wearable monitors, designs may not allow easy access into device housing for reasonable modification of machinery. An attachable dongle to these existing devices overriding the stock Bluetooth in favor of the secure method (desirable objective).
4. This technology should be able to transmit data across a distance of at least 240 m (the range of Bluetooth 5.0. Bluetooth 4.0 is 60 m).

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE III DUAL USE APPLICATIONS: Using the results and progress made during Phase II, complete any remaining work necessary to have the proposed solution meet the performance parameters described in this topic., Demonstrate its performance in a military-relevant environment and ensure production readiness.

Ensure that the final design solution is easily adaptable for occupations requiring physiologic monitoring during operations, including long-haul trucking. Availability to the private sector shall also be considered as the wearable medical device and fitness-tracker industries continue to grow and more of the public purchases for personal use.

The global wearable medical device and fitness-tracker market size is valued at $26.8 billion in 2022. Companies including Apple, Samsung, Google, Fitbit, Oura, and Amazon continue to develop smaller, wearable devices that incorporate physiologic monitoring. Additionally, these devices also include GPS tracking, as well as integration and linking of cell phone/cloud account (AppleID, Google account, etc.) features such as ApplePay.

Commercial applications for such technology would be healthcare providers employing wearable PhysMon devices for their patients, long-haul trucking or commercial airline industry for monitoring alert-status of drivers and pilots, and, finally, private citizens using wearables for recreational use such as fitness trackers.

Secure wireless interlinking of commercial wearables, particularly those with the capability of contactless payment, would be highly received by the public.

REFERENCES:

1. Commander U.S. Pacific Fleet. (2017, June 12). Comprehensive review of the T-45 and F/A-18 physiological episodes. Department of Defense. https://news.usni.org/2017/06/15/document-the-navys-physiological-episodes-comprehensive-review
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3. Shaw, D. M., & Harrell, J. W. (2023). Integrating physiological monitoring systems in military aviation: a brief narrative review of its importance, opportunities, and risks. Ergonomics. https://pubmed.ncbi.nlm.nih.gov/36946542/
4. Hernández-Álvarez, L., Bullón Pérez, J. J., Batista, F. K., & Queiruga-Dios, A. (2022). Security threats and cryptographic protocols for medical wearables. Mathematics, 10(6), 886. https://doi.org/10.3390/math10060886

KEYWORDS: Physiologic monitoring; PhysMon; Encryption; Bluetooth; Aircrew; Electrocardiogram; Photoplethysmography

N241-D03 TITLE: DIRECT TO PHASE II: Extended Lifetime Near-Infrared Lasers for Quantum Sensing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear;Quantum Science; Space Technology

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 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: Enhance the reliability and operational lifetime of near-infrared (NIR) lasers to support the development of quantum sensors and atomic clocks.

DESCRIPTION: Atom-based instruments such as microwave and optical atomic clocks, atom interferometers, and atomic magnetometers, may be used to address a variety positioning, navigation and timing (PNT) challenges by providing ultra-precise timing, inertial sensing, and other auxiliary field measurements [Ref 1, 2]. Alkali atoms, particularly rubidium and cesium, are advantageous for low-size, -weight and power (SWaP) quantum sensors and clocks due to their high atomic vapor pressure, convenient microwave frequency ground state energy splittings, and strong optical transitions for state preparation and readout [Ref 1]. Unfortunately, the optical spectral lines of greatest interest for these atoms (particularly the D2 lines at 780 nm and 852.5 nm) fall at wavelengths near the low end of the NIR, so devices requiring these laser wavelengths do not benefit from the technical maturity and reliability of lasers developed for telecommunications (telecom) applications. The need for low-SWaP lasers operating at these alkali transition frequencies is currently well-served by distributed Bragg reflector (DBR) and distributed feedback (DFB) devices based on a Gallium arsenide (GaAs)/Aluminum gallium arsenide (AlGaAs) platform. Lasers of this type are currently limited to operational lifetimes in the range of 10,000 hours. Many applications for quantum sensors would benefit from extended operational lifetimes, enabling extended deployments on the order of 10 years or more without requiring costly servicing operations or replacement of components.

The Navy has a need for narrow linewidth, tunable NIR laser diodes in the range of 770-852.5 nm with extended operational lifetime. The increased aluminum content of the underlying epilayer material of diodes operating natively at these short wavelengths may lead to defects which reduce laser efficiency and reliability, ultimately shortening laser lifetime. Possible approaches to improving the performance of GaAs/AlGaAs devices include designs that reduce the aluminum content in active gain regions [Ref 3]. Alternative approaches to improving laser reliability include frequency-doubling a more mature, long-lifetime diode operating at a telecom wavelength [Ref 4], but this architecture requires development and miniaturization to remain SWaP-competitive with native frequency diodes.

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 and 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:

- Innovative approaches to the design of miniature packaged diode based lasers
- Operational lifetime exceeding 100,000 hours.
- Candidate laser technologies must be capable of single frequency operation (linewidth under 1 MHz),

• Must have the ability to be frequency-tuned to cover at least one atomic transition in the range of 770-852.5 nm (such as the Rb D2 line at 780.2 nm),
• Must produce high output power (> 100 mW) in a single transverse spatial mode.
SWaP efficiency of proposed approaches should be similar to that of existing commercial DFB/DBR devices.

PHASE II: Design, fabricate, package, and characterize a production run of high-reliability diode-based lasers meeting the linewidth, power, and tunability performance goals stated above. Lasers should be designed for nominally room temperature operation (20-30 °C). Any innovations relating to laser design and manufacture, from epitaxy through packaging may be considered in order to meet a threshold mean time to failure (MTTF) of 100,000 hours at nominal operating temperature (with a goal MTTF of 200,000 hours). An accelerated aging study shall be performed to assess the predicted lifetime of prototype devices, and a report summarizing results and methodology should be provided. A suitable laser package shall be identified for prototype laser delivery. By the end of Phase II, five (5) packaged lasers shall be delivered for testing. Each delivered device should pass initial burn-in tests, and should be characterized in terms of power and efficiency (light-current-voltage curve). Each delivered device must also be characterized in terms of its ability to be tuned over one alkali spectral line in the range 770 nm to 852.5 nm. The prototypes should be delivered by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: The laser designs and fabrication processes developed in Phase II will enhance the reliability of quantum sensing and timekeeping systems. Support the Navy in transitioning the technology to Navy use. The prototypes will be evaluated through optical characterization and testing with relevant quantum sensing or timing systems. The end product technology could be leveraged to support both military/strategic applications as well as commercial applications. Military applications include optical atomic clocks and GPS denied navigation aids for long-duration missions such as quantum gravimeters and magnetometers. Additional commercial applications for these systems include resource exploration, geosensing, mapping, timing, time transfer for telecommunications, and deep space navigation.

REFERENCES:
1. Kitching, John. “Chip-scale atomic devices.” Applied Physics Reviews, 2018, 5, 031302. https://doi.org/10.1063/1.5026238
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3. Gaetano, E. D.; Watson, S.; McBrearty, E.; Sorel, M. and Paul, D. J. “Sub-megahertz linewidth 780.24??nm distributed feedback laser for 87Rb applications.” Opt. Lett., Optica Publishing Group, 2020, 45, 3529-3532. https://doi.org/10.1364/OL.394185
4. Caldani, R.; Merlet, S.; Pereira Dos Santos, F.; Stern, G.; Martin, A.-S.; Desruelle, B. and Ménoret, V. “A prototype industrial laser system for cold atom inertial sensing in space.” The European Physical Journal D, 2019, 73, 248. https://doi.org/10.1140/epjd/e2019-100360-2

KEYWORDS: Laser reliability; Laser lifetime; Near-infrared laser; Quantum sensing; Atomic clock; Atom interferometry

DEPARTMENT OF THE AIR FORCE
24.1 SMALL BUSINESS INNOVATION RESEARCH (SBIR) PHASE I
PROPOSAL SUBMISSION INSTRUCTIONS

The Air Force intends these Phase I proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Offerors must ensure proposals meet all requirements of the SBIR 24.1 BAA posted on the Defense SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

Applicants are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Complete proposals **must** be prepared and submitted via https://www.dodsbirsttr.mil/submissions/ (DSIP) on or before the date published in the DoD SBIR 24.1 BAA. Applicants are responsible for ensuring proposals comply with the requirements in the most current version of this instruction at the proposal submission deadline date/time.

The DAF 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 DAF 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 DAF 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 One Help Desk.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF 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 DAF. **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 SBIR/STTR One Help Desk.** The message shall include the subject line, "24.1 Address Change".

Points of Contact:

- General information related to the AF SBIR/STTR program and proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us.
- Questions regarding the DSIP electronic submission system, 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 the DoD SBIR 24.1 BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
    - Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

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.

PHASE I PROPOSAL SUBMISSION

The DoD SBIR 24.1 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.

The complete proposal 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.**

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit www.sam.gov. A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its representations and certifications are up-to-date to avoid delay in award.

On April 4, 2022, the DUNS Number was replaced by the Unique Entity ID (SAM). The Federal Government will use the UEI (SAM) to identify organizations doing business with the Government. The DUNS number will no longer be a valid identifier. If the proposing small business concerns has an entity registration in SAM.gov (even if the registration has expired), a UEI (SAM) has already been assigned. This can be found by signing into SAM.gov and selecting the Entity Management widget in the Workspace or by signing in and searching entity information. For proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the Small business concern profile with the UEI (SAM) as soon as possible.

For new proposing small business concern registrations, follow instructions during SAM registration on how to obtain a Commercial and Government Entry (CAGE) code and be assigned the UEI (SAM). Once a CAGE code and UEI (SAM) are obtained, update the Small business concern's profile on the DSIP at https://www.dodsbirsttr.mil/submissions/.

PHASE I PROPOSAL FORMAT

Complete proposals must include all of the following:
Volume 1: DoD Proposal Cover Sheet
Note: If selected for funding, the proposal's technical abstract and discussion of anticipated benefits will be publicly released. Therefore, do not include proprietary information in this section.
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents
Volume 6: Fraud, Waste, and Abuse Training

DoD PROPOSAL COVER SHEET (VOLUME 1)

Complete the proposal Cover Sheet in accordance with the instructions provided via DSIP. 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 keywords/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.

TECHNICAL VOLUME (VOLUME 2):

The Technical Volume should include all graphics and attachments but should not include the Cover Sheet, which is completed separately as Volume 1. The Phase I technical volume (uploaded in Volume 2) shall contain the required elements found below. Ensure that all graphics are distinguishable in black and white.

The Phase I Technical Volume page/slide limits identified for the topics do not include the Cover Sheet, Cost Volume, Cost Volume Itemized Listing (a-h). 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 reviewed. The documents required for upload into Volume 5, “Other”, do not count toward the specified limits.

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 included
- 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. Additional information may be requested during negotiations in order to verify the foreign citizen’s eligibility to participate on a contract issued as a result of this announcement. **Note:** Do not upload information such as Permanent Resident Cards (Green Cards), birth certificates, Social Security Numbers, or other PII to the DSIP system.

Phase I Work Plan Outline

NOTE: The DAF 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, if selected, and may delay contract award.

Include a work plan outline in the following format:
Scope: List the effort’s major requirements and specifications.
Task Outline: Provide a brief outline of the work to be accomplished during the Phase I effort.
Milestone Schedule
Deliverables
Progress reports
Final report with SF 298

COST VOLUME (VOLUME 3)

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.-g. below) regarding funds use. The DSIP Cost Volume and Itemized Cost Volume Information will not count against the specified page limit. The itemized listing also may be submitted in Volume 5 under the “Other” dropdown option.

a. **Direct Cost Materials**: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, prices and where appropriate, purpose. Material costs may include the costs of such items as raw materials, parts, subassemblies, components, and manufacturing supplies.

b. **Other Direct Costs**: This category includes, but is 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 v. purchase justification.

c. **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 for the CO to determine whether these hours, fringe rates, and hourly rates are fair and reasonable.

d. **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.

e. **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 (do not include profit in the calculation), unless otherwise approved in writing by the CO. 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.

f. **Special Tooling, Special 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 special test equipment purchases must, in the CO's opinion, be advantageous to the Government and relate directly to the effort. These toolings or equipment should not be of a type that an offeror would otherwise possess in the normal course of business. These may include items such as innovative instrumentation and/or automatic test equipment.

g. **Consultants**: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

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 CO identified on the cover page. The Government reserves the right to reopen negotiations later if the CO determines doing so to be necessary.

COMPANY COMMERCIALIZATION REPORT (VOLUME 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR 24.1 BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

SUPPORTING DOCUMENTS VOLUME (VOLUME 5)

The following documents are required for all proposal submissions:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1 to the DOD SBIR 24.1 BAA)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2 to the DOD SBIR 24.1 BAA)
3. Disclosure of Funding Sources (Attachment 4 to the DOD SBIR 24.1 BAA)

The following documents may be required if applicable to your proposal:

1. DD Form 2345: For proposals submitted under export-controlled topics, either International Traffic in Arms or Export Administration Regulations (ITAR/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/DD2345Ins tructions.aspx. DD Form 2345 approval will be required if proposal if selected for award.
2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 24.1 BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)

Note that the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The Air Force does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals submitted in response to DAF topics shall not include TABA.

AIR FORCE PROPOSAL EVALUATIONS

Proposals will be evaluated for overall merit in accordance with the criteria discussed in the 24.1 BAA. DAF is seeking varying technical/scientific approaches and/or varying and new technologies that would be responsive to the problem statement(s) and area(s) of interest in the topic. Multiple procurements are planned and anticipated to be awarded as a result of the topic, each proposal is considered a separate procurement and will be evaluated on its own merit, and that the Government may award all, some, or none of the proposals. Any per-award or per-topic funding caps are budgetary estimates only, and more or less funding may become available. Funding decisions are made with complete disregard to the other awards under the same topic.

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may decide not to select the proposal for award based upon a totality of the review.

DAF USE OF SUPPORT CONTRACTORS

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, Montech, 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. Contact the AF SBIR/STTR CO Daniel J. Brewer (Daniel.Brewer.13@us.af.mil) with concerns.

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.

Automated feedback will be provided for Phase I proposals designated Not Selected. Additional feedback may be provided at the sole discretion of the DAF.

IMPORTANT: Proposals submitted to the DAF are received and evaluated by different organizations, handled 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.

The Air Force anticipates that all proposals will be evaluated and selections finalized within approximately 90 calendar days of solicitation close. Please refrain from contacting the BAA CO for proposal status before that time.

Refer to the DoD SBIR Program BAA 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: Air Force SBIR/STTR Contracting Officer Daniel J. Brewer, Daniel.Brewer.13@us.af.mil.

AIR FORCE SUBMISSION OF FINAL REPORTS

All Final Reports will be submitted to the awarding DAF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

PHASE II PROPOSAL SUBMISSIONS

DAF organizations may request Phase II proposals while technical performance is ongoing. This decision will be based on the contractor’s technical progress, as determined by an DAF Technical Point of Contact review using the Phase II review criteria outlined above.

Phase II is the demonstration of the technology found feasible in Phase I. Only Phase I awardees are eligible to submit a Phase II proposal. All Phase I awardees will be sent a notification with the Phase II proposal submittal date and detailed Phase II proposal preparation instructions. If the physical or email addresses or firm points of contact have changed since submission of the Phase I proposal, correct information shall be sent to the DAF SBIR/STTR One Help Desk. Phase II dollar values, performance periods, and proposal content will be specified in the Phase II request for proposal.

NOTE: The DAF primarily makes SBIR Phase I and II awards as Firm-Fixed-Price contracts. However, 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, including award of Cost-Reimbursement types of contracts. Please address questions to the Phase II CO, if selected for award.

All proposals must be submitted electronically via DSIP by the date indicated in the Phase II proposal instructions. Note: Only ONE Phase II proposal may be submitted for each Phase I award.

AIR FORCE SBIR/STTR PROGRAM MANAGEMENT IMPROVEMENTS

The DAF reserves the right to modify the Phase II submission requirements. Should the requirements change, all Phase I awardees will be notified. The DAF also reserves the right to change any administrative procedures that will improve management of the DAF SBIR/STTR Program at any time.

Air Force SBIR 24.1 Phase I Topic Index

Topic Number	Topic Name	Maximum Value*	Maximum Duration**	Technical Volume Page Limit***
AF241-0001	Wargaming and AI for All	$180,000	6	20
AF241-0002	Real-time magnetic field generator for hardware-in-the-loop testing	$180,000	6	20
AF241-0003	Operational Arctic Aerospace Warning & Control to Enhance Information Dominance & Domain Awareness for Rapid Decision Making	$180,000	6	20
AF241-0004	Context-Aware RF Electromagnetic Surveying for Exploiting Signals of Opportunity	$180,000	6	20
AF241-0005	SUU-67/A Pylon Modification for Advanced Weapons	$180,000	6	20
AF241-0006	Mobile Target Tracking	$180,000	6	20
AF241-0007	Advanced Battery Development and Integration for Airborne Platforms	$180,000	6	20
AF241-0008	Additive Manufacturing & Repair of 7075 Aluminum for Weapon Systems	$180,000	6	20
AF241-0009	Spectroradiometric Suite	$180,000	6	20
AF241-0010	Improved Digital Engineering Techniques for Test Data Leveraging	$180,000	6	20
AF241-0011	Enhanced Timing-Programming System	$180,000	6	20
AF241-0012	High Temperature Mach number or Static Pressure Probes for Vitiated Flows	$180,000	6	20
SF241-0013	Planar Hyperspectral Imager	$180,000	6	20
SF241-0014	MUOS SATCOM Simulator Connectivity Over IP	$180,000	6	20
SF241-0015	Securely Operating Through 5G for Enterprise Space Data Transport Applications	$180,000	6	20
SF241-0016	Numerical Simulation of VLF Antennas in Space Plasma	$180,000	6	20
SF241-0017	Satellite Cyber Immune Response to Evolving Threats	$180,000	6	20
SF241-0018	Mitigating Negative Effects of Polysulfide Dissolution in 18650 Lithium Sulfur Battery	$180,000	6	20
SF241-0019	Resonator Laser Gyro	$180,000	6	20
SF241-0020	Trusted Automated Satellite Operations for Mission Life	$180,000	6	20
SF241-0021	Optical Interconnects for High-Speed High-Efficiency Intra-satellite Data Transfer in the Space Environment	$180,000	6	20

SF241-0022	Ultra-Broadband High-Definition High-Frame Rate NIR-MWIR Imager	$180,000	6	20
SF241-0023	Low Latency Space Object Maneuver Detection	$180,000	6	20
SF241-0024	Evaluating Data Strategies in Training AI Solutions for Space C2	$180,000	6	20
SF241-0025	Modernizing USSF BMT	$180,000	6	20

***Proposals that exceed this amount will be disqualified**
**** Proposals that exceed this duration will be disqualified**
*****Pages in excess of this count will not be considered during evaluations**

AF241-0001 TITLE: Wargaming and AI for All

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software

OBJECTIVE: Implement a game server capable of engaging significant portions of allied warfighters in operationally relevant, enjoyable, and analyzable joint operation wargames. This "wargaming cloud" will harness the American democratic and competitive ethos to both train our service members in the operational warfighting "family business" and crowdsource the development of potentially disruptive operational strategies. The dataset created through this effort will enable both traditional data analysis methods and more modern approaches based on machine learning and artificial intelligence. SBIR phases will seek a warfighting game that balances playability, DoD relevance, and data extraction capability.

DESCRIPTION: Our proposal aims to build an initial repository of operational wargames designed to educate every allied warfighter on the intricacies of the operational level of war while enabling statistical analysis and AI-informed decision-making through significant quantities of game iterations. Leveraging public and popular games, the SBIR awardees will produce a large dataset from their existing online servers from which military planners could derive decision analyses at the appropriate operational level. Further, if not already developed, SBIR funds should develop a Markov Decision Process dataset for reinforcement learning applications.

Additionally, SBIR awardees will provide plug-in capabilities to their games which allow for the DAF to adjust and create novel scenarios and assets. These plug-ins will provide extensibility and adaptability for future in-depth data-driven strategy analysis.

Further, utilizing these gaming platforms, our approach will allow every airman and guardian to test their operational instincts against the best tacticians worldwide, fostering a sense of pride, competition, and ownership while teaching the family business of warfare.

The datasets that are created via these games will populate a gameplay database, which can be used to analyze trends from worldwide player data, develop alternative strategies from that data, and train AI agents.

These trained AI models will enhance the high-level traditional wargaming process in three primary ways. First, it will add fidelity to adjudication by actually simulating tactical level encounters based on moves, rather than the current process of having 'white cell' declare an outcome based on a spreadsheet, dice-roll, or rule of thumb.

Second, it will greatly accelerate logistics and laydown planning, which provides re-playability. One initial early finding from the adoption of Command:PE was that human planners only started taking risk and exercising creativity after the 'conventional' plan had tried and failed multiple times, but when they did they were able to actually start winning scenarios that were assumed losses. Replayability gets human players into a place where they can produce these valuable outcomes - if the work-hours required to run a traditional wargame only allow for one rep, bold concepts and disruptive approaches may not get a hearing.

Last, AI agents can provide the ability to 'MoneyBall' diverse approaches to wargaming and planning. 'Anti-fragile' strategies that incorporate both chaos and order is a strong suit for a free society, especially against an authoritarian regime. Since logistics planning is a necessity, this form of modeling would allow for enough branches to make space for mission command at echelon, which will in turn impose costs on an adversary well prior to conflict.

In order to pursue these objectives, three goals must be met by the AI modeling effort:
-1) Tactical modeling. The ability for AI agents to model tactical encounters in a relevant wargaming system, which will provide a rigorous tool for adjudicating operational-level wargaming moves.
-2) Logistical modeling. Given a combat desired force in a scenario, AI agents can model one or ideally several scenarios for basing and logistical support.
-3) Operational modeling. (stretch goal) Given an operational design, complete laydown, tactical encounters, and operational level branching in order to provide a 'strawman' initial analysis of a concept of operations.

This proposal supports the requirement for DAF warfighters to be educated about real operational threats. Further, this will provide the ability for warfighters to better assess strategies, tactics, and procedures against thinking and adaptive opponents. In so doing, this SBIR will help prepare DAF members to be ready to deploy and fight (OI 7) while ensuring an operational understanding of JADC2 (OI 2) and enabling the analysis of alternatives for resilient forward-basing options (OI 5).

Engaged Stakeholders: AFWERX Spark, AFIMSC, Morpheus, Air Force Gaming, Lincoln Labs, DAF, MIT AIA

PHASE I: The objective of Phase I is that projects will demonstrate their game's playability, DoD relevance, and data extraction capability. The team is seeking games that can balance abstraction and realism, sufficiently mimicking the operational level of war for warfighter education and human evaluation while maintaining high levels of engagement and playability. Additionally, games will demonstrate their ability to export gameplay data that fully and efficiently captures in-game experience for a broad gamut of post processing. In this feasibility study, companies will demonstrate their capability of data extraction.

PHASE II: Phase II will focus on game flexibility, scaleability, and capability demonstration with real gameplay. In addition to Phase I goals (playability, relevance, and extraction capability), performers will demonstrate the commercialization potential of their game (more data to capture for AI agent training), their ability to host their game on government servers and provide a continuous stream of data during the PoP from all hosted games. Additionally, performers shall give the USG the ability to extend scenarios with user-defined assets, inject AI agents as players, and permit faster-than-real-time command-line gameplay suitable for agent training.

PHASE III DUAL USE APPLICATIONS: The future of gaming will require extensible, AI-ready games capable of employing cooperative and competitive agents as NPCs. The ability to inform the development of these agents using real gameplay data from experienced users could be invaluable. These capabilities for small game companies improve the reach, enjoyability, and accessibility of their games to the worldwide market. In ensuring their games are AI-ready, games will improve their marketability for future research and development to unique markets.

REFERENCES:
1. Vinyals, Oriol, et al. "Grandmaster level in StarCraft II using multi-agent reinforcement learning."Nature 575.7782 (2019): 350-354.;
2. Meta Fundamental AI Research Diplomacy Team (FAIR)†, et al. "Human-level play in the game of Diplomacy by combining language models with strategic reasoning." Science 378.6624 (2022): 1067-1074.;
3. Siu, Ho Chit, et al. "Evaluation of human-AI teams for learned and rule-based agents in Hanabi. "Advances in Neural Information Processing Systems 34 (2021): 16183-16195.;

4. Lyons, Joseph, et al. "Measuring Perceived Agent Appropriateness in a Live-Flight HumanAutonomy Teaming Scenario." Ergonomics in design (2022): 10648046221129393.;
5. Silver, David, et al. "Mastering the game of Go with deep neural networks and tree search." nature 529.7587 (2016): 484-489.;

KEYWORDS: Wargaming, Data Analysis, Artificial Intelligence, Imitation Learning, Reinforcement Learning

AF241-0002 TITLE: Real-time magnetic field generator for hardware-in-the-loop testing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics

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 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 project is to develop and prototype a magnetic field scenario generation system that can be used to drive software- and hardware-in-the-loop test configurations for magnetic field based alternate navigation systems. The system required will interface with existing magnetic field emulation hardware to provide calibrated phenomenology representative of the vector field induced by the Earth's crust and other dynamic environmental sources as sensed by aerospace platforms performing a wide range of Air Force missions.

DESCRIPTION: An active area of research in AFRL is the use of the Earth's magnetic field variations as a means for navigation. This technique is thought to be used in nature by animals during long migrations and has been explored by AFRL, MIT, and others as a possible alternative to conventional GPS-based guidance. Given the interest in this area, AFRL has also been exploring development of laboratory simulation capabilities for the purpose of testing navigation systems as an integral part of the guidance and control of aircraft, weapons, and other aerospace assets. This type of navigation research and development is enabled by digital simulations and real-time Software-In-the-Loop (SIL) and Hardware-In-the-Loop (HIL) simulation environments. Recently, the Kinetic-kill Hardware-In-the-Loop Simulation (KHILS) facility at Eglin AFB developed a 3-D vector field simulator, the Magnetic field Navigation Integration Testbed (MagNIT) to demonstrate HIL capability for future Guidance, Navigation & Control (GNC) technologies. While much progress has been made, challenges remain in development of the simulator control system, i.e., User Interface for simulator configuration and calibration, Real-Time Simulation Engine for accurate real-time field generation, Run-time Interface development, environment and self-induced Field Contamination Modeling, and Data Logging. Essential to this capability will be review and implementation of magnetic field models to form the basis of simulations. Numerous magnetic field models exist, e.g., the World Magnetic Model, the Enhanced Magnetic Model, International Geomagnetic Reference Field, etc. One challenge for testing will be to establish maturity and robustness of navigation algorithms that are trained on databases that are known to be continuously changing over time. Another challenge is calibration to deal with the laboratory environment and establishing what facility controls and modifications are necessary to provide an accurate test environment. Another is emulation of fields induced by the sensing platform as it dynamically performs a mission, rapidly changing attitude and altitude using electrically driven control systems and actuators. These processes, along with the more fundamental User and Facility interface functionality, must be instantiated and demonstrated under this activity. Validation test cases are required to demonstrate accuracy of the simulator and viability of the simulation process. The described capability must be adaptable to operate in a digital signal injection mode, an analog signal injection mode, and as a driver for the existing KHILS MagNIT HIL simulator. Innovative solutions, based on demonstrated experience in GN&C, HIL Testing, E-M Phenomenology, Calibration processes, and Software Development, are desired to develop and demonstrate effective and efficient processes for validated magnetic field simulation.

PHASE I:

1. Establish simulator functional requirements and modes of operation.
2. Document facility interface requirements and characterize the test facility environment.
3. Research available databases to use to present sufficiently accurate and relevant crust magnetic field data at altitudes of interest.
4. Establish Use Cases and range of vehicle dynamics.
5. Research validation data sets for assessing simulator calibration accuracy.
6. Document range of potential airframe induced interference magnitudes and dynamics and potential modeling strategies to represent dynamic fields resulting from servos, motors, etc.
7. Develop and build a prototype system to demonstrate baseline functional capability at TRL 4.
8. Demonstrate software externally driven with an appropriate flight profile and using playback of canned flight profiles interfaced to the MagNIT, or an appropriate emulation, with data logging.
9. Build a plan to improve performance, fidelity, and integration into simulation frameworks in order to interface with sensors and the AFRL owned MagNIT.

PHASE II:

1. Build improved prototype of the magnetic field generation controller with User Interface and full operational functionality (TRL 7).
2. Demonstrate all calibration functions in connection to the MagNIT to validate facility constraints and/or modifications and upgrades required to meet future test requirements.
3. Demonstrate real-time operation using 6DOF state data from a HIL simulator through an appropriate interface. 1) Demonstrate magnetic field vector sensor emulation for injection into a processing system, as in a software-in-the-loop simulation. 2) Demonstrate driving the AFRL owned magnetic field generation system (MagNIT).
4. Execute validation test cases and document results with all developed procedures and solutions. Establish and document limitations and required improvements for the MagNIT simulator.
5. Demonstrate prototype system in real-world conditions with full range of potential conditions:
   a. Airframe attitude dynamics
   b. Field perturbation dynamics
   c. Velocities
   d. Arbitrary global locations and trajectories
   e. Atmospheric induced anomalies
6. Document software in User Manual, Technical Manual, Programmer's Manual so that source code can be modified by the government for future interface and compatibility upgrades.
7. Establish transition plan for other government agencies and contractors.

PHASE III DUAL USE APPLICATIONS:

1. Develop a commercial capability to deliver software to DoD and contractors to accurately simulate Earth crust magnetic fields that will run at real-time at TRL 8.
2. Software should be portable, flexible, and able to integrate to most hardware-in-the-loop facilities, software-in-the-loop facilities, and for non-real-time software algorithm testing.

REFERENCES:

1. Enhanced Magnetic Model (EMM) https://www.ngdc.noaa.gov/geomag/EMM/;

2. A. J. Canciani, “Magnetic Navigation on an F-16 Aircraft using Online Calibration,” IEEE Trans. Aerosp. Electron. Syst., pp. 1–15, 2021, doi: 10.1109/TAES.2021.3101567;
3. A. R. Gnadt, “Machine Learning-Enhanced Magnetic Calibration for Airborne Magnetic Anomaly Navigation,” in AIAA SCITECH 2022 Forum, 2022, pp. 1–16, doi: 10.2514/6.2022-1760;
4. Contract No.: FA864920C0317 STTR Phase II Proposal No.: F19A-018-0018 Hardware-in-the-Loop Test Bed for Magnetic Field Navigation Preliminary Final Report;
5. Ewing, Craig, “The Advanced Guided Weapn Testbed (AGWT) at the Air Force Research Laboratory Munitions Directorate,” AIAA Modeling and Simulation Technologies Conference, August 2009, https://doi.org/10.2514/6.2009-6129.;

KEYWORDS: Magnetic field in Earth’s crust; Alternative Navigation; Magnetic navigation; Real-time processing; Closed-loop simulation; Hardware-in-the-loop; Hypersonic; Signal injection

AF241-0003 TITLE: Operational Arctic Aerospace Warning & Control to Enhance Information Dominance & Domain Awareness for Rapid Decision Making

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Integrated Sensing and Cyber; Human-Machine Interfaces; Integrated Network System-of-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 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 methods to enhance ADA using low-cost existing and emerging technological solutions that can operate all seasons in the Arctic above 70N latitude.

DESCRIPTION: The Arctic has a complex environment to operate in. Geographically, the Arctic region consists of the Arctic Ocean, adjacent seas, and parts of eight nations: the United States, Canada, The Kingdom of Denmark (which includes Greenland), Finland, Iceland, Norway, Russia, and Sweden (AF Arctic Strategy). The area above the 66 degrees North latitude Arctic Circle is almost 2.5 times the size of the continental United States and mostly over ocean. Due to climatological reasons, the North American Arctic hosts a much harsher climate than the European Arctic. The thick, multi-year ice around the coast lines means there is significantly less road and maritime infrastructure compared with the European Arctic. While roads can be made on the snow in the winter, the changing climate removes this stable surface. Melting permafrost and coastal erosion creates a much less stable environment for transportation and infrastructure. When operating any electronic equipment in the Arctic region, the equipment must be able to withstand extremely cold temperatures, corrosive environments, and damage from sea life like Polar Bears and Arctic Foxes who are known to rip apart or play with buoys in the ice (Author’s experience). Because of this, the Alaskan NORAD Region (ANR) is particularly reliant on ground-based line of site systems to provide rapid access, reach, and air domain awareness in the AOR. A solution is required that takes into account the complexities of achieving ADA in the arctic environment for both current and future threats. This Phase 1 SBIR focuses on any emerging or existing technology that can contribute to the ability to perform Aerospace Warning (AW) and Aerospace Control (AC) in the Arctic beyond the line of site ground-based systems as a connected system. It focuses on low-cost passive or active sensors, information, or other novel applications of traditional equipment in a broader electromagnetic spectrum range (RADAR, EO&IR, etc.). The equipment operating environment must be able to operate in temperatures ranges from –40 degrees Celsius to 10 degrees Celsius, where an average of 20-50 cm of snow fall on the sea ice in the winter, average salinity of the ocean from 32 to 37 PSU, and with relative humidities up to 100% (NSIDC).

PHASE I: Demonstrate a method or conduct a feasibility study that is capable of enhancing ADA in the Arctic for operational use. The method should employ existing and emerging sensors, services, techniques, and solutions that integrate into existing programs of record and data lakes within the Air Force and CDAO office.

PHASE II: Development of an observing network using one or more sensors, services, techniques, and solutions at low-cost that integrate into the operational picture for air domain awareness in the Arctic.

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.

REFERENCES:

1. Fesler, Peter M., Brigadier General USAF & O'Shaughnessy, Terrence J., General USAF "Hardening the Shield: A Credible Deterrent & Capable Defense for North America" Canada Institute September 2020;
2. Vanherck, Glen D., General USAF, "NORAD and USNORTHCOM Strategy Executive Summary" March 2021;
3. Savitz, Scott, "Strategic Competition in the Arctic- European Security & Defence/Maritime Defence Monitor, Combined Special Issue, pages 36-41 (October 2022)";
4. Tingstad, Abbie and Savitz, Scott, "U.S. Military May Need to Invest More in Arctic Capabilities" the RAND Blog, February 10, 2022;
5. The White House "National Strategy for the Arctic Region" October 2022;
6. Lee, Caitlin, PHD and Poling, Aidan, "Bolstering Arctic Domain Awareness to Deter Air & Missile Threats to the Homeland- MITCHELL INSTITUTE Policy Paper" Vol. 41, June 2023;
7. The Department of the Air Force "The Department of the Air Force Arctic Strategy," 2020;
8. Multiple Authors, National Snow and Ice Data Center (NSIDC) https://nsidc.org/data/explore-data;

KEYWORDS: Arctic Mobile Observing Systems; arctic capability; improved northern acoustic monitoring; northern communication capabilities; arctic communication capabilities; arctic sea ice acoustic monitoring; arctic sea ice ground based sensors

AF241-0004 TITLE: Context-Aware RF Electromagnetic Surveying for Exploiting Signals of Opportunity

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a capability to use 3D environment models and RF propagation patterns to develop low-latency CNNs for RF geolocation and signal-type identification that can be run in parallel on low SWaP RF Electronic Spectrum Monitoring (ESM) antenna arrays for Class I and Class II UAS airframes.

DESCRIPTION: Highly realistic and accurate 3D models are available for nearly all locations of our globe. These models often include coarse geometric and visible light (EO) information as textures. This project will develop algorithms that autonomously or semi-autonomously construct detailed 3D RF propagation models using available 3D geometry-and-texture, i.e., skinned, models of real-world locations. The resulting RF models will be used to develop context-specific AI technologies that estimate candidate 3D RF source locations and signal types from a low SWaP Ultra-Wide Band antenna array consisting of 4 antennas or less. Frequency ranges of interest for geolocation include 0.8 GHz - 6 GHz and solutions extending this range without sacrificing SWaP or performance are welcome. Geolocation approaches should be capable of detecting RF sources in complex multi-path environments where the strongest sensed signal may arrive to the sensor via direct-path propagation or propagation paths involving up to 2 bounces.

Geolocation capabilities will be part of a larger Electronic Surveillance Monitoring (ESM) algorithm suite which can be deployed as downstream analysis capabilities for the payload. Algorithm suite capabilities can provide search, intercept, collect, classify, geolocate, monitor, copy, and exploit capabilities.

PHASE I: Performer shall conduct and report on a feasibility study, survey of relevant technologies, and prototype algorithms that demonstrate an ability to deploy context-specific RF geolocation algorithms inside a 16 hour window that outperform competing approaches in terms of either accuracy and computational complexity or the SWaP of the required payload specifications. Applications should be capable of being run in Zynq Ultrascale+ RFSoC hardware in parallel and deployable as a payload to Class I and Class II UAS.

PHASE II: Building upon their Phase I, Performer shall implement a selected algorithm and approach. Deliver a prototype payload that can be integrated with a UAS that demonstrates the conceptual design of Phase I. Evaluate the performance of the prototype for direct-path, single-bounce and double-bounce geolocation contexts and geolocate targets including those that may exist in low-impedance indoor locations, e.g., inside windows.

PHASE III DUAL USE APPLICATIONS: Phase III efforts transition the prototype technology of Phase II to a fully-developed technology for use as a commercial or warfighter solution. A viable business model for the developed technology must be demonstrated through the performer or in partnership with other contractors. Transition partners would be in a position to supply this capability and future realizations to the Air Force and other DoD entities.

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1. N211-091 Real-time Simulation of Radio Frequency (RF) Signal Returns from Complex Targets and Backgrounds, Phase I, 2021;
2. Willis, A., Hossain, M., Godwin, J, Hardware-accelerated SAR simulation with NVIDIA-RTX technology, SPIE Defense and Commercial Sensing: Algorithms for Synthetic Aperture Radar Imagery XXVII, 2020;
3. Martian, A. Real-time spectrum sensing using software defined radio platforms. Telecommun Syst 64, 749–761, 2017;
4. Mansfield, T.O., Ghita, B.V. & Ambroze, M.A. Signals of opportunity geolocation methods for urban and indoor environments. Ann. Telecommun. 72, pp. 145–155, 2017;
5. E. Kupershtein, M. Wax, and I. Cohen, “Single-site emitter localization via multipath fingerprinting,” IEEE Transactions on Signal Processing, vol. 61, no. 1, pp. 10–21, 2013;
6. B. R. Phelan, Location of GSM transmitters in an urban environment via unique multipath characterizations, The Pennsylvania State University, State College, Pa, USA, 2012.;

KEYWORDS: Geolocation; RF source models; Electronic Surveillance Monitoring; context-specific RF geolocation

AF241-0005 TITLE: SUU-67/A Pylon Modification for Advanced Weapons

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Integrated Network System-of-Systems; Advanced 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(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 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 proposal seeks to study, engineer, and prototype a modified SUU-67/A Pylon with MIL-STD-1760 aircraft interface. AFGSC is developing a new conventional High Speed, Air-breathing cruise missile capable of range >1000 miles. Such a missile carried by the B-52 will likely exceded the capacity of the existing conventional weapons pylon and Heavy Stores Adapter Beam (HSAB). AFGSC is exploring other means of missile carriage on the B-52. One option is repurposing the existing SUU-67/A Aircraft Pylon for conventional use. The SUU-67/A is currently used to carry the AGM-86/B Air Launched Cruise Missile (ALCM).

DESCRIPTION: Without this effort to repourpose the SUU-67/A, AFGSC will likely have diminished carriage cabability to carry cruise missiles on the B-52. Potential andversaries and conflicts in the Pacific region will need dozens of cruise missiles in mass attacks against hostile forces. The B-52 carries eight missiles internal and twelve missiles on external underwing pylons, each pylon carries six missiles. Without a capable external pylon, B-52 carraige is diminished 60%.

PHASE I: Define a system concept, perform a feasibility study, and propose a solution for creating a modified SUU-67/A with MIL-STD-1760 aircraft interface for the B-52. The developed CAD and SysML models developed during this project will be government-owned, and that the government will have unlimited rights to use, modify, reproduce, release, perform, display, or disclose such technical data or computer software.

PHASE II: "The objective of this Phase II SBIR project is to further develop the solution for a modified SUU-67/A with MIL-STD-1760 aircraft interface for the B-52 integration created in Phase I. The project will focus on refining and improving the digital twin, creating a well-defined deliverable prototype that can be used for commercialization.

Approach:
The project will involve the following steps:

Refinement of the 3D Model: The 3D model of the SUU-67/A created in Phase I will be refined and improved to enhance its accuracy and functionality. This will involve further validation of the model to ensure its accuracy and the addition of new components to improve functionality and future sub-system integration.

Integration of New Equipment: The digital twin will be used to integrate new equipment, wiring, and necessary hardware with the SUU-67/A. Integration will involve testing the new equipment in different scenarios to identify potential issues and make necessary modifications.

Testing: The modified SU-67/A will undergo rigorous testing to ensure its integrity, functionality, and connectivity to the aircraft. The testing will involve simulated carriage in a wide range of scenarios, including adverse weather conditions, various payload combinations, equipment failures, and system malfunctions.

Success Criteria: The success criteria for this project will be the delivery of an modified SUU-67/A prototype.

Commercialization Plan: A commercialization plan will be developed to promote the technology and identify potential licensing and partnership opportunities. A marketing strategy will also be developed to reach potential customers and partners. The proposer will have identified potential customers and partners and have a plan to seek additional funding opportunities to continue the development of the digital twin technology and explore other potential applications in the aerospace industry.

Operating Parameters/Prototyping Expectations:
The modified SUU-67/A prototype will be delivered as an ready-to-integrate & ready-to-flight demonstrate asset.

Conclusion:
The success of this Phase II project will result in a well-defined deliverable modified SUU-67/A prototype ready for integration and testing."

PHASE III DUAL USE APPLICATIONS: "The objective of this Phase III/Dual Use SBIR project seeks to study, engineer, and prototype a modified SUU-67/A Pylon with MIL-STD-1760 aircraft interface for equipment integration and testing created in Phase II. The project will focus on transitioning the technology to government and commercial applications and achieving a high technology readiness level (TRL).

Expected Phase III Effort:
The expected Phase III effort will involve prototyping, testing, and commercializing the modified SUU-67/A for government and commercial applications. The technology will be refined and optimized to meet the specific requirements of these applications. The project will involve collaboration with potential customers and partners to identify their specific needs and develop a plan for commercialization. The project will also involve seeking additional funding opportunities to further develop the technology and explore other potential applications in the aerospace industry.

Expected TRL at Phase III Entry:
The expected TRL at Phase III entry is 9, which means the technology is fully developed, tested, and validated in relevant environments. The SUU-67/A prototype will have been tested and validated in a wide range of testing environments, and its functionality will have been demonstrated through an in-flight demonstration. The technology will be ready for commercialization and deployment.

Additional Transition Planning:
The additional transition planning for this Phase III project will involve identifying the government approvals required for the commercialization of the technology. The project team will work closely with the Department of Defense (DoD) to identify any necessary certifications, approvals, or standards that need to be met for the technology to be deployed in military applications. The project team will also work with potential commercial partners to identify any necessary certifications, approvals, or standards required for commercial deployment.

Known Government Approvals Required:

The known government approvals required for this project will vary depending on the specific application and customer. However, potential approvals that may be required include certification by the Federal Aviation Administration (FAA) or the Department of Defense (DoD), compliance with relevant military standards, and approval by the appropriate government agencies.

Additional DAF Customer Opportunities:
The additional DAF customer opportunities for this project include potential applications in military and commercial aviation. The digital twin technology can be used to improve the safety and performance of aircraft, reduce risk, save time and money, and increase efficiency. The technology can also be used for training and maintenance, providing a realistic and accurate representation of the aircraft that can improve safety and reduce errors during actual operations. The project team will work closely with potential customers and partners to identify additional opportunities for deployment and commercialization of the digital twin technology.

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REFERENCES:
1. MIL-STD-1760;

KEYWORDS: Digital twin; Legacy aircraft; Equipment integration; Testing; Virtual model; Accurate data; Physical dimensions; Risk reduction; Accredited digital simulation; Time and money saving; Realistic representation; Designing CAD; SysML files; B-52; Non Recurring Engineering cost reduction; Digital engineering; Model development

AF241-0006 TITLE: Mobile Target Tracking

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 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 target tracking method that can be utilized to autonomously track targets based on operator selecting a ground target from sensor data . The method will provide feedback to a flight controller carrying an appropriate sensor and allow the vehicle to track and follow the target without further input from an operator. The method should be sized to be integrated on an FAA Group 2 Unmanned Aircraft System and could be utilized for tracking ground targets from a distance or tracking ground targets as part of a loitering munition system and should be capable of provided guidance data for both use cases.

DESCRIPTION: Unmanned air vehicles play an important role in today's military operations. They are invaluable in locating time critical targets, reporting enemy positions and movements to battlefield commanders, and destroying tactical targets.

Projected great power competitions nearly always include the loss of ability to use Global Positioning System (GPS) for guidance. In today's Department of Defense, GPS is used for a multitude of missions including guiding reconnaissance aircraft and munitions. The objective of this topic is to develop a method to autonomously track a selected target that will reduce manpower requirements, dependence on GPS, and system resources in the amount of bandwidth taken up by having to be continuously connected to the aircraft.

The method should have the ability to track and follow one mobile target from a distance as in a reconnaissance mission, as well as track a mobile target and provide data to achieve terminal guidance and successful strike as in the case of a small loitering munition. To fit this mission, any system under consideration should fit inside the normal hardware and software constraints of a Group 2.

Any hardware or software approach is appropriate. However, it is anticipated that some approaches will utilize commercially available hardware, such as gimbled electro-optical/infrared sensors, and implement a software solution to interpret the data gathered and translate it into flight control commands to guide the system.

Some key desired capabilities of the method are:
- Simply integration onto a multitude of small platforms
- Interoperability with different sensor types and/or different brands of the same sensor
- A simple and intuitive user interface
- Process data and provide flight commands fast enough to allow an appropriately capable aircraft to track a mobile target moving at up to 80km/h all the way through impact
- Potential targets could include, but aren't limited to, sedans, small trucks, armored personnel carriers, and dismounted personnel

PHASE I: The contractor shall provide trade studies & engineering design necessary to define the operational system & associated technologies. The contractor shall show evidence that key enabling technologies are adequately mature (e.g. Technology Readiness Level >=6). Key enabling technologies shall include but aren't limited to sensor hardware, sensor software, target tracking software, interface links with flight control surfaces, user interfaces, data processing systems.

PHASE II: The contractor shall develop and test a method that provides the capability to track a mobile target moving at speeds up to 80km/h, selected by an operator. The test program shall culminate in a demonstration, on a government test range, striking a moving target using only guidance provided by the system under development with a surrogate loitering munition platform.

PHASE III DUAL USE APPLICATIONS: The various technologies developed in Phase II are applicable to military and government applications. There are potential commercial applications in a wide range of diverse fields that include crop and traffic monitoring as well as site security and police surveillance.

REFERENCES:

1. 1. Part 107 – Small Unmanned Aircraft Systems https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-107
2. Gettinger, Dan, and Arthur Holland Michel. "Loitering munitions." Center for the Study of the Drone (2017).
3. Zhang, Zhidong, et al. "Research on speed scheme for precise attack of miniature loitering munition." Mathematical Problems in Engineering 2020 (2020): 1-19.;

KEYWORDS: Loitering munition, small UAS, Group 1, Group 2, unmanned, unmanned aerial system, autonomous, mobile target tracking, targeting

AF241-0007 TITLE: Advanced Battery Development and Integration for Airborne Platforms

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network System-of-Systems; Advanced Materials; Microelectronics

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 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 explore, develop, and employ advanced battery technologies with specific attributes, namely high energy density and adaptable power density, while maintaining low Size, Weight, Power Consumption, and Cost (SWaP-C) characteristics. The goal is to create highly versatile, stretchable, and shape-changing batteries suitable for use in Bomber aircraft, externally carried weaponry, and electronic equipment. These batteries must possess unique qualities, such as the ability to withstand extreme temperatures and fit securely into tight or irregular spaces without compromising safety.

DESCRIPTION: AFGSC aims to explore, develop, and employ advanced battery technologies with specific attributes. The focus is on achieving high energy density and adaptable power density while ensuring the batteries have low Size, Weight, Power Consumption and Cost (SWaP-C) characteristics. These batteries are envisioned to be highly versatile, stretchable, and shape-changing to suit their use in Bomber aircraft, as well as for internal and externally carried weaponry and electronic equipment. AFGSC is actively involved in the research and development of various externally carried weapons and an externally carried pod designed to accommodate a diverse range of electronic equipment. Each of these applications demands batteries with unique qualities, as mentioned earlier. Critical features include the ability to withstand extreme temperatures, both hot and cold, and fit securely into tight or irregular spaces without the risk of fire, explosion, or adverse changes that could compromise the safety of the aircraft or the equipment.

PHASE I: The Phase 1 SBIR performance objectives involve a comprehensive evaluation of the scientific and technical feasibility of developing highly versatile, stretchable, and shape-changing batteries with specific characteristics for military applications. Extensive research will be conducted across various key areas to achieve the objectives. Researchers will explore advanced battery technologies, materials, and manufacturing techniques to identify options with high energy density, adaptable power density, and shape-changing capabilities, all while being cost-effective.

The focus will be on developing and optimizing battery components, such as cathodes, anodes, electrolytes, and separators, to enhance overall performance and achieve the desired high energy density and power density. Additionally, research will delve into new energy storage materials, including solid-state electrolytes and advanced nanomaterials, to push the boundaries of energy density and adaptability. Innovative engineering and material science will play a crucial role in designing batteries that can stretch and change shape while maintaining performance and safety. This could involve using flexible substrates, new electrode designs, or stretchable materials to ensure secure fitting into tight or irregular spaces without compromising structural integrity. Furthermore, effective thermal management solutions will be developed to ensure battery performance and safety across a wide temperature range, vital for their use in bomber aircraft and weaponry.

Safety and reliability are of utmost importance, and the batteries will undergo rigorous testing and validation to ensure their ability to withstand harsh environments, shocks, vibrations, and other stresses without compromising overall safety. Additionally, engineers will focus on miniaturization and SWaP-C optimization to reduce weight and size while maintaining high energy density. Collaboration with relevant stakeholders will ensure seamless integration with existing aircraft and weaponry systems. Scalable and cost-effective manufacturing processes will also be explored to achieve mass production without sacrificing performance and cost targets. Compliance with military and aviation regulations and standards will be addressed, ensuring safety and performance requirements are met, and necessary certifications obtained for deployment. The Phase 1 SBIR will lay the foundation for a successful multidisciplinary approach in the development of advanced batteries, paving the way for Phase 2 SBIR and further advancement in military applications.

PHASE II:
Expected Outcomes:
The Phase 2 SBIR project aims to deliver a matured battery technology with demonstrated performance and capabilities. The functional prototypes will showcase the batteries' potential for integration into military aircraft and weaponry systems. The research and testing conducted during this phase will provide essential data to address technical challenges, safety concerns, and regulatory requirements. Additionally, the project will explore pathways for commercialization, increasing the impact of the technology beyond defense applications.

The ultimate goal of this Phase 2 SBIR is to pave the way for the practical deployment of these advanced batteries in military operations, enhancing the capabilities of bomber aircraft, weaponry, and electronic equipment. The successful completion of this project will contribute to strengthening the technological edge of the United States Air Force and furthering innovation in the field of energy storage for military and civilian applications.

Objective:
The Phase 2 SBIR will focus on advancing the research and development efforts initiated in Phase 1, aiming to mature the battery technology to a level where it can be transitioned into practical applications. The objective is to create highly innovative batteries that meet the stringent requirements of bomber aircraft, externally carried weaponry, and electronic equipment in terms of performance, reliability, and adaptability.

Approach:
Technology Refinement: Researchers will refine and optimize battery technologies, which may include battery chemistry, materials, and manufacturing processes, to enhance energy density, power density, and shape-changing capabilities.

Prototype Development: Building upon the research conducted in Phase 1, the team will develop functional prototypes of the batteries to demonstrate their performance and functionality under real-world conditions.

Performance Testing: Rigorous testing and evaluation will be conducted on the prototypes to assess their safety, reliability, and performance across a wide temperature range and in various environmental conditions and physical shapes.

Miniaturization and Integration: Engineers will further optimize the battery designs that may accomplish milestones such as reducing their SWaP-C footprint, ensuring seamless integration into tight spaces in military aircraft and weaponry.

Scalable Manufacturing: When possible, the focus will be on developing scalable and cost-effective manufacturing processes to enable mass production without compromising on performance and cost targets.

Compliance and Certification: Regulatory compliance with military and aviation standards will be ensured, including things such as obtaining necessary certifications for deployment in military equipment.
Collaboration and Funding: Collaboration will continue among the necessary parties such as the research team, government agencies, defense contractors, and academic partners to pool expertise and resources for successful battery development.

Market Analysis and Commercialization: A comprehensive market analysis will be conducted to identify potential applications beyond military use, exploring commercialization opportunities for the developed battery technology.

PHASE III DUAL USE APPLICATIONS: The Phase III effort for this project aims to transition the highly versatile, stretchable, and shape-changing batteries from the SBIR/STTR-funded R&D phase to practical applications in both Department of Defense (DoD) and commercial domains. The primary goal of Phase III is to achieve technology maturation and commercialization, ensuring widespread adoption and integration into various military and civilian platforms.

Expected TRL at Phase III Entry:
At the Phase III entry, the battery technology is expected to be at a Technology Readiness Level (TRL) of 7 or higher. This indicates that the technology has been demonstrated in an operational environment and is ready for integration into relevant systems and platforms.

Transition Planning and Government Approvals:
Transition planning in Phase III will involve close collaboration between partners such as the research team, government agencies, defense contractors, and potential commercial partners. The primary focus will be on the following aspects:

Validation and Certification: The battery technology will undergo rigorous validation and certification processes to meet all requisite standards including the necessary military and aviation standards required for deployment in DoD applications.

Market Analysis and Commercialization: Further market analysis will be conducted to identify additional commercial opportunities and potential applications outside the DoD domain. Commercialization strategies will be developed to maximize the technology's impact in the commercial market and ensure long-term viability.

Intellectual Property (IP) Protection: Appropriate steps will be taken to protect the intellectual property generated during the R&D phase, ensuring that the technology remains secure and proprietary.
Funding and Investment: Secure funding from non-SBIR/STTR sources will be sought to support the scale-up, production, and commercialization of the batteries. This may involve collaborations with venture capitalists, industry partners, and private investors.

Technology Integration: Consideration will be given towards integrating the batteries into various military platforms, such as bomber aircraft, externally carried weaponry, off-board pods, and electronic equipment, through partnerships with relevant defense contractors and DoD agencies.

Additional DAF Customer Opportunities:
Beyond the initial DoD applications, the Phase III effort will explore additional opportunities within the

Defense Acquisition Framework (DAF) customer landscape. This may include engagements with other branches of the U.S. Armed Forces, government agencies, and allied defense organizations that can benefit from the advanced battery technology
.
Overall, the Phase III effort will focus on successfully transitioning the battery technology from the SBIR/STTR-funded R&D phase to commercial applications, further enhancing the capabilities of military platforms and fostering innovation in the energy storage sector. Through effective transition planning and collaboration with industry partners, the technology is poised to have a significant impact on both defense and civilian sectors, contributing to the technological advancement and competitiveness of the United States.

REFERENCES:

1. 1. MIL-STD-1760;

KEYWORDS: Batteries; Stretchable; Shape-changing; Energy Density; Power Density; SWaP-C; Battery Chemistries; Energy Storage; Solid-State Electrolytes; Nanomaterials; Innovative Engineering; Material Science; Thermal Management; Battery Safety; Reliability; Miniaturization; Integration; Manufacturing.

AF241-0008 TITLE: Additive Manufacturing & Repair of 7075 Aluminum for Weapon Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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(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 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 structural repair of 7075 parts using AM processes. Provide recommendations on material and processes used to achieve structural repairs. Provide test results for tensile strength of repaired test coupons.

DESCRIPTION: High strength aluminum is used in aircraft and air warfighting components throughout the Air Force Inventory. AL 7075 T6 is used to combine high strength and lightweight material. EBW specifically uses AL 7075 T6 in construction of Launcher Rail Bodies. Some of these parts, which have a life limiting wear condition, are prohibitively expensive to manufacture new but could be repaired and put back into service. The Air Force currently spends $2M per year on the manufacture of new rail bodies to replace ones that could be repaired. Also, the use of this technology could be used to support aircraft sustainment, possibly saving 100s of millions. Many new technologies are currently being developed in the world of AM for printing high strength aluminum alloys. This SBIR would focus on testing the strength that would be achieved from a repair, where the new technology and materials are used with preexisting 7075 T6 Al.

PHASE I: Develop high strength alloy aluminum that can be used in Additive Manufacturing and Repair.

PHASE II: Development of repair process and testing of repairs with the AM high strength alloy aluminum to demonstrate that it can attain at least 70% strength of original 7075 tensile strength.

PHASE III DUAL USE APPLICATIONS: Repair capabilities for 7075 could be used by every military branch and manufacturer that maintains aircraft. All aircraft use AL 7075 components.

REFERENCES:
1. Jones A.C, Rhys & Cizek, Jan & Kovářík, Ondřej & Lang, Jeff & Ang, Andrew & Michopoulos, John. (2021). Characterising crack growth in Scalmalloy". Procedia Structural Integrity. 34. 39-44. 10.1016/j.prostr.2021.12.006.;

KEYWORDS: Additive manufacturing, repair, aluminum

AF241-0009 TITLE: Spectroradiometric Suite

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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OBJECTIVE: The objective is to have an single system that can perform automated spectroradiometric measurements across the ultra-violet, visible and infrared spectrum, 200nm to 14500nm. System will be used to characterize EO/IR imagers (spectral responses) and perform filter and optical window transmittance measurements. System will have the ability for the user to select spectral resolution and bandpasses within operating spectrum.

DESCRIPTION: Design and fabricate a spectroradiometer system that enables the system to make automated measurements from 200nm to 14500nm. System will produce spectral responses for radiometers and imaging sensors and transmittance curves for filters and optical windows. Meeting the requirements below ensures that the spectroradiometer system is capable of accurately characterizing the spectral responses and transmittance of optical systems, allowing for various scientific, industrial, and research applications.

Spectral Range: It should cover the desired wavelength range relevant to the sensor's application, this should include ultraviolet, visible, and infrared regions. Threshold wavelength range – 200nm to 14500nm

Spectral resolution: The system must have sufficient spectral resolution to distinguish between different wavelengths accurately. Higher resolution allows for more precise analysis of spectral features.
Sensitivity: The spectroradiometer should be able detect and measure low-sensitivity spectral signals, to ensure accurate and reliable data collection.

Calibration: Regular calibration is crucial to maintain accuracy and traceability of the measurements.
Stability: The system should demonstrate stability over time to ensure consistent and repeatable measurements.

Integration with other radiometric systems: The spectroradiometer must be designed to integrate seamlessly with other COTS systems, threshold - GigE Vision Standard interface.

Data Output: The system should provide data in a format suitable for analysis, often in the form of spectral radiance, spectral irradiance, normalized spectral , or transmittance.
User Interface: A user-friendly interface is essential for easy operation, data visualization, and data processing.

Environmental Considerations: The system needs to be designed to operate in a laboratory environment.
Cost and Size: Depending on the application and portability requirements, the spectroradiometer should be affordable and available in a suitable size.

PHASE I: In Phase l, the vendor will determine the ability of creating a single automated system that can make sprectroradiometric measurements from 200nm to 14500nm. Feasability to combine multiple reference detectors in one system to span overlapping regions of UV, visible and IR. And the ability to provide a source with high spectral resolution across the 200nm to 14500nm region.

PHASE II: Phase II will demonstrat a working protype spectroradiometer that operates across the 200nm to 14500nm wavelength range. The system will be able to provide spectral responses for any given sub-band within the threshold wavelength range. Additionally, the system will be capable of measuring the transmittance of filters and optical windows within the threshold wavelength range.

PHASE III DUAL USE APPLICATIONS: For entrance into Phase lll, the complete system shall be TRL 6 or greater. In Phase III the vendor will be capable of producing a fully working automated system with accessories that allow customers to tailor the system to interface with other COTS or custom sensors outside of the original design parameters. Input from other AF agencies and services will be provided to further broaden commercialization requirements.

REFERENCES:

1. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/spectroradiometers;

KEYWORDS: IR; EO/IR; Midwave IR, Visible; Longwave IR; Spectrometer; UV, ultraviolet; monochromator; Spectroradiometer; Filter transmission: Spectral Detector Response; transmittance.

AF241-0010 TITLE: Improved Digital Engineering Techniques for Test Data Leveraging

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

OBJECTIVE: Develop and demonstrate a data analysis tool methodology to capture relevant test parameters from past data into a usable form and create a digital engineering-level model capable of evaluating variables and providing accurate predictive answers. Models must be able to quickly learn from new data to improve predictions

DESCRIPTION: Aircraft survivability and ballistic test data have been collected for over sixty years. This data needs to be converted to a format to aid in performing data analysis and for extracting answers to assist in new test and evaluation predictions. With current test reports, which are often stored in Portable Document Format (PDF) for later reference, little regard is given to the usefulness of the data beyond the current project and often insufficient background information is documented along with the data to allow useful models to be created and tailored to new applications. In addition, new test data is often difficult to merge with this previous data without a detailed link to caveats associated with the previous testing. This may include future testing which may make use of enhanced instrumentation techniques able to capture higher resolution or details than data captured in previous testing. The lack of clarity on the past testing and the diligence required for finding and extracting the past test report data often results in duplication of effort and/or re-learning of lessons learned. This, in turn, leads to additional cost and time to get vital answers. Even when engineering level models were built upon the past test data, the addition of new test data most often results in the creation of new Monte Carlo inputs that may not properly capture parameters and constraints.

The digital engineering paradigm requires more coupon, subscale, and large-scale testing to be performed earlier to support design and trade study activities before prototypes are built. Much of this test data will need to come from previous test programs and be adapted to new aircraft survivability test objectives. With only static reports available from the past and perhaps no traceability to raw data or no accurate way to interpret that data, there is often no ability to capture all the necessary information from past testing to create useful test data products for the future. In addition, there is certainly no way to improve upon the past data, as additional related test or simulation data become available. This means that digital engineering will be difficult to carry out in practice.

This SBIR Phase I effort will focus on demonstrating a data encapsulation methodology to apply to coupon, sub-scale, and large-scale survivability test data relating to threat/target interactions. Target-related test data may include stress/strain, pressure, temperature, damaged structure, cracking, hydrodynamic ram effects, fuel spurt and more. Threat-related data may include flash/function probability, residual velocity, residual mass, and more. The data encapsulation methodology should include a demonstration of how various forms of data can be preserved, relevant variables are preserved, accurate predictions can be made, how the resulting tool can improve with additional test data, and how previously generated test data can be used for new and novel test programs.

PHASE I: Significant work equivalent to a Phase I effort in demonstrating the feasibility of a data encapsulation methodology applicable to aircraft survivability test data must be documented in the proposal. The methodology must be able to integrate previous survivability test and analysis data along with data from current and future testing and analyses into a comprehensive analytical tool. This analytical tool will aid survivability engineers in developing future survivability test programs and analyses that will produce more reliable test and analysis results

PHASE II: Development of a data encapsulation methodology should be completed and demonstrated in the form of an engineering-level model for a set of ballistic test data related to threat/target interaction.

Demonstration should be conducted for a new test data being incorporated with previous test data.

PHASE III DUAL USE APPLICATIONS: Digital engineering is not limited to aircraft survivability or military development efforts. With custom materials and new technologies commonly being incorporated into new designs, building efficiently on older test data is essential to both military and commercial applications.

REFERENCES:

1. D. Varas, R. Zaera, J. López-Puente, Numerical modelling of the hydrodynamic ram phenomenon, International Journal of Impact Engineering, Volume 36, Issue 3, 2009, Pages 363-374;
2. Peter J. Disimile, Norman Toy, Liquid spurt caused by hydrodynamic ram, International Journal of Impact Engineering, Volume 75, 2015, Pages 65-74;

KEYWORDS: test data; survivability; machine learning

AF241-0011 TITLE: Enhanced Timing-Programming System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Hypersonics; Microelectronics; Integrated Network System-of-Systems; Human-Machine Interfaces

OBJECTIVE: Develop a modernized system to control timing distribution and electronic event capture with nanosecond accuracy along a 10-mile-long high-speed test track. The system should integrate legacy stand-alone systems into a single overarching mission control system.

DESCRIPTION: The Holloman High Speed Test Track carries out rocket sled tests at speeds ranging from subsonic to hypersonic. The track utilizes a diverse array of sensors to control event timing and capture data. For example, sled velocity is captured using continuous wave Doppler radar; sled position is captured using precisely located breakwires that are time-stamped when the sled breaks them as it passes by; meteorological variables such as altitude, temperature, humidity, and wind speed are captured using various sensors located along the track. Additionally, high-speed camera arrays are used to capture sled and test article behavior throughout the test. Test events, such as seat ejections or bomb impacts, must be initiated, tracked, and terminated using accurate common time to align input & output data across multiple sensor platforms. The current Timer-Programmer control system was updated in the 1980s and utilizes a copper cable network that extends from a centralized control facility to utility risers along the 10 miles of track as well as to various bunkers. It does not incorporate all data collection and control systems currently in use.

This SBIR topic focuses on replacement of the legacy Timer-Programmer system. The new system should provide common timing to distributed data collection and event control systems, provide controlled timing of test events, measure event times, and report data. It should use the existing copper cabling infrastructure and integrate other independent data acquisition systems into one overarching mission control system. The system needs to output nanosecond accuracy timing to multiple locations traveling distances as great as eight miles. It must time tag events in the field with nanosecond accuracy and relay back to a base station computer for processing. All data collected must be stored in a centralized data base for post-mission analysis. The system should integrate real-time data from multiple dispersed data collection and control equipment (radars, ultrasonic anemometers, cameras, McQ portable event controllers) into one heads-up display. The system must deliver real time in formats required by various data collection and event control systems, general time, programmable frequencies, and programmable DC level signals which are outputted through balanced and unbalanced line drivers. In addition, these line drivers should be computer controllable for output signal selection, amplitude and on and off times. Standard data collection reports should include sled first motion, velocity window computations, parallel and serial event times, and weather data. The system must passively record mission day land mobile radio communications for post-test display or playback. Data should be downloadable to widely used data formats such as Microsoft Excel or to structured query language server format for post-mission analysis. Other user requirements include the ability to initiate or terminate events on a programmed time schedule; real-time operator ability to stop/start/restart tests for safety reasons; high system reliability; ability to expand the system to incorporate new equipment in the future; low-maintenance need; low upkeep costs; and non-intrusive for existing wireless systems.

PHASE I: Conduct a feasibility study that decomposes user-level timing, event control and data collection requirements into technical requirements, identifies options (equipment and/or infrastructure) that will meet requirements, and provide an approach for developing a replacement Timer-Programmer system.

PHASE II: Develop and demonstrate a functional system that will provide timing and event controls to meet user requirements. Deliver a deployable system ready for immediate integration into Track operations with only the need for technician training.

PHASE III DUAL USE APPLICATIONS: This technology will have applications to other government, university and commercial test facilities involved highly dynamic test events.

REFERENCES:

1. https://www.arnold.af.mil/News/Article-Display/Article/3398244/846th-ts-brings-the-need-for-speed-to-holloman/;
2. https://www.arnold.af.mil/News/Article-Display/Article/3050680/holloman-high-speed-test-track-sets-record-with-fastest-recovery-mission-in-30/;
3. https://www.af.mil/News/Article-Display/Article/3337705/joint-effort-underway-to-power-rocket-sleds-into-the-future/;

KEYWORDS: Timer-Programmer; mission control; event control; data collection

AF241-0012 TITLE: High Temperature Mach number or Static Pressure Probes for Vitiated Flows

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Integrated Sensing and Cyber; Advanced Materials

OBJECTIVE: Develop and demonstrate a local Mach number or Static Pressure probe technology suitable for hypersonic and high enthalpy flows.

DESCRIPTION: The Aerodynamic and Propulsion Test Unit (APTU) at the Arnold Engineering Development Complex (AEDC) is a high-speed hypersonic (HS/H) test facility capable of producing flight representative conditions (true temperature and pressure) via a combustion air heater (CAH). Understanding of any HS/H system under test requires a thorough understanding of the as-delivered free stream test conditions. The test conditions are typically characterized during dedicated test runs using intrusive diagnostics such as flow-field rakes with multiple discrete probes. Currently, the probes are limited to the assessment of total pressure and temperature with no direct measurement of local static pressure or Mach number. As such several assumptions and iterative techniques are required to assess the flow-field characteristics. With only wall statics along the nozzle inner mold line, analysis is limited to assuming a uniform static pressure across the flow field. Any divergence in the static pressure from this assumption is superimposed on the total pressure and Mach number profiles. A direct measurement of either static pressure or Mach number will negate the need for the assumptions and reduce the overall uncertainty of test results.

PHASE I: Consult with AEDC personnel to understand APTU operations and gain familiarity with current intrusive rake and probe designs. Survey industry to assess potential solutions to the problem, including later commercialization opportunities. Develop the concept and design of the probe technology for the APTU flow-field conditions. Evaluate the achievable measurement uncertainty and illustrate plans for state-of-the-art improvements.

PHASE II: Develop and demonstrate a prototype probe-rake devices in the APTU flow-field conditions early into the Phase II to allow design iterations design as needed to demonstrate robustness and sufficient accuracy.

PHASE III DUAL USE APPLICATIONS: Reduce device complexity and size for use within the facility rake systems. This technology will result in a product easily commercialized to other highspeed and high temperature wind tunnels.

REFERENCES:

1. Porro, R. A. (2001). Pressure Probe Designs for Dynamic Pressure Measurements in a Supersonic Flow Field. NASA Glenn Research Center. Cleveland, OH. Retrieved 12 2, 2022, from https://ntrs.nasa.gov/api/citations/20010093214/downloads/20010093214.pdf;
2. Pinckney, S. Z. (1975). A Short Static-Pressure Probe Design for Supersonic Flow. NASA Langley Research Center. Hampton, VA. Retrieved 12 2, 2022, from https://ntrs.nasa.gov/api/citations/19750019233/downloads/19750019233.pdf;
3. Pinckney, S. Z. (1975). US Patent 3914997;
4. Capone, F. J. (1961). Wind-Tunnel Tests of Seven Static-Pressure Probes at Transonic Speeds. NASA Langley Research Center. Hampton, VA. Retrieved 12 2, 2022, from https://ntrs.nasa.gov/api/citations/19980227993/downloads/19980227993.pdf;

KEYWORDS: High Temperature; High Pressure; Scramjet; Ground Testing; APTU

High Temperature; High Pressure; Scramjet; Ground Testing; APTU

VERSION 5

High Temperature; High Pressure; Scramjet; Ground Testing; APTU

SF241-0013 TITLE: Planar Hyperspectral Imager

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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 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: Advances in satellite technology are driving a new space architecture that relies on constellations of small satellites for proliferated systems. This proliferated architecture will require low cost, rapidly produced optical payloads for intelligence, surveillance, and reconnaissance (ISR). Advances in material science, including nanofabrication and computer based design, are bringing in a new era for achieving high functionality in low SWaP-C (size, weight, power, and cost) payloads. This includes novel planar optics that are broadband, can be fabricated on short timelines, and provide higher functionality in a low-SWaP-C system. This solicitation seeks a low-SWaP-C ISR payload that can provide simultaneous multiband imaging over the range of 500-12000 nanometers. This payload must be compatible with integration into an ESPA class satellite. The system must have a common optical path for the visible through the infrared to use wavelength diversity during data fusion. The system from low earth orbit must be able to achieve NIRS 5 or better (https://fas.org/irp/imint/niirs.htm). The anticipated use case of this payload will be to identify features on the ground such as man-made structures, geographical features such as streams, agricultural fields, roadways, and dwellings.

DESCRIPTION: Advances in satellite technology are driving a new space architecture that relies on constellations of small satellites for proliferated systems. This proliferated architecture will require low cost, rapidly produced optical payloads for intelligence, surveillance, and reconnaissance (ISR). Advances in material science, including nanofabrication and computer based design, are bringing in a new era for achieving high functionality in low SWaP-C (size, weight, power, and cost) payloads. This includes novel planar optics that are broadband, can be fabricated on short timelines, and provide higher functionality in a low-SWaP-C system. This solicitation seeks a low-SWaP-C ISR payload that can provide simultaneous multiband imaging over the range of 500-12000 nanometers. This payload must be compatible with integration into an ESPA class satellite. The system must have a common optical path for the visible through the infrared to use wavelength diversity during data fusion. The system from low earth orbit must be able to achieve NIRS 5 or better (https://fas.org/irp/imint/niirs.htm). The anticipated use case of this payload will be to identify features on the ground such as man-made structures, geographical features such as streams, agricultural fields, roadways, and dwellings.

PHASE I: During Phase I, system analysis will be completed to determine the system requirements of the system and conduct a system's requirements review. This will include breadboard validation of components and the production of a 10-cm or greater single primary optical element that transmits light from 500 to 12000 nm that performs on par (efficiency, resolution, Strehl ratio, etc.) with the quality of a traditional optical aperture across those wavelengths. Design and fabrication of the optics must be completed within 30 calendar days using readily available computational and fabrication facilities. The SWaP of the overall system must be 1/10th of a traditional optical train that uses traditional optical materials. A design with minimal optical elements is highly desired. The plan to develop algorithms for wavelength diversity and data fusion that takes advantage of imaging across the visible and the infrared will also be investigated with a viable path forward for Phase II. The use of COTS hardware is encouraged for the more traditional aspects of the payload.

PHASE II: During Phase II a prototype payload will be constructed and tested on the ground by imaging space based targets. Use of COTS hardware is strongly encouraged to reduce the cost of the prototype and future follow-on systems. The only non-COTS component is expected to be the planar optical elements. This system must meet the system requirements identified in Phase I. Phase II will also require development of algorithms identified in Phase I. The payload developed must be robust enough to survive launch into LEO and survive the harsh space environment for at least three years of space operations not including the spacecraft initialization period (this could take up to 1.5 years to conclude). The payload must be designed and built to integrate into an ESPA class satellite for ISR applications from LEO measuring the ground.

PHASE III DUAL USE APPLICATIONS: Phase III is anticipated to identify a satellite vehicle to launch the payload and collect and analyze images collected of the ground from low earth orbit. There are many potential planned R&D systems that may be willing to host the payload for nominal investment. The imager will be designed for ground ISR but this system may also offer ISR potential from many different platforms. Future integration into the Hybrid Architecture Demonstration (HAD) program as well as contribution to a forthcoming multi-nation space-based Hyperspectral Microsatellite constellation Project Agreement (PA) may also be part of Phase III.

REFERENCES:
1. "Patrice Genevet, Federico Capasso, Francesco Aieta, Mohammadreza Khorasaninejad, and Robert Devlin, ""Recent advances in planar optics: from plasmonic to dielectric metasurfaces,"" Optica 4, 139-152 (2017);
2. NIRS Reference System see https://fas.org/irp/imint/niirs.htm;
3. https://www.spaceforce.mil/Portals/1/Space%20Capstone%20Publication_10%20Aug%202020.pdf;
4. S. Banerji & B. Sensale-Rodriguez, “May. 3D-printed diffractive terahertz optical elements through computational design” In Micro-and Nanotechnology Sensors, Systems, and Applications XI (Vol. 10982, p. 109822X). International Society for Optics and Photonics (2019);
5. M. Meem, S. Banerji, A, Majumder, C. Pies, T. Oberbiermann, B. Sensale-Rodriguez and R. Menon, “Inverse-designed flat lens for imaging in the visible & near-infrared with diameter > 3mm and NA=0.3,” Appl. Phys. Lett. 117(4) 041101 (2020).;

KEYWORDS: ISR; Planar Optics; Imaging Payload; Metamaterials; Engineered Materials; Wavelength Diversity; Data Fusion

SF241-0014 TITLE: MUOS SATCOM Simulator Connectivity Over IP

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network System-of-Systems; Space Technology

OBJECTIVE: The objective of this topic is to explore the available configurations of MUOS SATCOM simulators to achieve Air Force mission objectives. The USAF requires a mission engineering and testing tool to evaluate the most appropriate combination of software and processing simulation capability to achieve end to end connectivity analysis with the MUOS satellite constellation. These capabilities should be captured and communicated in a SysML or other MBSE model. At minimum, this is for a single simulator configuration, the Mighty MUOOS," but we will give preferred consideration for multi-satellite communications simulators.

DESCRIPTION: The DoD is transferring from legacy SATCOM systems to the MUOS constellation, This transfer will require significant testing to ensure that legacy terminals ae able to work with the MUOS constellation. Currently , this testing can be performed using the MUOOS simulator or by requesting live satellite time. A simulator, the "Mighty MUOOS," was built and deployed by W5 Technologies under contract FA8750-18-C-0198. However, the MUOOS simulator requires a direct connection (hard wire) between the radio under test and the MUOOS. The USAF requires a global capability to test MUOS equipped terminals like the ARC-210 Gen 6 and to do so, must connect MUOS capable radio terminals and the simulator remotely, via the AFIN or another IP-based network, to test and evaluate data and voice payloads top be passed over the MUOS constellation. Currently the simulator may only be used with an ARC-210 radio. In the interest of expanding the usability of the simulator, identify the feasibility of using the simulator with any SATCOM terminal that operates in the MUOS frequency ranges, including as a minimum, the PRC-117G radio set. This SIBR requests that an investigator identify, test and the evaluate the most appropriate combination of software and processing capability to achieve these ends. These capabilities should be captured and communicated in a SysML or other MBSE model. At minimum, this is for a single simulator to terminal configuration, but we will give preferred consideration for multi-platform configurations. This topic is not focused on a specific production simulator, and the expectation is to model connectivity for any SATCOM simulator that connects to a terminal directly for testing. It is expected that in Phase III, the performer will implement an open architecture interface at the physical level on at least the AF NIPRNet Network and, preferably, for a SIPRNet connection as well.

PHASE I: Demonstrate understanding of current capabilities MUOS SATCOM simulators and how those relate to AF testing requirements. Demonstrate understanding of SysML and MBSE tools as well as the understanding of how to represent COMSAT terminals in this format. Demonstrate understanding of AFSIM capabilities and methods to represent complex SATCOM simulators, particularly MUOSbased simulators in this format.

PHASE II: Develop optimal configurations for MUOS simulators mapped to Air Force SATCOM terminals using Interconnectivity, both non-secure and secure. Present hardware-agnostic model of the IP terminal to simulator linkage using SysML or other Model Based Systems Engineering (MBSE) tools and best practices. Develop ways to represent complex, multi-purpose systems in SysML or other MBSE tools for effective analysis. Develop and present an unclassified scenario(s) to demonstrate the network-based simulator to terminal transmission capability and modeling the desired capability to capture effectiveness of remote network based connections compared to traditional approaches. Capture all documentation and results in the model based form that can be shared and re-used by other developers and/or RY divisions.

PHASE III DUAL USE APPLICATIONS: Implement an open architecture interface at the physical level for a specific MUOS simulator to include the hardware, software, processor, modes and algorithms. The interface will be capable of customization to support connectivity of any USAF SATCOM terminal currently in use to the simulator.

REFERENCES:

1. AF171-043;
2. Mobile User Objective System (MUOS) for Moderate Data Rate Communications (MMDR);

KEYWORDS: MUOS, MUOOS, IP connectivity Radio Frequency; ARC-210 Gen 6, PRC-117G

SF241-0015 TITLE: Securely Operating Through 5G for Enterprise Space Data Transport Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): FutureG; Trusted AI and Autonomy; Integrated Sensing and Cyber; Integrated Network System-of-Systems; Space Technology; Human-Machine Interfaces

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 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: Add-on software modules, hybrid space and terrestrial communications architectures, and enhancements to 5G user equipment, base stations, and/or augmentations to 5G core infrastructures to best support seamless integration of 5G terrestrial and satellite communications technologies and thus, potentially decreasing costs, increasing coverage, and providing added resilience and multi-level security compatibility to critical communication needs.

DESCRIPTION: New standards and technologies, such as Fifth-Generation (5G) that are expected to meet large throughput increase, seamless connectivity, reliability, and connection density, have become important to the fulfillment of the significantly demanding requirements in flexible interconnections of heterogeneous terrestrial assets, timely data dissemination in non-contested radio environments as opposed to those in military-hardened networks and systems. Recently, DoD has made significant efforts to leverage commercial 5G investments in vendors and operators that are untrusted. Those initiatives that rely on commercial 5G products, create emerging security challenges involving in data integrity, confidentiality, and availability. Concerning the Fighting Satellite Communication (SATCOM) vision by US Space Command that requires future military SATCOM capable of multi-band and multi-waveform operations, whenever possible, to support agile, path-agnostic connectivity, reducing vulnerability to interference and jamming, this topic solicitation is to focus on potential cross-cutting areas required to integrate 5G terrestrial networks with military satellite networks. Such a realization of the enterprise satellite and terrestrial data transport capability across all joint-domain mission areas can only be achieved by means of a radical shift in the way both security and resilience of 5G are designed. For instance, a new dimension for security with path-agnostic and location privacy considerations against denial-of-service (DoS) threats would pose severe challenges to the realization of a 5G-based space data transport. Of particular interest includes but is not limited to: space data transport using cooperative and untrusted indigenous 5G networks where the U.S. and its allied spanning military operators, government services, and DoD controlled infrastructure securely operate through untrusted indigenous 5G wireless communications infrastructures whenever possible. Along with such development for novel security architecture and add-on software modules, both 5G core network and user equipment solutions are necessary to aid in evaluation of expected performance for anomaly detection and recovery, network slicing together with zero-trust protocols, integrity guarantees and covert communications.

PHASE I: Develop necessary plans and concept designs for the proposed 5G-based space data transport or capability in order to demonstrate its viability. Conceptualize a secure hybrid 5G terrestrial & SATCOM system design with potential enhancements to full-stack user software solutions for user equipment and leveraging existing infrastructures. Include appropriate initial laboratory demonstrations as required.

PHASE II: Mature the findings in Phase I. Develop a modeling and simulation capability of a family of security solutions along with user-centric and Open Random Access Network (ORAN) that would leverage artificial intelligence and machine learning intrusion detection analytics. Perform trade studies for security and performance at user equipment and ORAN. Demonstrate a proof of concept to evaluate necessary enhancements and augmentations required pertaining to resilience against DoS threats, integrity guarantees, path-agnostic connectivity, and location privacy subject to variability of untrusted indigenous 5G networks and DoD controlled infrastructures.

PHASE III DUAL USE APPLICATIONS: Integrate with prospective follow-on transition partners to provide improved operational capability to a broad range of potential Government and civilian users and alternate mission applications. Government organizations such as Air Force Research Laboratory and Space Systems Command could sponsor a government reference design of secure 5G networks for legitimate DoD and civil users, in collaboration with small business and industry partners. Successful contractor technology demonstrations will inform the technical requirements of future acquisitions by Primes and subcontractors.

REFERENCES:

1. L. You, K. Li, J. Wang, X. Gao, X. Xia, B. Ottersten, “Massive MIMO Transmission for LEO Satellite Communications”, IEEE Journal on Selected Areas in Communications, 2020;
2. R. Dangi, P. Lalwani, G. Choudhary, L. You, and G. Pau, “Study and Investigation on 5G Technology: A Systematic Review”, Sensors (Basel). 2022 Jan;
3. 22(1): 26;
4. L. Bai, L. Zhu, X. Zhang, W. Zhang and Q. Yu, "Multi-Satellite Relay Transmission in 5G: Concepts, Techniques, and Challenges," in IEEE Network, vol. 32, no. 5, pp. 38-44, September/October 2018.;

KEYWORDS: 5G; SATCOM; single hybrid space and terrestrial communications architectures; security; resilience; military, government, or critical infrastructure operator; 5G Radio Access Network; network slices; network virtualization; multi-access edge computing; end devices; end system security; zero trust architectures; system resilience; human factors

SF241-0016 TITLE: Numerical Simulation of VLF Antennas in Space Plasma

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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 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 multi-scale 3D numerical Electro-Magnetic (EM) plasma simulation capable of resolving a real electric dipole antenna (cm width and 100 m length) or magnetic loop antenna (cm wire, 20 m diameter) as well as the electromagnetic radiation produced by the antenna with km scale wavelengths.

DESCRIPTION: Energetic electrons (100 - 2000 keV), due to either natural process or a High Altitude Nuclear Explosion, HANE, become trapped in the Earth's magnetic field where they are a threat to satellites in low Earth orbit. One technique for removing these electrons is to mimic nature with electromagnetic (EM) Whistler waves that are known to scatter electrons onto trajectories aligned with the magnetic field, where they are lost into the atmosphere [Starks, 2020]. The recent DSX (Demonstration and Science Experiment) mission [Johnston, 2023] successfully demonstrated transmission by an 80 m dipole antenna and reception by a remote satellite. While DSX was able to measure the dissipated power, it was unable to quantify the efficiency of radiation versus local dissipation i.e., plasma heating. Since follow-on systems must be precision engineered for a required size, weight, and power, this topic calls for a numerical model capable of representing antenna concepts in realistic detail while modeling both the local plasma response and the distant radiation including the wave mode. Whistler waves can exist in a range of modes from electrostatic (ES) to electromagnetic (EM). Current thinking holds that EM waves are more effective at modifying the electron pitch angle since the magnetic interaction consumes no energy; while antennas that are small compared to the free space VLF wavelength (100 km) preferentially excite ES waves due to the high index of refraction that matches the wavelength in plasma to the antenna size. Current antenna concepts include: the electric dipole such as with DSX, the magnetic loop antenna, the magnetic rod antenna; and engineered plasma modification for such (near the antenna) to produce non-linear beat wave interference and conversion from ES to EM radiation [Sotnikov, 2018]. The end product will be a computer plasma model capable of aiding the design of a space-based antenna immersed in the low or near Earth plasma. This model will be capable of simulating the performance of the recent DSX antenna, a 100A 20 m diameter magnetic loop, and a compact magnetic rod producing a similar dipole moment. While the usual SBIR rights will apply to the model, so also will the government's limited right to effectively use the model following conclusion of the SBIR effort.

PHASE I: In Phase I, the contractor will identify and demonstrate the numerical methods to be used, and at conclusion have demonstrated the viability of the approach. This effort is expected to be computationally intensive so a limited demonstration will be acceptable i.e., it will not be necessary to obtain production levels of super-computer access. Never-the-less, since super-computing is an anticipated requirement, such capability must be convincingly demonstrated

PHASE II: During Phase-II, the capability to effectively model one or more antenna concepts is expected, and a fully functional design tool should be delivered at the conclusion of Phase-II.

PHASE III DUAL USE APPLICATIONS: In Phase-III the antenna-plasma design tool will be used to design candidate systems for the radiation of radios waves at Very Low Frequency.

REFERENCES:

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2. Johnston, W. R., et al. (2023). J.Geophys. Res.: Space Physics,128, doi: 10.1029/2022JA030771;
3. Sotnikov V., et al 2018, Plasma Phys. Control. Fusion 60 044014;

KEYWORDS: Radiation Belt Remediation; High Altitude Nuclear Explosion; Particle-In-Cell, SF241-0017 TITLE: Satellite Cyber Immune Response to Evolving Threats

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Space Technology

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Currently, for USSF satellites there are large amounts of telemetry to monitor to ensure the full health of the system. An auto immune response system for cyber events would remove the need for constant monitoring by operators by detecting currently known vulnerabilities and then classifying unknown vulnerabilities. This system follows the operational capabilities of the human immune system to allow for long term and evolving effectiveness of the detect and response capabilities of a space platform. The Objective of the SBIR is to research and develop algorithms and system architectures that can detect a cyber event both known and unknown using bio-inspired computing techniques.

DESCRIPTION: For an operator to be able to respond to a cyber event in a proficient and responsive timeline the event would need to be quickly detected. Classic cyber detection and mitigation systems, such as Firewalls and Intrusion Detection Systems, lack the ability to detect/respond to unknown attack signatures [1]. A bio-inspired immune response system complements the classic system to handle the unknown signatures, much like how the human immune system can react and handle known pathogens [1]. There exists cloud based systems, such as IBM Watson for Cyber Security [2], but those systems tend to have large computational requirements and false positive rates. Therefore future research and work would need to inter operate with existing security systems, detect unknown cyber events with high accuracy and decrease computational resources to fit within a satellites SWAP-C.

PHASE I: Conduct a literature survey of bio-inspired computing and cyber immune response to understand the current state of the art. Using the survey generate a representative software and hardware architecture for use in implementing a cyber immune response system. Using the architecture create an analysis of alternatives for the key aspects of the architecture. Using the architecture and analysis of alternatives generate a list of data source needs to feed into the system to be able to generate a course of action. Given a vignette mission from the technical point of contact generate a set of courses of action that would pertain.

PHASE II: Operating off the phase 1 vignette and proposed architecture implement a proof of concept system that can generate actionable courses of actions in a simulated digital twin of a space platform. Using the simulation demonstrate the ability of the system to learn and respond to known and unknown threats to the platform. Using the proof of concept and simulation determine the optimal location for the response system based on data source and computational needs. Using the simulation and digital twin generate a set of mitigation techniques possible to act on the course of actions coming from the immune response system. Implement the most impactful mitigation techniques and demonstrate the ability for the system to now detect and respond to known and unknown cyber threats. Develop the proof of concept into a space ready prototype that can be tested government test space test range to determine to operational-ability of the prototype.

PHASE III DUAL USE APPLICATIONS: Entering into phase 3 the immune response system should be at Technology Readiness Level 5-6 and should be nearing Technology Readiness Level 7, based on National Aeronautics and Space Administration's Technology Readiness Levels. The performing company should now work towards getting on-board a flight test program, such as AFRL RV's small-sat, Department of Defense Space Test Program or University Nano Satellite Program.

REFERENCES:

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2. IBM launches Watson for Cyber security beta program. IBM (2016). https://www.ibm.com/news/ca/en/2016/12/06/v881650s90213z16.html;

KEYWORDS: Cyber-Security; Bio-Inspired Computing; Satellites;

SF241-0018 TITLE: Mitigating Negative Effects of Polysulfide Dissolution in 18650 Lithium Sulfur Battery

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Microelectronics; Space Technology; Renewable Energy Generation and Storage; Advanced Materials

OBJECTIVE: The objective of this topic is to improve cycle life and capacity retention of Lithium-Sulfur battery chemistry by addressing and resolving negative effects of parasitic polysulfide reactions.

DESCRIPTION: The current state-of-practice specific energy in 18650 Li-ion cells used in space missions is as low as 150 W-h/kg. Lithium-Sulfur, with its 2600 W-h/kg theoretical specific energy, has been identified as a promising chemistry to achieve for the U.S. Space Force's (USSF) short-term 18650 rechargeable battery target of 450 W-h/kg. A higher energy rechargeable power source would have impacts across all areas of the USSF mission to enable spacecraft resilience and survivability. Most practical issues with Lithium-Sulfur chemistry can be attributed to “polysulfide shuttling”, the dissolution of Lithium Polysulfide in liquid electrolyte which results in parasitic reactions and its relatively low volumetric energy density, especially when in a small form factor battery cell such as an 18650. These reactions cause low Sulfur utilization and capacity fade, resulting in poor cycling efficiency. Recent efforts have been focused on either (1) suppressing diffusion of the dissolved polysulfides out of the cathode, or (2) protecting the lithium anode from reacting with the dissolved polysulfides. Li-S modelling is necessary to understand the technology development way-forward. This topic proposes the investigation of these or other methods to mitigate the inhibiting effects of polysulfide dissolution and improve its volumetric energy density. Findings will be incorporated into materials and 18650 cell design that can improve cycle life performance while maintaining a high specific energy intrinsic to the chemistry.

PHASE I: Investigate the feasibility of practical solutions to the polysulfide dissolution problem affecting the lithium-sulfur chemistry while maintaining a high 18650 specific energy and energy density. Using the results of this investigation, synthesize and characterize proof-of-concept anode, cathode, separator, and/or electrolyte materials that will provide a potential for improved cycle life and capacity retention to be used in the 18650 cell form factor. Model proposed Li-S cell-level performance. A small quantity of material and the cell-level model are encouraged Phase I deliverables.

PHASE II: Continue the research efforts initiated in Phase I. Optimize materials and test the impact on the cyclability of resultant Lithium-Sulfur cells using coin cell, pouch cell, and/or other cell methodology. Optimize Li-S cell model. Utilizing the materials developed during Phase I and optimized during Phase II, construct 18650 cells and provide an appropriate number of cell samples to conduct electrochemical performance testing to AIAA S-144-202X. Performance targets for deliverables include specific energy of 450 W-h/kg at the 18650 cell level and 500 cycles of at least 80% capacity retention at 20% DOD.

PHASE III DUAL USE APPLICATIONS: Transition technology to the USSF supply chain by completing AIAA S-144-202X qualification. Lithium-Sulfur battery chemistry is the USSF’s most near-term high specific energy storage solution. Successful Phase I and II development provides opportunities for transition to the USSF's supply chain into programs of record.

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3. Cheon, et al. "Rechargeable Lithium Sulfur Battery: Structural Change of Sulfur Cathode During Discharge and Charge." Journal of The Electrochemical Society, 150(6). 2003;
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KEYWORDS: Rechargeable Battery; Lithium-Sulfur; High Specific Energy; Polysulfide Shuttling

SF241-0019 TITLE: Resonator Laser Gyro

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

OBJECTIVE: The U.S. Space Force (USSF) will require high accuracy navigation attitude systems for use in proliferated constellations with smaller space vehicles. Current low mass micro electro-mechanical (MEMS) gyroscopes do not have the required performance to allow precision operation in small space vehicles. A gyroscope with MEMS size weight and power but with high navigation-grade performance would enable precision pointing of small space vehicles. Small high-grade gyros would also have applications in counterspace uses both for offensive and defensive efforts. Laser communication terminals and hosted sensor payloads would benefit from low mass rate sensors on the gimbaled assembly.

DESCRIPTION: There is an ongoing effort to leverage unique advantages in gyro sensitivity versus size when an optical system is operated at what is termed an exceptional point. The exceptional point in a nanophotonic system which occurs when the gain and loss are balanced. The resulting operational singularity radically changes the behavior of the optical system and creates large changes in system response to external stimulus. A macro scale ring laser gyro (RLG) has sensitivity that is highly dependent on the optical ring resonator loss and the enclosed path length that the light travels. Operation of a nano scale RLG at an exceptional point promises to overcome the limitations of the very short optical path length. Utilization of the behavior singularity at the exceptional point is only possible due to recent developments in exploiting gain/loss properties in nano scale waveguides. To develop a nano scale RLG which operates at the exceptional point, you first need a nano scale RLG which operates in the standard regime of parity-time (PT) symmetry. Once that is achieved, the design can be manipulated to reach the point where parity-time symmetry breaks down and operation is at the exceptional point. This effort supports development of the PT-symmetry chip level RLG as well as error modeling for a future RLG operating at the exceptional point. The project will attempt to leverage advances in gyro technology to enable better than navigation grade performance from a single channel gyro with a one cubic inch volume. The final design should target 1 W per active channel for power consumption. The technology employed will need to be radiation hardened in the future. Target ARW is 0.005 deg/rt-hr. Bias stability at constant temperature target is 0.05 deg/hr at 30 minutes. The gyro dynamic range will be up to 10 deg/s. Performance must be maintained through TBD g acceleration in any orientation relative to the gyro sensing axis. Gyro scale factor nonlinearity from 1 deg/sec to 10 deg/sec magnitude will be less than 10 ppm after any compensation. The SF error of between +1 deg/sec and -1 deg/sec will be 0.036 deg/hr. The SF spec is 2-sigma. These performance goals are very challenging for the sensor size and could be reconsidered if the technology demonstrates promise in initial prototypes.

PHASE I: Phase I will produce a design for a chip level phase-time (PT) symmetric ring laser gyro (RLG). Further investigation into what is required to push the design to the exceptional point will be done. While the concept of an RLG operating in the mode is still at an early stage of development, it is desired to assess the practical aspects of operational use of the device. For example, operation at the exceptional point (EP) requires high bandwidth servos to assess where is the EP is and to keep the gyro at that point. Behavior on either side of the EP is drastically different than at the singularity itself. Models should be developed to assess expected instrument output in the presence of EP control loop error. Temperature sensitivity could be quite high. Models should be developed to assess required temperature stability of the nano-optical substrate needed to maintain EP operation. Phase I will design a sensor which demonstrates 50% of the required static environment performance. Brass board electronics without flight representative size are acceptable. The sensor form factor will be flight representative. Meeting the 50% static performance goal with a 1 ci sensor volume is a challenging task and will enable assessment of the technology’s suitability to meet the higher performance goals. Error models of the sensor shall be presented which show a path to the target static and dynamic performance.

PHASE II: Phase II will produce a sensor which satisfies the complete performance requirement. Error models described in Phase I would be enhanced to account for measured characteristics of the functional device. The supporting electronics should be small enough at the end of Phase II to be able to be mounted on a 24" rate table platter to facilitate dynamic testing. Error models should be sufficiently developed to be able to provide a realistic prediction of gyro noise, gyro bias stability, and scale factor non-linearity.

PHASE III DUAL USE APPLICATIONS: The prototype gyro and Phase II electronics will be tested in an actual dynamic environment with DC rate, AC rate, and reasonable temperature diurnal. The data will be used to validate behavioral models from Phase II. Testing of this type can be performed at The Aerospace Corporation if the small business does not have suitable facilities.

REFERENCES:
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2. J. Ren, H. Hodaei, G. Harari, A. U. Hassan, W. Chow, M. Soltani, D. Christodoulides, M. Khajavikhan, "Ultrasensitive micro-scale parity-time-symmetric ring laser gyroscope," Optics Letters, Vol. 42, Issue 8, pp. 1556-1559, (2017), https://doi.org/10.1364/OL.42.001556;

KEYWORDS: ring laser gyro; distributed constellations; nanophotonic system; precision pointing; Gyroscope, GNC (Guidance, Navigation, & Control), RLG (Ring Laser Gyro), MEMS (micro electro-mechanical), gimbal, attitude control, Sagnac effect

SF241-0020 TITLE: Trusted Automated Satellite Operations for Mission Life

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Integrated Sensing and Cyber; Space Technology

OBJECTIVE: Space assets are currently almost completely operated from the ground. In order to ensure operation in an increasingly contested space environment, the spacecraft must make autonomous decisions and take action. The USSF will require trusted autonomous spacecraft to operate throughout their lifetimes under these circumstances. Hence, technology is needed to provide long periods of time without operator intervention, and this need should be extended to the life of the vehicle.

DESCRIPTION: Create an on-orbit autonomous software suite or architecture which can autonomously evaluate and recommend courses of action in combination with information derived off-board, doing so autonomously when needed.

The current state of the art is that many autonomous sub-modules for spacecraft control have been devised. The modules vary in their use from CubeSats up to small refrigerator sized form factor systems and from single spacecraft to clusters/mega constellations. But there has not been an effort to bring together these advances into a lifetime autonomous software suite. The full capability desired for this tech topic is to go beyond single modular autonomy approaches to one of operating through normal pattern of life from launch and early orbit to normal operations, to end of life. While the goal is a fully autonomous on-orbit system, multiple sub-elements are needed to develop a trusted capability and which the effort solution would need to address: 1) Data analytics techniques such as machine intelligence to build statistical understanding of a spacecraft's own normal pattern of life, deviations and course of action (COA) assessment tools 2) Methods for validation and verification of autonomous decision-making 3) Visualization tools focused on interaction between autonomous system and human users 4) A cyber-secure environment for this software suite 5) Electronics capability to enable computation and COA execution on-orbit.

PHASE I: Conduct a comprehensive review of current research in spacecraft autonomy including academic, civil and commercial sources. Investigate and compile the possible requirements for an integrated autonomy suite including key subsystems such as guidance, navigation, and control; thermal; propulsion; communications; and payload maintenance over the three major phases of spacecraft lifetime: Launch and early orbit, normal operations, and end of life. Describe how to merge current work on modular autonomous software and provide a design path to integrate across multiple subsystems software modules and across the life cycle of the spacecraft. The form factor of the spacecraft could range from a CubeSat up to a rideshare class (size of a half refrigerator) which may require different solutions. The deliverable should be a critical design review (CDR) quality engineering artifact and or a demonstration of the qualities of a lifecycle autonomy on a testbed (Software in the loop (SIL)) by the proposer.

PHASE II: Phase II will build and deliver a breadboard (TRL5) or hardware in the loop (HIL) quality solution, to be demonstrated on at least one form factor size, from 6, 12, 27 U CubeSat up to rideshare class (size of half a refrigerator), for vehicles of 3-year, 5-year and 10-year operational lifetimes. The simulation shall take in normal environmental influences, micrometeoroid impacts, radiation events, and maintain the vehicle operations in all three life phases as well as maintain a positive energy balance, pointing stability, and payload operational environments. Payloads can be communications, navigation, and sensing.

PHASE III DUAL USE APPLICATIONS: The prototype lifetime autonomous system from Phase 2 shall be tested by a government sponsored entity (UARC, FFRDC, DoD Lab) to validate the capability of the software and hardware to meet the requirements. Formal documentation will be provided to enable the

proposer to share the architecture verification and validation with others in the supply chain as a direct injection to the DIB.
Evaluate and document transition opportunities for utilization in approved Government and civilian applications.

REFERENCES:

1. Operations for Autonomous Spacecraft, Castano, R, et al. Proceedings of the 2022 IEEE Aerospace Conference, arXiv:2111.10970v1, 16 pgs.;
2. Design and Testing of Autonomous Distributed Space Systems, Cramer, N., et al, Small Satellite Conference 21-1-04.;

KEYWORDS: autonomous spacecraft; spacecraft decision making;

SF241-0021 TITLE: Optical Interconnects for High-Speed High-Efficiency Intra-satellite Data Transfer in the Space Environment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Space Technology

OBJECTIVE: Develop and demonstrate a photonics-based optical data transfer capability suitable for use in the space environment for intra-satellite data movement between electronic components.

DESCRIPTION: Advances in digital microelectronics enable critically important capabilities for DoD space systems in the areas of information processing, sensors, and communications. System performance in these domains is now more and more constrained not by the limits of processing speed at individual chips, but rather by the ability to move data between them electrically. Optical interconnects for intra-satellite data transfer is already in use in some commercial space ventures, but for military use these implementations are inadequate in terms of size, mass, and power. Currently, they do not have the reliability and robustness that is required for long-term use in the natural and strategic space environments. The target performance is a minimum data rate of 250 Gb/s with maximum energy loss of 5 pJ/bit. To meet size, weight, and power constraints, the approach should implement an optical transceiver with photonic and electronic integrated circuits in a multi-chip package to enable sending and receiving data via optical fiber. The environmental objectives are as follows: Radiation Environment: ≥300 krad of total ionizing dose (TID) and >75 MeV·cm2/mg linear energy transfer (LET) for single event effects (SEE), Temperature Range: -55 to 135 C.

PHASE I: The resource constraints are 6 months and $150,000. Vendors will evaluate design trades, component selection, packaging options, etc., to select a candidate design to meet system performance and environmental objectives. They will provide a roadmap for Phase II execution.

PHASE II: The resource constraints are 24 months and $1,500,000. Vendors will develop a prototype of the candidate design, leveraging components that will provide a path to environmental qualification. They will demonstrate that the design achieves the data rate and efficiency targets. The vendor will identify qualification risks and propose a qualification test plan.

PHASE III DUAL USE APPLICATIONS: The Phase III effort will be an on-orbit demonstration of intra-satellite data transfer operations. This will be enabled by laboratory demonstration of the capability and TRL 5 at the conclusion of the Phase II. Lower cost to orbit, proliferating commercial activity, and more complex military operations in mission areas that include Space Domain Awareness and autonomy are expected to lead Phase III opportunities to validate the capability.

REFERENCES:

1. International Defense Security & Technology December 12, 2021 "DARPA PIPES developing optical transceiver capabilities into multi-chip modules for high throughput parallel processing". https://idstch.com/technology/electronics/darpa-pipes-developing-integrated-optical-transceiver-capabilities-multi-chip-modules-high-throughput-parallel-processing/;

KEYWORDS: Optical Transceiver; Optical Interconnects; High-speed data comm; Photonics; Radiation hard photonics

VERSION 5

SF241-0022 TITLE: Ultra-Broadband High-Definition High-Frame Rate NIR-MWIR Imager

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 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: Development of an infrared imager with an ultrawide bandpass encompassing the Near Infrared (NIR) to the Mid-Wave Infrared (MWIR) spectrum: 0.7 micrometers to 5.5 micrometers.

DESCRIPTION: Broadband infrared imagers are required to characterize signatures of military targets, both cooperative and hostile. The specific need is the characterization of missile plume and hardbody signatures in static and free flight tests. This threat characterization supports the design and testing of missile warning and countermeasure systems. The combination of a broadband imager with multiple filters allows registered imagery to be acquired in multiple bands, covering a broader spectral range than currently available hyperspectral imagers. The multi-band ultra-broadband data would also be useful in temperature/emissivity determination of hypersonic thermal protection systems during ground tests in arc-heated facilities. The infrared detector material InAsSb is an enabling technology to be considered.

The focal plane of the imager should consist of at least 2040 x 1100 pixels with a pixel pitch no greater than 5 mm. Full-frame frame rate needs to be at least 500 frames/sec. An f# of f/2.4 is preferred. An integral filter wheel with at least 4 positions accommodating both warm bandpass and neutral density filters in each position is required. Special attention is required to ensure the sandwiching of bandpass and neutral density filters does not result in ghosting or other image artifacts. The filter wheel should not only remotely addressable, but should be able to be driven at some rate during a data collection. The acquisition of high-rate multispectral registered imagery in several sub-bands along with the wideband (in a single imager) is the requirement. High sensitivity is also required, with a well depth of at least 1.8 $x10^6$ electron-volts, a noise floor of no greater than 150 mV, and a minimum detectable temperature difference of 35 mK.

PHASE I: The Phase 1 effort should develop and prove the feasibility of the proposed approach through an analysis of alternatives, identification of high-risk technical elements, and generation of a conceptual design matrix that lays out how achievable design parameters impact system requirements – e.g. frame rate achievable as a function of focal plane array size. The system design should be sufficiently detailed to guide the Phase II work with a minimum of risk. The Phase I effort will culminate in a conceptual design that optimally meets system requirements and a detailed plan for development of a prototype system during the Phase II effort.

PHASE II: The conceptual design will be matured into a detailed design. Iterative prototypes will be developed to validate the fundamental approach. The Phase II effort will culminate in the demonstration and delivery of a fully operational prototype imager along with a validated design for future larger scale production.

PHASE III DUAL USE APPLICATIONS: Phase III efforts would include a limited production of a number of imagers for inclusion in existing signature measurement systems, such as the Arnold

Engineering Development Complex Field Measurement Team and the Center for Countermeasures Joint Standard Instrumentation Suite. Broadband infrared imagers of this type would find wide military application for surveillance, night vision, and target detection, identification, and tracking. As mentioned above, applications for non-contact temperature/emissivity measurements for hypersonic systems and other defense applications are also possible. Commercial applications for security, surveillance, and non-contact imaging thermometry for manufacturing should also be pursued. Infrared imagers are now a ubiquitous piece of laboratory hardware. Advances in infrared imagery will find wide application supporting many disciplines.

REFERENCES:

1. Rogalski A, Martyniuk P, Kopytko M, Madejczyk P, Krishna S. “InAsSb-Based Infrared Photodetectors: Thirty Years Later On.” Sensors (Basel). 2020 Dec 9;
2. 20(24):7047. doi: 10.3390/s20247047. PMID: 33317004;
3. PMCID: PMC7763214;
4. Ting, David Z., Sir B. Rafol, Arezou Khoshakhlagh, Alexander Soibel, Sam A. Keo, Anita M. Fisher, Brian J. Pepper, Cory J. Hill, and Sarath D. Gunapala. 2020. "InAs/InAsSb Type-II Strained-Layer Superlattice Infrared Photodetectors" Micromachines 11, no. 11: 958. https://doi.org/10.3390/mi11110958;

KEYWORDS: Near Infrared, NIR, InAsSb, Indium Arsenide Antimonide, focal plane array

SF241-0023 TITLE: Low Latency Space Object Maneuver Detection

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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 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 methods for reducing the latency in space object maneuver detection, utilizing existing sensor phenomenologies, cadences, and data types, with the objective of identifying and characterizing the maneuver with as few observations and as short of time as possible.

DESCRIPTION: The ability to detect space object maneuvers is fundamental in enabling space domain awareness and space traffic management. When a space object maneuvers, deviations from its previous track can be sufficiently large to prohibit association of the observed object to the track. The result is an uncorrelated track (UCT), a trackable object whose origin has not yet been established. Only upon reconciliation of the UCT to a previously known object's track can the association be made so that a full state history of the track is available. This process, known colloquially as UCT resolution, typically involves the backwards and forward propagation of states to identify possible candidate maneuver times, and is often done well after the maneuver has been performed. This time lag can result in critical information about maneuvering satellites to be delayed in sharing with analysts who monitor the space object population. While the optimal solution involves observing all maneuvering satellites persistently, such a solution is not feasible. The best case is therefore for analysts to detect, characterize, and identify satellite maneuvers as soon as new observation data is collected.

Solutions are sought that enable space object maneuver detection with limited latency once new observational data has been acquired. This will aid in maintaining persistent awareness of on-orbit objects. The problem is further compounded by the various orbital regimes in which important space assets reside, and the various sensor phenomenologies that dominate that regime. Solutions that bridge various orbital regimes, allowing for a comprehensive all-space solution are preferred to regime-specific solutions.

PHASE I: Develop solution methodology. Conduct analysis of alternatives, propose solution, and develop algorithm. Algorithm should be implemented in prototype simulations against synthesized or real data to demonstrate potential for success. Assess computing requirements necessary for Phase II effort.

PHASE II: Fully develop and implement solution methodology as prototype software. Methodology should be tested against real-world data across multiple orbital regimes. Quantify performance across multiple sensor types including variations to noise and sensing cadence. Compare timeliness of detection and characterization performance to legacy methods.

PHASE III DUAL USE APPLICATIONS: Phase III efforts may include integration of solution into operational test environments for evaluation with real-time data feeds, and transition to operational users. Military applications include more timely and accurate conjunction assessment and threat awareness. Expected TRL at Phase III entry is 5.

REFERENCES:

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2. N. Singh, J. T. Horwood, and A. B. Poore, "Space object maneuver detection via a joint optimal control and multiple hypothesis tracking approach," in Proceedings of the 22nd AAS/AIAA Space Flight Mechanics Meeting, Charleston, SC, January 2012 (Paper AAS-12-159);
3. Pastor, A., Escribano, G., Sanjurjo-Rivo, M. et al. Satellite maneuver detection and estimation with optical survey observations. J Astronaut Sci 69, 879–917 (2022). https://doi.org/10.1007/s40295-022-00311-5;

KEYWORDS: space domain awareness; space situational awareness; space traffic management; maneuver detection

SF241-0024 TITLE: Evaluating Data Strategies in Training AI Solutions for Space C2

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 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: Evaluate and illustrate the consequences of employing various data strategies in training autonomous systems (Artificial Intelligence and Deep Learning based algorithms). Demonstrate how space superiority may depend on employing AI which is sufficiently trained and how space domain awareness data can be used to support this training.

DESCRIPTION: Autonomous space command and control systems are already being fielded within mega-constellations and are being considered for other space systems in deep space. Today flight dynamics teams are informed by third party space situational awareness products which are derived from different approaches to collecting data on operational spacecraft and debris. As increased activity which is considered to be dual-use becomes more prevalent, we will increasingly see the use of autonomy in addressing various challenges for which human cognition may not scale to or be capable of responding to in time. A key step in the development of AI solutions is the training of the algorithms which will do the decision-making. This effort seeks to evaluate the relative performance of such algorithms when they are trained by space domain awareness data of varying quality, density, geometric diversity, precision, and timeliness.

The past few years have seen successful proximity operations in GEO, a rapid increase in maneuverable traffic in LEO, and more technology options for autonomous systems to perform enhanced services in space including life extension, refueling, inspection, etc. As more interactions between spacecraft are observed, there is an increasingly comprehensive body of data which can be used to train algorithms which enable autonomous space command and control (C2) solutions. We are already seeing evidence of this training possibly being employed today. As digital twins of space systems become available, it will be increasingly possible to model space systems, their onboard logic, and to enable training within a digital environment. As new systems are fielded, their autonomous logic can be further trained on-orbit and it will be desirable to compare on-orbit experience to models used to train within the digital environment. This topic seeks to develop the digital training environment for space C2 algorithms, and to demonstrate how the agents within this environment can be trained using real-world and simulated SDA data.

PHASE I: Design a digital traning environment which can enable modeling and simulation using digital representations of space systems, as well as data-driven reconstructions of real-world operations informed by SDA data.

PHASE II: Develop a prototype digital training environment which can enable modeling and simulation using digital representations of space systems as well as data driven reconstructions of real-world operations informed by SDA data. Using this environment, train AI algorithms for space command and control and demonstrate the relative performance of these agents as the data strategies used for training are varied. Evaluate the impact of training autonomous systems using SDA data of varying quality, density, geometric diversity, precision, and timeliness.

PHASE III DUAL USE APPLICATIONS: Integrate prototype solution into systems available in operational environments for operator and analyst evaluation and feedback. Expected TRL at Phase III entry is 5.

REFERENCES:

1. Kyriakopoulos, George & Pazartzis, Photini & Koskina, Anthi & Bourcha, Crystalie. (2021). ARTIFICIAL INTELLIGENCE AND SPACE SITUATIONAL AWARENESS: DATA PROCESSING AND SHARING IN DEBRIS- CROWDED AREAS.;

KEYWORDS: ai/ml; artificial intelligence; space domain awareness; space c2

SF241-0025 TITLE: Modernizing USSF BMT

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

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 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: Technology has revolutionized military training environments in numerous ways, offering significant advantages and enhancing the overall effectiveness of training. This topic seeks to create a distinct Space Force Basic Military Training (BMT) program that integrates innovative technology and training strategies to drive improve training outcomes for Guardians.

DESCRIPTION: This topic seeks to develop a robust, distinctly Space Force basic military training program that leverages innovative technology to foster the development of critical skills, decision-making abilities, and muscle memory necessary for their roles.

Key aspects to be considered:
Cost-Effectiveness: Technology can significantly reduce training costs over time. Simulators, for instance, eliminate the need for live ammunition, fuel, and other expensive resources, making training more affordable and accessible.

Repetitive Practice: Technology permits soldiers to engage in repetitive practice without exhausting resources. This iterative learning approach enables trainees to refine their skills and improve performance over time.

Personalized Training: Different soldiers may have varying skill levels and learning styles. Technology allows for personalized training programs tailored to individual needs, ensuring that each soldier receives optimal instruction.

Immediate Feedback: Training technologies can provide instant feedback, offering insights into performance strengths and weaknesses. Trainees can learn from mistakes quickly and efficiently, improving their abilities in a shorter time.

Remote Training: With technology, soldiers can access training resources remotely, reducing the need to travel to specific locations. This is particularly beneficial for reservists or soldiers stationed in remote areas.

Tactical Communication: Advanced communication systems enhance coordination between units during training exercises. Efficient communication is essential in a military setting, and technology enables real-time information sharing and decision-making.

Data-Driven Analysis: Technology allows for the collection and analysis of vast amounts of training data. This data-driven approach helps identify trends, patterns, and areas for improvement, leading to more effective training methodologies.

Cybersecurity Training: As the importance of cybersecurity grows, technology facilitates realistic cybersecurity training, helping Guardians learn to defend against digital threats and safeguard sensitive information.

Equipment Familiarization: Guardians can use technology to familiarize themselves with complex military equipment before encountering them in real-life scenarios. This reduces the learning curve and enhances overall operational readiness.

Risk Mitigation: High-risk training exercises can be dangerous and potentially life-threatening. By using technology, Guardians can undergo preliminary training in safe environments, reducing the likelihood of accidents and injuries.

Scenario Customization: Technology allows trainers to create various scenarios, adapting training to meet specific objectives or challenges. This flexibility ensures that Guardians are prepared for a wide range of potential situations they may encounter in the field.

In summary, technology in military training environments offers realism, cost-effectiveness, personalized learning, immediate feedback, enhanced communication, and the ability to analyze data. These advantages contribute to better-prepared soldiers, improved operational capabilities, and ultimately, increased mission success rates.

PHASE I: The Phase I will be a collaborative effort with the Space Force BMT team to identify requirements and outline the curriculum for a 7 week basic military training program.

PHASE II: During Phase II, the curriculum generated during Phase I will be further refined and implemented, with a goal of having this new distinct Space Force curriculum ready for implementation.

PHASE III DUAL USE APPLICATIONS: Phase III efforts will consist of continued refinement and improvement. As operations, culture, and weapons systems change over time, so will the Space Force BMT program. Phase III efforts will ensure the Space Force's BMT program is always current.

REFERENCES:

1. Current USSF BMT curriculum;

KEYWORDS: U.S. Space Force; USSF; BMT; Basic military training

DEPARTMENT OF THE AIR FORCE (DAF)
24.1 SMALL BUSINESS INNOVATION RESEARCH (SBIR) DIRECT TO PHASE II (D2P2)
PROPOSAL SUBMISSION INSTRUCTIONS
AMENDMENT 1

The purpose of this Amendment is to provide additional information for all D2P2 applicants. This Amendment modifies the D2P2 instructions as follows:

1. The following language is deleted from the "Introduction" section on page 3 of the instructions:
   ~~Feasibility documentation MUST NOT be solely based on work performed under prior or on-going Federally funded SBIR and/or STTR work.~~

   The following language is added to the "Introduction" section on page 3 of the instructions:
   Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.

2. The following language is deleted from the "Technical Volume (Volume 2) Subheading 7(a)(i):
   ~~The draft is due 30 days after Phase II technical effort.~~

3. The following language is deleted from the heading of "Technical Volume (Volume 2)" Subsection (9):
   ~~Company Commercialization Report (CCR)~~

   The following language is deleted from the body of "Technical Volume (Volume 2)" Subsection (9):
   - ~~a) Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations. Note, even though the CCR is listed here under the Volume 2 heading, as stated in this document, the CCR comprises Volume 4 of the proposal submission.~~

4. The following language is added as "Technical Volume (Volume 2)" as part of a newly-created Subsection (e):
   Note, the "Commercialization Plan" and the "Company Commercialization Report" are distinct documents. The Company Commercialization Report (CCR) comprises Volume 4 as separately indicated in these instructions.

   The following language is deleted from "Technical Volume (Volume 2)" numbered subsection (8):
   ~~reviewers~~
   The following language is added to the "Technical Volume (Volume 2)" numbered subsection 8:
   applicant-identified subject matter experts, regardless of affiliation

5. The following language is deleted from the subheading of "Supporting Documents Volume (Volume 5)":
   ~~documents~~
   This word has been replaced by:

solicitation attachments

The following language has been added to the “Feasibility Documentation” subheading under “Supporting Documents Volume (Volume 5)” (additions in yellow):

“Feasibility documentation (required for all proposal submissions, contained within Volume 5, not subject to page limitations)

The following language has been deleted from the “Feasibility Documentation” subheading under “Supporting Documents Volume (Volume 5)” numbered subsection (1) (deletions in ~~red~~):

~~Offerors must adequately document completion of the Phase I feasibility requirement*. Offerors must demonstrate completion of R/R&D through means not solely based on previous efforts under the SBIR/STTR Programs to establish Phase II proposal feasibility based on criteria provided in the D2P2 topic descriptions.~~

The following language has been added to the “Feasibility Documentation” subheading under “Supporting Documents Volume (Volume 5)” numbered subheading (1) (additions in yellow):

Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.

The following language has been added to the “Feasibility Documentation” subheading under “Supporting Documents Volume (Volume 5)” numbered subheading (2) (deletions in ~~red~~):

~~as part of the Technical Volume (Volume 2)~~

The following language has been added to the “Feasibility Documentation” subheading under “Supporting Documents Volume (Volume 5)” numbered subheading (2) (additions in yellow):

Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.

6. Topic Language

All topics are edited to include the following language:

As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement.

7. This Amendment emphasizes the points of contact information that is contained within this solicitation to reiterate to applicants there are cognizant POCs to answer questions about these instructions:

Points of Contact:

- General information related to the AF SBIR/STTR program and **proposal preparation instructions**, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us.
- Questions regarding the **DSIP electronic submission system**, 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 the DoD 24.1 SBIR BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
  Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

All other terms and provisions remain unchanged as a result of this Amendment.

DEPARTMENT OF THE AIR FORCE (DAF)
24.1 SMALL BUSINESS INNOVATION RESEARCH (SBIR) DIRECT TO PHASE II (D2P2)
PROPOSAL SUBMISSION INSTRUCTIONS

The DAF intends these proposal submission instructions 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 24.1 SBIR BAA posted on the DoD SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Complete proposals **must** be prepared and submitted via https://www.dodsbirsttr.mil/submissions/ (DSIP) on or before the date published in the DoD 24.1 SBIR BAA. 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.

The DAF 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 DAF 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 One Help Desk.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF 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 DAF. **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 SBIR/STTR One Help Desk.** The message shall include the subject line, “24.1 Address Change”.

Points of Contact:

- General information related to the AF SBIR/STTR program and **proposal preparation instructions**, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us.
- Questions regarding the **DSIP electronic submission system**, 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 the DoD 24.1 SBIR BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
  Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

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.

DIRECT TO PHASE II

15 U.S.C. §638 (cc), as amended by the SBIR AND STTR EXTENSION ACT OF 2022, 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. DAF is conducting a "Direct to Phase II" implementation of this authority for these 24.1 SBIR topics and does not guarantee D2P2 opportunities will be offered in future solicitations. Each eligible topic requires documentation to determine whether the feasibility requirement described in the Phase I section of the topic has been met.

DIRECT TO PHASE II PROPOSAL SUBMISSION

The DoD SBIR 24.1 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.

The complete proposal 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.**

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit www.sam.gov. A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its representations and certifications are up-to-date to avoid delay in award.

On April 4, 2022, the DUNS Number was replaced by the Unique Entity ID (SAM). The Federal Government will use the UEI (SAM) to identify organizations doing business with the Government. The DUNS number will no longer be a valid identifier. If the proposing small business concerns has an entity registration in SAM.gov (even if the registration has expired), a UEI (SAM) has already been assigned. This can be found by signing into SAM.gov and selecting the Entity Management widget in the Workspace or by signing in and searching entity information. For proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the Small Business Concern profile with the UEI (SAM) as soon as possible.

For new proposing small business concern registrations, follow instructions during SAM registration on how to obtain a Commercial and Government Entry (CAGE) code and be assigned the UEI (SAM). Once a CAGE code and UEI (SAM) are obtained, update the Small business concern's profile on the DSIP at https://www.dodsbirsttr.mil/submissions/.

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 provided in the DoD SBIR 24.1 BAA.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: DAF 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.~~ Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.

DIRECT TO PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

B. Proposal Requirements. A Direct To Phase II proposal shall provide sufficient information to persuade the AF the proposed technology advancement represents an innovative solution to the scientific or engineering problem worthy of support under the stated criteria.

C. 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 in the work plan. See the DoD BAA regarding proprietary information marking.

D. 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 consecutivelynumbered. Offerors are discouraged from including promotional and non-programmatic items. If included, such material will count toward the page limit.

DIRECT TO PHASE II PROPOSAL FORMAT

Complete proposals must include all of the following:

Volume 1: DoD Proposal Cover Sheet

Note: If selected for funding, the proposal's technical abstract and discussion of anticipated benefits will be publicly released. Therefore, do not include proprietary information in this section.

Volume 2: Technical Volume

Volume 3: Cost Volume

Volume 4: Company Commercialization Report

Volume 5: Supporting Documents, e.g. DoD Form 2345 (if applicable), 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. 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 and its team members in the United States, as defined in the DoD SBIR 24.1 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 under18 U.S.C. Section 1001, punishable by a fine up to $250,000, up to five years in prison, or both.

Please note the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete. The DAF recommends completing submission early, as site traffic is heavy prior to solicitation close, causing system lag. **Do not wait until the last minute.** The AF will not be responsible for proposals not completely submitted prior to the deadline due to system inaccessibility unless advised by DoD. The DAF will not accept alternative means of submission outside of DSIP.

DOD PROPOSAL COVER SHEET (VOLUME 1)

Complete the proposal Cover Sheet in accordance with the instructions provided via DSIP. 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 keywords/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.

TECHNICAL VOLUME (VOLUME 2)

The technical proposal includes all items listed below in the order provided.

(1) **Table of Contents:** A table of contents should be located immediately after the Cover Sheet.

(2) **Glossary:** Include a glossary of acronyms and abbreviations used in the proposal.

(3) **Milestone Identification:** Include a program schedule with all key milestones identified.

(4) **Identification and Significance of the Problem or Opportunity:** Briefly reference thespecific technical problem/opportunity to be pursued under this effort.

(5) **Phase II Technical Objectives:** Detail the specific objectives of the Phase II work and describe the technical approach and methods to be used in meeting these objects. The proposal should also include an assessment of the potential commercial application for eachobjective.

(6) **Work Plan:** 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) 1.0 – Objective: This section is intended to provide a brief overview of thespecialty area. It should explain the purpose and expected outcome.

b) 2.0 – Scope: This section should provide a concise description of the work to beaccomplished, including the technology area to be investigated, goals, and majormilestones. 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) 3.0 – Background: The offeror shall identify appropriate specifications, standards, andother 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) 4.0 – Task/Technical Requirements: The detailed individual task descriptions 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."

(7) **Deliverables:** Include a section clearly describing the specific sample/prototype hardware/ software to be delivered, as well as data deliverables, schedules, and quantities. Be aware of the possible requirement for unique item identification IAW DFARS 252.211-7003, ItemIdentification 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 SBIR/STTR data rights in all data developed or generated under the SBIR/STTR contract for a period of 20 years, commencing at contract award. Upon expiration of the 20-year SBIR/STTR license, the Government has Government purpose rights to the SBIR data.

i. Final Report: ~~The draft is due 30 days after 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 result 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.

b) Additional Reporting: AF may require additional reporting documentation including:

i. Software documentation and users' manuals;
ii. Engineering drawings;
iii. Operation and maintenance documentation
iv. Safety hazard analysis when the project will result in partial ortotal development and delivery of hardware; and
v. Updates to the commercialization results.

(8) **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 applicant-identified subject matter experts, regardless of affiliation, ~~reviewers~~ providing comments regarding the offeror's knowledge of the state-of-the-art in the specific approach proposed.

(9) ~~Company Commercialization Report (CCR)/~~Commercialization Potential:

~~a) Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations. Note, even though the CCR is listed here under the Volume 2 heading, as stated in this document, the CCR comprises Volume 4 of the proposal submission.~~

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 Governmentalfunding 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 via SBA. These updates will be required at completion of the effort, and subsequently when the contractor submits a new SBIR/STTR proposal to DoD. Firms not submitting a new proposal to DoD will be requested to provide updates annually after the D2P2 completion.

e) Note, the “Commercialization Plan” and the “Company Commercialization Report” are distinct documents. The Company Commercialization Report (CCR) comprises Volume 4 as separately indicated in these instructions.

(10) **Military Applications:** Briefly describe the existing/potential military requirement and the military potential of the SBIR/STTR Phase II results. Identify the DoD agency/organization most likely to benefit from the project. State if any DoD agency has expressed interest in, or commitment to, a non-SBIR, Federally funded Phase III effort. This section should include not more than one to two paragraphs. Include agency point of contact names and telephone numbers.

(11) **Relationship with Future R/R&D Efforts**:

i. State the anticipated results of the proposed approach, specifically addressing plans for Phase III, if any.

ii. Discuss the significance of the D2P2 effort in providing a basis for the Phase III R/R&D effort, if planned.

E. **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 the DoD 24.1 BAA 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 becapable 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 sharedbroadly 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.

F. **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 andregulations of Federal, state, and local Governments for, but not limited to, airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulkwaste disposal practices, and handling and storage of toxic and hazardous materials.

G. **Consultants/Subcontractors**: Private companies, consultants, or universities may be involved in the project. All should be described in detail and included in the cost proposal. In accordance with the Small Business Administration (SBA) SBIR Policy Directive, a minimum of 50% of the R/R&D must be performed by the proposing firm, unless otherwise approved in writing by the Contracting Officer. These requests can only be made upon proposal submission. Signed copies of all consultant or subcontractor letters of intent must be attached to the proposal. These letters should briefly state the contribution or expertise being provided. Include 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 E above.

H. 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 this BAA is substantially the same as another proposal previously, currently, or in the process of being funded by another Federal

agency/DoD Component or the DAF, the offeror 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) towhich 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 besubmitted, or under which an award is expected or has been received.
f) If award was received, provide the contract number.
g) Specify the applicable topics for each SBIR proposal submitted or award received.

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

COST VOLUME (VOLUME 3)

A detailed cost proposal must be submitted. Cost proposal information will be treated as proprietary. Proposed costs must be provided by both individual cost element and contractor fiscal year (FY) in sufficient detail to determine the basis for estimates, as well as the purpose, necessity, and reasonableness of each. This information will expedite award 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 proposalincludes:

a) **Direct Labor:** Identify key personnel by name, if possible, and labor category, if not. Direct labor hours, labor overhead, and/or fringe benefits, and actual hourly rates for each individual are also necessary for the CO to determine whether these hours, fringe rates, and hourly rates are fair and reasonable.

b) **Direct Cost 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 theneed 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.

d) **Special Tooling, Special 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 special test equipment purchases must, in the CO's opinion, be advantageous to the Government and relate directly to the effort. These toolings or equipment should not be of a type that an offeror would otherwise possess in the normal course of business. These may include such items as innovative instrumentation and/or automatic test equipment.

e) **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-half of 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.

f) **Consultants:** For each consultant, provide a separate agreement letter briefly stating the service to be provided, hours required, and hourly rate, as well as ashort, concise resume.

g) **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.

h) **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.

i) **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.

NOTE: If no exceptions are taken to an offeror's proposal, the Government may award a contract without exchanges. 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 CO identified on the cover page. The Government reserves the right to reopen exchanges later if the CO determines doing so to be necessary.

COMPANY COMMERCIALIZATION REPORT (VOLUME 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR 24.1 BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

SUPPORTING DOCUMENTS VOLUME (VOLUME 5)

The following ~~documents~~ solicitation attachments are required for all proposal submissions:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1 to the DOD SBIR 24.1 BAA)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2 to the DOD SBIR 24.1 BAA)
3. Disclosure of Funding Sources (Attachment 4 to the DOD SBIR 24.1 BAA)

The following documents may be required if applicable to your proposal:

1. DD Form 2345: For proposals submitted under export-controlled topics, either International Traffic in Arms or Export Administration Regulations (ITAR/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/DD2315Ins tructions.aspx. DD Form 2315 approval will be required if proposal if selected for award.
2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 24.1 BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

Feasibility Documentation (required for all proposal submissions, contained within Volume 5, not subject to page limitations)

1. ~~Offerors must adequately document completion of the Phase I feasibility requirement*. Offerors must demonstrate completion of R/R&D through means not solely based on previous efforts under the SBIR/STTR Programs to establish Phase II proposal feasibility based on criteria provided in the D2P2 topic descriptions.~~ Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work. Phase II proposals require a comprehensive, detailed effort description. Proposals should demonstrate sufficient technical progress or problem-solving results to warrant more extensive RDT&E. Developing technologies with commercial and military potential is extremely important. Particularly, AF is seeking proposals emphasizing technologies' dual-use applications and commercialization.
2. * NOTE: The offeror shall provide information to enable the agency to make the 15 U.S.C. 638(cc) determination of scientific and technical feasibility and merit. Offerors are required to provide information demonstrating scientific and technical merit and feasibility has been established ~~as part of the Technical Volume (Volume 2)~~. The DAF will not review the Phase II proposals if it is determined the offeror 1) fails to demonstrate technical merit and feasibility are established or 2) the feasibility documentation does not support substantial performance by the offeror and/or the PI. Refer to the Phase I description within the topic to review the minimum requirements needed to demonstrate scientific and technical feasibility. **~~Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing Federally-funded SBIR or STTR work.~~ Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.**
3. If appropriate, include a reference or works cited list as the last page.
4. 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. 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 24.1 BAA for technical data rights information.

5. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated.

FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)

Note that the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DAF does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals submitted in response to DAF topics should not include TABA.

METHOD OF SELECTION AND EVALUATION CRITERIA

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.

Proposals will be evaluated for overall merit in accordance with the criteria discussed in the 24.1 BAA. DAF is seeking varying technical/scientific approaches and/or varying and new technologies that would be responsive to the problem statement(s) and area(s) of interest in the topic. Multiple procurements are planned and anticipated to be awarded as a result of the topic, each proposal is considered a separate procurement and will be evaluated on its own merit, and that the Government may award all, some, or none of the proposals. Any per-award or per-topic funding caps are budgetary estimates only, and more or less funding may become available. Funding decisions are made with complete disregard to the other awards under the same topic.

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may choose to either 1) create a plan to mitigate the risk(s) or 2) DAF may decide not to select the proposal for award based upon a totality of the review.

DAF USE OF SUPPORT CONTRACTORS

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), Montech, Oasis, 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 contract to 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 (Daniel.Brewer.13@us.af.mil) with concerns about any of these contractors**.

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.

Automated feedback will be provided for proposals designated Not Selected. Additional feedback may be provided at the sole discretion of the DAF.

IMPORTANT: Proposals submitted to the DAF are received and evaluated by different organizations, handled 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.

The Air Force anticipates that all proposals will be evaluated and selections finalized within approximately 90 calendar days of solicitation close. Please refrain from contacting the BAA CO for proposal status before that time.

Refer to the DoD SBIR Program BAA 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: Air Force SBIR/STTR Contracting Officer Daniel J. Brewer, Daniel.Brewer.13@us.af.mil.

AIR FORCE SUBMISSION OF FINAL REPORTS

All Final Reports will be submitted to the awarding DAF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

Air Force SBIR 24.1 Direct to Phase II Topic Index

Topic Number	Topic Name	Maximum Value*	Maximum Duration ** (in months)	Technical Volume Page Limit***
AF241-D001	Rapidly Deployable Base Fortification Systems	$1,800,000.00	24	35
AF241-D002	Machine Vision Work Assistance	$1,800,000.00	24	35
AF241-D003	Securing AI/ML Models Against Adversarial Threats for Advanced Command and Control (AC2) Missions	$1,800,000.00	24	35
AF241-D004	Explainable Reinforcement Learning (XRL) for Command and Control (C2)	$1,800,000.00	24	35
AF241-D005	UAS TRACKING SYSTEM	$1,800,000.00	24	35
AF241-D006	Rapid Deployment Sensor System	$1,800,000.00	24	35
AF241-D007	Air Force Defense and Biometric Network	$1,800,000.00	24	35
AF241-D008	Adaptive Robotic Behavior for Dynamic Environments	$1,800,000.00	24	35
AF241-D009	Rapidly Deployable Airborne Fuel Flowmeter (RDAFF)	$1,800,000.00	24	35
AF241-D010	Wireless Airborne Instrumentation Network (WAIN)	$1,800,000.00	24	35
AF241-D011	Robotic Electronic Component Replacement and Soldering in a Digital Depot Environment	$1,800,000.00	24	35
AF241-D012	Mandatory Declassification Review (MDR) Natural Language Processing (NLP) Tool	$1,800,000.00	24	35

AF241-D013	Trustworthy Generative Artificial Intelligence (GenAI) to Structure Data and Deliver Accurate Insights of Command, Control, Communication and Computer (C4) Systems	$1,800,000.00	24	35
AF241-D014	Optical Air Data System (OADS)	$1,800,000.00	24	35
AF241-D015	Collaborative Airborne Sensor Fusion via Maximizing Information under Constraints	$1,800,000.00	24	35
AF241-D016	Large RF Windows for High-Temperature Seekers	$1,800,000.00	24	35
AF241-D017	Augmented Reality Enhanced Corrosion Control Systems	$1,800,000.00	24	35
AF241-D018	Long Range Strike System	$1,800,000.00	18	35
AF241-D019	Low-Cost Long-Range Airdrop Delivery	$1,800,000.00	18	35
AF241-D020	Counter-UAS Long Bow	$1,800,000.00	18	35
AF241-D021	In-Place Heat Treat for Incrementally Formed Parts	$1,800,000.00	24	35
AF241-D022	Microelectronics Inoculation	$1,800,000.00	24	35
SF241-D023	Automated MBSE Model Generation of Space Systems	$1,800,000.00	24	35
SF241-D024	15 SPSS Path to Production Development for Electro-Optical Sensor Scheduling Software Modernization	$1,800,000.00	24	35
SF241-D025	Alternative Position, Navigation, and Timing	$1,900,000.00	24	35
SF241-D026	Digital Spaceport of the Future	$1,900,000.00	24	35

***Proposals that exceed this amount will be disqualified**
**** Proposals that exceed this duration will be disqualified**
*****Pages in excess of this count will not be considered during evaluations**

AF241-D001 TITLE: Rapidly Deployable Base Fortification Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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(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 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: Development of improved base fortification systems that provide rapid defense for personnel in an austere environment. Maximum utilization of readily available resources in the field it to be utilized in order to minimize transportation weight, deployment time, and destruction for withdrawal time. Technology should be about to be transportable on aircraft with minimal footprint.

DESCRIPTION: Currently, military personnel must bring equipment with them to austere environments in order to fortify their fighting position. For shorter durations, the sandbag is the most likely fortifying material to be utilized by personnel in the field. Additionally, the sandbag serves a pivotal function in long-term defensive applications. The basic sandbag requires ready access to dirt, sand, or similar earth material that be excavated to fill the bag and then it is arranged in a manner to provide a makeshift protection wall. Of particular interest are technologies that can reduce the employment time of sandbags or completely replace the sandbag system with a comparable system that provides equal, or better, levels of protection for personnel. Currently, the sandbag is manually filled with some in-field improvements that have been created by personnel. However, even with these manual creations, the process of filling and deploying sandbags is extremely time consuming, which increase personnel fatigue and reduces defensive capabilities. Improvement points may include, but not limited to: prefilled sandbags that fully deploy under certain conditions, lightweight systems capable of rapidly filling sandbags, lightweight systems capable of quickly deploying multiple sandbags, or a total sandbags replacement system. Further, the systems need to be minimal in size and weight to reduce cargo size and weight such that impact for transportation is minimized. This work is to be done at the unclassified level for Phase I and II.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. In order to be awarded a D2P2, the applicant’s technology should have a fully developed blueprint, concept or, at best, prototype to further develop. The proposer should demonstrate the feasibility of their design and its readiness for a Phase II.

PHASE II: Perform in-depth research and develop, resulting in a full-scale prototype package that demonstrates the capability of the product and the time to deploy as compared to a comparable dimension of standard fortification products in use today. Delivery and demonstration of the product will be conducted in the customer's environment, and performance will be evaluated.

PHASE III DUAL USE APPLICATIONS: Explore and pursue paths for military and commercial applications. Potential users may include, but are not limited to, Federal Emergency Management Agency, Department of Homeland Security, Border Patrol, and local governments. This phase will also focus on inserting and evaluating performance of the developed capability in operational environments.

REFERENCES:

1. Base defense fortification;

KEYWORDS: fortification; sandbag; emplacements; base building

AF241-D002 TITLE: Machine Vision Work Assistance

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

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 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: Maintainers gather data from multiple sources to diagnose and sustain weapon systems. These run the spectrum from cockpit dials and digital interfaces, to portable maintenance aids on laptops and tablets. To enable AR systems to capture that data for reference and logging, the sponsoring organization needs a machine vision system capable of observing an interface in various poses and extracting data from it. Key to scaling this capability will be a no code tool for a maintainer to train the system on a small number of example pictures that they can label. During maintenance the machine vision utility will integrate with other work tracking tools to record and reference the data.

DESCRIPTION: The next major goal for AR/VR systems is AI and ML to support work as it is performed. This requires a large data set to effectively develop. The sponsoring organization requires a framework to capture multidimensional data from AR/VR systems to create and sustain a corpus of data for development and refinement of ML/AI algorithms. This framework should integrate into cloud based storage concepts and be rapidly adaptable to new AR/VR systems as they develop. The work tracking itself is done in software which will be important context to the data and should be included in the framework.

Safety Assistant AI
Maintenance work on weapon systems frequently involves exposure to hazardous conditions, hot surfaces, pinch points, loud noises, etc. Initial, scalable development of an AI agent that can alert the maintainer to observable hazards via an AR system is of interest. Supporting good PPE and safety habits without annoying or disengaging the operator is the key balance of effective systems.

Work Recognition AI
A long term goal of AR/VR is to help maintainers accomplish work more effectively. With the work procedures digitized into a machine comprehensible form and the maintainer stepping through them in either AR or VR, the next enhancement is for an AI to be able to recognize the work that has been accomplished and assist with logging or proceeding to the next step. This enables virtual instructors and AI assistants to be developed from examples of the work being performed.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. In order to be awarded a D2P2, the applicant’s technology should have a fully developed blueprint, concept or, at best, prototype to further develop. The proposer should demonstrate the feasibility of their design and its readiness for a Phase II.

PHASE II: Perform in-depth research and development, resulting in a full-scale prototype package that demonstrates the capability of the product and the expense required to deploy as compared to personnel commensurate actions today (non-value added tasks). Delivery and demonstration of the product will be conducted in the customer's environment, and performance will be evaluated.

PHASE III DUAL USE APPLICATIONS: Explore and pursue paths for military and commercial applications. Potential users may include any organization that must record accomplished work, operate in a hazardous environments, verify the quality of accomplished work, evidence collection, or similar verification tasks. This phase will also focus on inserting and evaluating performance of the developed capability in operational environments.

REFERENCES:

1. Machine Vision;
2. Machine Learning;

KEYWORDS: machine learning; artificial intelligence; ai; ml; augmented reality; AR; computer vision; machine vision; work recognition; task recognition; safety; data analytics

AF241-D003 TITLE: Securing AI/ML Models Against Adversarial Threats for Advanced Command and Control (AC2) Missions

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Trusted AI and Autonomy

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 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 SBIR Phase II is to examine and develop effective methods for safeguarding AI/ML models from malicious threats. Specifically, the prototype should aim to identify vulnerabilities in AI/ML models, such as adversarial examples, data poisoning, and model extraction attacks. Additionally, it intends to propose innovative defense mechanisms that can mitigate the impact of these attacks. The research will also investigate the trade-off between the effectiveness of defense mechanisms and the computational resources required for their implementation. Ultimately, the goal is to improve the security and resilience of AI/ML models, thereby increasing their reliability and trustworthiness for real-world applications. There is an immediate demand for this capability across strategic, operational, and technical guidance and policies mandated by the Secretary of the USAF as follows: • Operational Imperatives o II - Achieving Operationally Optimized Advanced Battle Management Systems (ABMS) / Air Force Joint All-Domain Command & Control (AF JADC2) o IV - Achieving Moving Target Engagement at Scale in a Challenging Operational Environment

DESCRIPTION: The significance of artificial intelligence (AI) and machine learning (ML) has grown in various military applications. However, the susceptibility of AI/ML models to adversarial attacks has raised concerns regarding the security and reliability of these models in C2 real-world applications. Adversarial attacks involve deliberate attempts to manipulate or deceive an AI/ML model by introducing carefully crafted inputs that cause the model to misclassify or produce incorrect outputs [1]. Such attacks can have severe consequences in safety-critical applications like autonomous agent route planning or medical diagnosis, and they can also result in privacy violations and data breaches. The most prevalent form of adversarial attack is the generation of adversarial examples, which are inputs slightly altered from legitimate inputs but can cause the model to produce incorrect outputs. Adversarial examples can be created using various techniques, such as gradient-based methods or evolutionary algorithms, and they can be challenging to detect and defend against. Other types of adversarial attacks include data poisoning, where an attacker injects malicious data into the training dataset to bias the model towards a specific outcome, and model extraction, where an attacker attempts to steal the model's architecture or parameters to replicate or enhance the model. Consequently, the development of effective techniques to secure AI/ML models against adversarial attacks has become imperative for operational performance within the USAF. Therefore, this proposal seeks innovative prototypes to engage and deter cyber threats under AI/ML models, which will incorporated into the Air Force's core operational mission.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. The scope of the phase I feasibility study should include at minimum research on identifying vulnerabilities in AI/ML models, such as adversarial models, data poisoning, and model extraction attacks and others securing AI/ML techniques innovative defense mechanisms that can mitigate the impact of these attacks as the minimum basis for qualifications for this phase II solicitation proposal.

PHASE II: Proposals should include development, installation, integration, demonstration and/or test and evaluation of the proposed solution prototype system. This demonstration should evaluate the proposed solution against the proposed objectives; describe how the solution will fulfill the AF's requirements; identify the technology's transition path; specify the technology's integration; and describe the technology's sustainability. Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

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 solution 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 technology is adopted.

REFERENCES:
1. Ibitoye, Olakunle, et al. "The Threat of Adversarial Attacks on Machine Learning in Network Security--A Survey." arXiv preprint arXiv:1911.02621 (2019);
2. Song, Liwei, Reza Shokri, and Prateek Mittal. "Privacy risks of securing machine learning models against adversarial examples." Proceedings of the 2019 ACM SIGSAC Conference on Computer and Communications Security. 2019;
3. Apruzzese, Giovanni, et al. "Addressing adversarial attacks against security systems based on machine learning." 2019 11th international conference on cyber conflict (CyCon). Vol. 900. IEEE, 2019;

KEYWORDS: Adversarial Threats;data poisoning;model extraction attacks;adversarial attacks;

AF241-D004 TITLE: Explainable Reinforcement Learning (XRL) for Command and Control (C2)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 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 effective (SBIR Phase II) prototype to enable practical application (s) of Reinforcement Learning (RL) to be explained for interpretability (i.e., generating explanations that are intuitive and understandable to humans), trust (i.e., to verify an agent's behavior), performance-explanation trade-off (i.e., strike a balance between the performance of the RL agent and the quality of explanations it provides), accountability and safety (i.e., RL agents to be held accountable for their actions to be able to identify and rectify potential risks/errors in agent's behavior) and finally, human-AI collaboration (i.e., collaboration by effective communication and collaboration). This topic undertakes the operational imperatives as follows: • Operational Imperatives o II - Achieving Operationally Optimized Advanced Battle Management Systems (ABMS) / Air Force Joint All-Domain Command & Control (AF JADC2) o V - Defining optimized resilient basing, sustainment, and communications in a contested environment

DESCRIPTION: RL represents a groundbreaking technology with the ability to perform long-term decision-making in complex and dynamic domains at a level surpassing human capabilities [1]. Leveraging this capability holds immense strategic significance for the United States Department of Defense (DoD), given that RL-enabled systems have the potential to outperform even the most exceptional human minds in a wide range of tasks [2]. Its adoption in high-risk real-world domains like military applications has been limited due to the challenges associated with explaining RL agent decisions and establishing user trust in these agents, despite remarkable improvements. For instance, while the AI AlphaStar competes against highly skilled StarCraft 2 players, comprehending its inner workings necessitates extensive and impractical empirical investigations [3]. This substantial and inhibitory constraint arises because current Explainable Reinforcement Learning (XRL) methods inadequately address the fact that autonomous decision-making agents can alter future data observations through their actions and effectively reason about long-term objectives aligned with the agent's mission. Therefore, it is imperative to develop effective XRL approaches that overcome these limitations to unlock the widespread utilization of RL's capabilities. Therefore, we seek to have proposals that would adhere to effective and efficient models for XRL, which will be used for the US Air Force's direct operational use.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. The Offeror is required to provide detail and documentation in the Direct-to-Phase-II (D2P2)proposal which demonstrates accomplishment of a "Phase I-type" effort where the Offeror demonstrate a case study or prototype of having performed explainable reinforcement learning for any practical applications where they have been able to provide intuitive and understandable explanations to humans based off their AI/ML inference findings to verify an agent behavior.

PHASE II: This phase II topic proposal seeks 6.2 explainable AI/ML solutions using reinforcement learning for command and control applications. Proposals should include development, installation, integration, demonstration, test and evaluation of the proposed solution prototype system that verifies an agent behavior, provides performance trade-off, trust, quality explanation that ultimately translates into intuitive interpretability for human understanding of how the agent arrived at such decision.

PHASE III DUAL USE APPLICATIONS: Phase III efforts will focus on transitioning the developed technology to a working commercial or warfighter solution. The offeror will identify the transition partners. The technology will meet a minimum of TRL 6 and will be mature and operationally ready. Solution will be configured, tailored, further developed to match the customer requirements and specific environment configuration for deployment. A transition plan will be required to be developed and delivered. Phase III are not competed thus it is the responsibility of the offeror to seek funding opportunities.

REFERENCES:

1. V. Mnih, K. Kavukcuoglu, D. Silver, A. A. Rusu, J. Veness, M. G. Bellemare, A. Graves, M. Riedmiller, A. K. Fidjeland, G. Ostrovski and S. Petersen, "Human-level control through deep reinforcement learning," Nature, vol. 518, pp. 529-533, 2015, February;
2. "THE NATIONAL ARTIFICIAL INTELLIGENCE RESEARCH AND DEVELOPMENT STRATEGIC PLAN: 2019 UPDATE, "https://www.nitrd.gov/pubs/National-AI-RD-Strategy-2019.pdf" A Report by the SELECT COMMITTEE ON ARTIFICIAL INTELLIGENCE of the NATIONAL SCIENCE & TECHNOLOGY COUNCIL, 2019, JUNE.;

KEYWORDS: Reinforcement Learning interpretability; Reinforcement Learning explanations;

AF241-D005 TITLE: UAS TRACKING SYSTEM

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber

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 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 Air Force Security Forces Center (AFSFC) has identified the need to develop effective countermeasures to mitigate the emerging threat of unmanned aerial systems (UAS). The AFSFC's objective is to enhance UAS tracking capabilities, which align with the Secretary of the Air Force's (SECAF) operational imperative of achieving tactical air dominance, moving target engagement and operationally focused Advanced Battle Management System (ABMS).

DESCRIPTION: To effectively mitigate the threat posed by unmanned aerial systems (UAS) to USAF personnel, assets, and operations, the UAS tracking device must be designed to be easily deployable and operable by personnel in the field. The device should be compact and lightweight to allow for easy transport to different locations and quick setup. The UAS tracking device should be able to detect and track multiple UAS simultaneously and provide real-time updates on their position, speed, altitude, and other relevant information. It should also be able to differentiate between friendly and hostile UAS and provide alerts when potential threats are detected. These features will help provide an accurate and timely understanding of the UAS activity in the surrounding airspace, allowing USAF personnel to respond quickly and effectively to any potential threat. To ensure maximum effectiveness, the UAS tracking device should be designed to integrate with other USAF systems and equipment, such as command and control systems and other UAS detection and tracking devices. The integration will provide a comprehensive view of the UAS activity in the surrounding airspace and enhance situational awareness, enabling rapid response to potential threats. Furthermore, the UAS tracking device should be capable of operating in diverse environments and weather conditions. It should be rugged and durable, able to withstand harsh weather conditions, and operate in extreme temperatures. This ensures the device can be deployed in different locations and environments, providing comprehensive UAS tracking capabilities across the entire spectrum of operations.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. "Phase I-type" development will have involved a comprehensive requirements analysis to determine the exact capabilities and features needed for the UAS tracking device. This "phase" would have involved gathering input from a wide range of stakeholders, including USAF operators, cybersecurity experts, and other technical experts to understand the operational and technical requirements. This would have also included a review of the current UAS threat landscape to identify potential risks and vulnerabilities that need to be addressed. The requirements analysis would lay the groundwork for the subsequent development phases and help ensure that the final product meets the needs of the USAF.

PHASE II: Technology Development; The second phase of development would focus on the design and development of the UAS tracking device. This would involve selecting the appropriate technology components, such as sensors, processors, and communication systems, and integrating them into a functional system. This phase would require a team of experts in various technical fields, such as electronics, software development, and mechanical engineering, to work together to develop a prototype UAS tracking device. The device would be tested extensively in a controlled environment to ensure that it meets the requirements identified in the first phase. Once the device has been successfully developed and tested, it can be further refined and optimized for deployment in the field.

PHASE III DUAL USE APPLICATIONS: Tracking device development could involve exploring dual-use applications for the product. Dual-use applications are those that can be utilized by both military and civilian organizations for a range of purposes. The UAS tracking device, designed for military use, could have several potential dual-use applications, such as; Border Security; UASs have increasingly been used by criminal organizations to smuggle drugs, weapons, and other contraband across borders. The UAS tracking device could be utilized by border security agencies to detect and track these UASs and help prevent illegal activities. Critical Infrastructure Protection: UASs have the potential to be used as weapons to target critical infrastructure, such as power plants, airports, and government buildings. The UAS tracking device could be used to detect and track UASs near these sensitive locations and provide alerts to security personnel to respond appropriately.

REFERENCES:

1. Air Force Instruction (AFI) 13-204 https://static.e-publishing.af.mil/production/1/af_a3/publication/afman13-204v1/afman13-204v1.pdf
2. Unmanned Aircraft Systems (UAS) Operations; https://www.faa.gov/uas
3. Department of Defense Directive (DoDD) 3200.11 https://www.esd.whs.mil/#

KEYWORDS: Unmanned Aerial Systems (UAS); Tracking; Security; Air Force; Countermeasures; Detection; Threats; Situational awareness; Technology;

AF241-D006 TITLE: Rapid Deployment Sensor System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber

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 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 project is to develop mobile sensors that can be deployed to remote and rough terrain using robotic dogs or unmanned aerial systems (UAS). The sensors should be designed to withstand harsh environmental conditions and provide reliable and accurate data in real-time. The use of robotic dogs or UAS would enable efficient and safe deployment of the sensors to remote or difficult-to-reach locations. The sensors should be lightweight and compact, enabling easy transport and deployment by the robotic dogs or UAS. The goal is to enhance surveillance and monitoring capabilities in challenging environments where traditional methods of deployment are not feasible or safe.

DESCRIPTION: The system must be capable of overcoming the limitations of traditional data collection methods that are often hindered by hazardous conditions or difficult terrain, thereby minimizing the risks and increasing efficiency. The mobile sensor system has the potential to revolutionize data collection by providing a reliable solution that can access locations that were previously inaccessible, enabling critical insights into environmental conditions and security threats. The system must consist of lightweight and compact sensors that can be easily transported and deployed by robotic dogs or unmanned aerial systems (UAS). The sensors must be designed to withstand harsh environmental conditions, ensuring reliable data collection in challenging environments. The system must also integrate with navigation and positioning technology to ensure accurate data collection. The sensors must be able to collect data in real-time and transmit it wirelessly to a central location for analysis. The development of a custom robotic dog or UAS platform is crucial for the successful implementation of the mobile sensor system. The platform must be designed to be lightweight, compact, and durable, enabling it to navigate rugged terrain and harsh environmental conditions with ease. The robotic dog or UAS platform must be capable of transporting and deploying the sensors in difficult terrain, thereby reaching previously inaccessible locations. A robust wireless communication system is necessary for transmitting data from the sensors to a central location in real-time. This system must ensure that the data collected is transmitted quickly and reliably, providing real-time insights into environmental conditions and security threats. The system must also be secure and resilient, ensuring that data is protected from unauthorized access or interference. Data analysis software must be developed to process, analyze, and visualize the data collected by the sensor system. This software must provide critical insights into environmental conditions and security threats, enabling informed decision-making. The software must be designed to be user-friendly, allowing non-experts to easily interpret the data collected.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. Offerors are expected to provide a white paper containing the following information: 1. A detailed technical design of the mobile sensor system. 2. A detailed technical explanation of the data analysis software that will be incorporated into the sensor system. 3. An explanation of how the sensors will be deployed and retrieved by either UAS or Robotic Dogs or both.

PHASE II: Develop and test a suite of capabilities to address any issues or limitations identified in the previous phases. The development plan for this phase involves identifying potential areas for improvement based on feedback from previous testing and evaluation. This includes addressing any issues or limitations in the current system and exploring new capabilities that could enhance the system's effectiveness and versatility. Once potential areas for improvement have been identified, the development team will create a plan to design and test the new capabilities. The team will conduct rigorous testing and evaluation to ensure the safety, effectiveness, and compatibility of the new capabilities with the existing system. Throughout the development and testing process, the team will collaborate with security forces personnel to ensure that the new capabilities meet their needs and can be effectively integrated into existing operational procedures. Ongoing training and education for security forces will also be necessary to use the new capabilities effectively. Once the new capabilities have been successfully tested and integrated into the system, the team will conduct a final round of testing and evaluation to ensure that the system is functioning at its full potential.

PHASE III DUAL USE APPLICATIONS: The third phase of this project will focus on the identification and implementation of dual-use applications for the mobile sensor system. Dual-use applications refer to the adaptation of military technology for civilian use. This phase will involve conducting research and development to identify additional features or improvements that could enhance the system's effectiveness and versatility for both military and civilian applications. Ongoing testing and evaluation will ensure the safety and effectiveness of the system for both applications. This phase will also involve ongoing training and education for both military and civilian users to ensure the effective use of the system. The goal is to maximize the potential of the mobile sensor system beyond military applications and leverage its capabilities to benefit civilian industries such as environmental monitoring, disaster response, and infrastructure inspections.

REFERENCES:

1. AFI 11-202V3;
2. AFI 13-1;
3. AFI 14-202;
4. AFI 31-101;

KEYWORDS: Wireless communication; Robotic dogs; Unmanned aerial systems; Rough terrain; Mobile sensors; Data collection; Real-time analysis; Environmental monitoring; Security surveillance; Logistical challenges.

AF241-D007 TITLE: Air Force Defense and Biometric Network

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber; Integrated Network System-of-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 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 current access control systems utilized by Air Force Installations are becoming outdated, inefficient, and costly to maintain. Considering the SECAF's Operational Imperative of Achieving Operationally Optimized Advanced Battle Management Systems/Air Force Joint All-Domain Command and Control, there is a critical need to design and build a biometric system for deployment at Access Control Points (ACPs) across Air Force Installations. The objective of this system is to verify the access authorization of individuals entering Air Force installations and facilities by utilizing advanced technologies, including artificial intelligence, machine learning, cloud computing, and advanced sensors, to create a networked system that can provide real-time information to warfighters at all levels of command. This will allow for more effective and efficient operations, enabling decision-making based on up-to-date information in any environment.

DESCRIPTION: As technology advances rapidly, the United States Air Force (USAF) must stay current to remain relevant. Older systems are becoming increasingly difficult and expensive to maintain, and current USAF systems are quickly becoming outdated, slow, bulky, and cost-ineffective. To address this issue, the Air Force Security Forces Center seeks a cloud-based software solution meeting specific criterion. This effort aligns with the Secretary of the Air Force's operational imperative, Achieving Operationally Optimized Advanced Battle Management Systems/Air Force Joint All-Domain Command and Control. This initiative requires the integration of various technologies, including artificial intelligence, machine learning, cloud computing, and advanced sensors, to create a networked system that can provide real-time information to warfighters at all levels of command. The system must enable decision-making based on the most up-to-date information, allowing for more effective and efficient operations in any environment by meeting the following criteria: Credential Verification- The system must be capable of verifying credentials through scanning of Common Access Cards (CAC) or other forms of identification such as temporary passes. This must be done at the ACP through a handheld scanner or, in some cases, a stationary scanner. • Be able to integrate with the Identity Matching Engine for Security and Analysis (IMESA) for access to authoritative data sets (RAPIDS, NCIC, TSDB) • Personal Identification Verification (PIV) compliant • Provide the capability to vet credentials to authoritative law enforcement databases including but not limited to: National Crime Information Center (NCIC) Person Files (including Wanted Persons, Violent Persons, Immigration Violators, Known or Appropriately Suspected Terrorists, and National Sex Offender Registry), Interstate Identification Index (III), National Law Enforcement Telecommunications System (Nlets), and Commercial criminal background screening. The system must be able to scan a barcode or Quick Response code (QR code) on an authorized credential to compare the information to the individual's biometric data and access authorization. The system should be designed to quickly and accurately scan the credentials, allowing for efficient and streamlined access control. • Examples include, but not limited to: o State issued ID o State issued Driver's License o DoD Common Access Card (CAC) o Federal Employee CAC o Teslin IDs (Military/Civil Service retiree, Military Dependent, etc.) o Personal Identity Verification (PIV) credentials o Personal Identity Verification-Interoperable (PIV-I) credentials o Passport o Locally produced credentials containing a barcode/QR Code • Provide the service while adhering to the following: o Web based system accessible from GOV NIPR network o No major infrastructure requirements o Discrete handheld screens o Flexible credential scanning options (barcode, contact, contactless) o Flexible vetting options • Provide equipment that meets following criteria: o Mobile Handheld devices for scanning credentials o Docking/charging station o Spare batteries o Local servers to store local cache o Wireless router o Web based Registration software o Public access to Registration site for Non-DoD personnel requesting access o Ability to upload documents and pictures Proper training and protocols should be established to ensure that personnel are properly trained to use the credential scanning feature and that any issues with scanning or verification are addressed promptly. The integration of credential scanning capabilities into the biometric system will enhance the overall security of Air Force installations and facilities by ensuring that only authorized personnel are granted access. Cloud-Based- A cloud-based system offers several advantages over traditional on-premises systems. First, a cloud-based system provides flexibility, scalability, and easy access to data from anywhere, anytime. This is essential for Air Force installations with multiple ACPs spread across large geographic areas. Additionally, a cloud-based system can be easily integrated with other systems, such as security cameras and sensors, to provide a comprehensive security solution. Cloud-based systems also offer high levels of security and reliability, as data is stored in secure data centers with multiple levels of redundancy and backups. Finally, a cloud-based system is typically more cost effective than traditional on-premises systems, eliminating the need for expensive hardware, software, and maintenance costs. Overall, a cloud-based system is a logical choice for the Air Force as it offers several advantages over traditional on-premises systems. Web-Based Dashboard- A web-based dashboard must be included in the design and build of the system. It must provide real-time visibility into system performance and can quickly alert operators to any issues or anomalies. The dashboard must display key performance indicators (KPIs) such as the number of access requests, success rates, and average processing times. These metrics will help operators identify areas for improvement and optimize system performance. In addition, the web-based dashboard should provide a user-friendly interface for operators to interact with the system. It must allow them to quickly and easily view and manage access requests, monitor system performance, and generate reports. This must help operators to make informed decisions and take timely action to address any issues. Moreover, a web-based dashboard must enable authorized and verified personnel to remotely access the system from any location with a verified internet connection. This is particularly important for Air Force installations with multiple ACPs across large geographic areas. With a web-based dashboard, operators can manage the system from a central location, increasing operational efficiency and reducing costs. Virtual Visitors Center capability: A virtual visitors center capability must be added to the system. This will allow visitors to remotely submit their access requests and provide the necessary information, such as identification and purpose of visit. The virtual visitors center can also provide information on installation procedures, security policies, and directions to various locations on the installation. The virtual visitor center must generate an electronic pass for the visitor to use at the ACP. The virtual visitors center capability will reduce the burden on ACP operators by allowing them to focus on security and access control tasks. It will also increase convenience for visitors by reducing wait times and allowing them to submit their requests before arrival at the installation. The virtual visitors center should have a user-friendly interface that guides visitors through the process and provides clear instructions and feedback. Moreover, the virtual visitors center should be integrated with the cloud-based system and web-based dashboard to provide real-time access requests and visitor information updates. This will enable ACP operators to process requests and identify potential security threats quickly. Integration: The system must be integrated with various law enforcement and administrative networks, such as Defense Manpower Data Center (DMDC), Identity Matching Engine for Security Analysis (IMESA), Real-Time Automated Personnel Identification System (RAPIDS) and NCIC (National Crime Information Center). This will enable ACP operators to quickly verify the identity and access authorization of individuals entering the installation by accessing relevant databases and information. Integration with DMDC will allow for real-time verification of personnel information, such as rank, status, and clearances. I In contrast, integration with NCIC will provide access to criminal history and warrant information. Other law enforcement networks, such as state and local databases, can also be integrated to provide additional security and background checks. The integration with these law enforcement networks should be designed to ensure secure and timely data transmission, with appropriate access controls and encryption methods in place. The system should also have built-in protocols to ensure compliance with relevant regulations and policies, such as the Privacy Act and the Electronic Communications Privacy Act, as well as many other Air Force and DOD operating instructions specifically Air Force Instruction 31-101 v3.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. Offerors are expected to demonstrate feasibility by submitting a white paper that details: A detailed description of the system requirements, including the types of biometric identification to be used, the number of ACPs to be equipped with the system, the system's capacity to handle peak-hour traffic, and the level of security required to protect sensitive data. A detailed description of the system architecture, including hardware components (such as cameras, scanners, and servers), software that will process and store biometric data, and the network infrastructure that will connect the system to the ACPs and other relevant Air Force facilities. A discussion of the development and testing process for the system, including creating software that performs biometric identification, integrating hardware components, and testing the system in various scenarios to ensure reliability and accuracy.

PHASE II: System Development, Testing, Deployment The system must apply for and receive an Authority to Operate (ATO) to ensure compliance with security regulations and standards. Once the ATO is received, the system can be deployed at the designated ACPs. • Develop and Test the System: Develop software that performs biometric identification, integrates hardware components, and test the system in various scenarios to ensure reliability and accuracy. Ongoing testing and evaluation should ensure the system meets the operational requirements of Achieving Operationally Optimized Advanced Battle Management Systems/Air Force Joint All-Domain Command and Control. • Deploy the System: Deploy the system at the designated ACPs, including site preparation, installation of hardware and software, and integration with existing ACP systems. Personnel should be trained to operate the system and respond to potential issues. • Maintain the System: Ongoing maintenance requirements should be carried out, including software updates, hardware maintenance, and security updates. Ongoing testing and evaluation should ensure the system meets the operational requirements of Achieving Operationally Optimized Advanced Battle Management Systems/Air Force Joint All-Domain Command and Control. • Monitor the System: Monitor the system's performance and security to identify and address potential issues promptly.

PHASE III DUAL USE APPLICATIONS: Phase III dual-use applications involve transitioning the biometric system from military to commercial or civilian applications. This may involve modifications to the system to meet the unique requirements of non-military applications and obtaining necessary certifications and approvals for commercial use. Potential civilian applications could include access control for government buildings, airports, and other secure facilities and authentication for financial transactions or other sensitive operations. The development of dual-use applications can provide additional revenue streams for the system and broaden its impact beyond military use.

REFERENCES:

1. Protection of Sensitive Compartmented Information and Controlled Access Programs," February 2012;
2. Joint Publication 1-02: "Department of Defense Dictionary of Military and Associated Terms," December 2010;
3. Department of Defense Biometrics Enterprise Strategy, January 2013;

4. Department of Defense Biometrics Task Force, "Biometrics in Support of Military Operations: Lessons from Afghanistan," September 2011;
5. Defense Advanced Research Projects Agency (DARPA) Information Innovation Office (I2O), https Air Force Instruction 31-501, Personnel Security;
6. Air Force Instruction 31-113, Installation Security;
7. Air Force Instruction 10-701, Information Assurance Management;
8. Air Force Instruction 10-2501, Air Force Emergency Management Program Planning and Operations;
9. Air Force Instruction 31-101, Integrated Defense;
10. Air Force Instruction 31-204, Air Force Physical Security Program;
11. Air Force Manual 31-222, Physical Security;
12. Air Force Manual 31-201, Security Forces Management Operations Air Force Manual 31-113, Installation Security;
13. Air Force Manual 31-201, Security Forces Management Operations;
14. Air Force Handbook 31-214, Security Forces Investigations and Reports;

KEYWORDS: Biometric; Access Control Points; Air Force Installations; Cloud-based system; Joint All-Domain Command and Control (JADC2); Advanced Battle Management Systems (ABMS);Artificial intelligence; Machine learning; Network infrastructure; Scalability; Reliability; Security; Testing and evaluation; Virtual visitors center; DMDC; NCIC; Law enforcement networks; Authority to operate; Dual-use applications; System architecture

AF241-D008 TITLE: Adaptive Robotic Behavior for Dynamic Environments

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

OBJECTIVE: Research, evaluate, and ultimately determine the proper sensing required to develop the software control needed to enable existing mobile heavy industrial robots (non-collaborative) to work in the same areas as humans and everchanging environments without the need for static safety fencing, door interlocks, and/or light/laser curtains.

DESCRIPTION: Recent developments in robotic controls have allowed the number of industrial robotic systems, both mobile and stationary, in sustainment and depot environments to grow significantly. These systems provide great improvements in safety, quality, agility, and throughput metrics. This growth shows no signs of slowing down. As these systems are scaled across more locations, the issue that needs to be addressed is the dynamic nature of the depot environment. In the depot environment, toolboxes move daily, work stands are continuously repositioned, and people must be present when these robotic systems are performing their work. The use of industrial robotics for aircraft maintenance operations currently requires very controlled (static) and well-protected "cells" that give the robot a place to work where it understands its surroundings and protects/prevents humans from entering that cell. This can severely limit where these robots can be used, and the safety devices used take up valuable floor space. In the case of mobile robots, this is even more difficult. These systems are designed to move from building to building, meaning there must be "safe cells" in each location so the systems can be used in those buildings. This multiplies the lost space problem by the number of buildings the robot has the potential to operate in. With the proper sensing and controls in place, these systems will be able to function efficiently in dynamic environments and allow for safe interactions with humans. Existing technologies allow the interaction between humans and industrial robots, but again only in very static and controlled situations. The development of this technology will allow this interaction to expand outside of the "safe cells", making industrial robotic systems (especially mobile systems) even more agile and impactful for all production sectors in governmental and private manufacturing areas. The discrete defense need addressed in this will be more effective and more reconfigurable industrial layout designs and utilizations, hence enhancng thoughputs such aircraft and other weapon system availabilities.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. For this topic, the Government expects that Offerors demonstrate the ability to detect unexpected obstacles and humans with COTS sensors, and demonstrate the accuracy and integration of these sensors into robotic systems.

PHASE II: Develop working prototype to detect and respond to unexpected obstacles and humans and command the robotic system to respond accordingly. Maximizing the efficiency of the robotic system by allowing the robot to operate in a real-world depot and other manufacturing environments in both military and private sectors with minimal external safety systems.

PHASE III DUAL USE APPLICATIONS: Refine hardware and software to increase accuracy and reliability. Achieve production-ready state for marketing to the Air Force, other related federal agencies, and private industries involved in all manner of production or manufacturing.

REFERENCES:

1. Villani, et al. "Survey on human–robot collaboration in industrial settings: Safety, intuitive interfaces and applications." November 2018, Survey on human–robot collaboration in industrial settings: Safety, intuitive interfaces and applications - ScienceDirect;

2. Moretz. . “Mobile Robot Standard R15.08-1-2020 – What You Need to Know.” February, 2021, https://www.automate.org/industry-insights/mobile-robot-standard-r15-08-1-2020-what-you-need-to-know;
3. Pedrocchi, et al. “Safe Human-Robot Cooperation in an Industrial Environment”, January 2013, Safe Human-Robot Cooperation in an Industrial Environment - Nicola Pedrocchi, Federico Vicentini, Malosio Matteo, Lorenzo Molinari Tosatti, 2013 (sagepub.com);

KEYWORDS: Mobile Robotics, Industrial Robots, Human Sensing, Safety

AF241-D009 TITLE: Rapidly Deployable Airborne Fuel Flowmeter (RDAFF)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

OBJECTIVE: Develop a flowmeter that can be attached to the outside of aircraft fuel lines and accurately read fuel flow within the pipe.

DESCRIPTION: Current methods for gathering fuel flow measurements during military flight test events involve the installation of highly precise, highly accurate and commercially available turbine-type flow meters in-line with fuel supply lines. This invasive process results in significant aircraft down-times to accommodate these in-line fuel flowmeters through substantial re-engineering and modification of OEM fuel supply lines. The primary purpose of the Rapidly Deployable Airborne Fuel Flowmeter (RDAFF) is to allow for rapid installation and removal of fuel flowmeter instrumentation components from the system under test, while retaining the accuracy, linearity and repeatability of legacy turbine-type flowmeters. Solutions must conform to the following: 1) Be easily and quickly, attached, calibrated and removed when needed. 2) Be versatile and non-invasive to fuel lines, i.e., mounted on the exterior of fuel lines. 3) Operate with excitation voltage supplied by standard aircraft power (28VDC). 4) Provide flow measurements with an accuracy ≤ +/-0.5% on any straight-pipe length, including non-ideal locations. 5) Provide fuel flow measurements on various aircraft fuels (JP-8, JP-5, Jet-A, Jet-A-1, AVGAS) up to 20,000 lbs./hr. 6) Data is time correlated with IRIG or IEEE 1588 v2 standards. 7) Compensate for changes in fuel temperature and density. 8) Provide output in RS-422 as engineering units for mass flow and temperature. 9) System packaging will comply with Air Force Airworthiness standards. 10) Final system will comply with Air Force standards for Technical Readiness Level (TRL) 6. 11) Able to withstand high performance aircraft flight envelopes. 12) Able to survive hostile aircraft environments, such as engine bays.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. Offerors interested in participating in D2P2 must include in their response to this topic "Phase I-type" feasibility documentation that substantiates the scientific and technical merit and "Phase I-type" effort such as developed a concept for a workable prototype or design to address, at a minimum, the basic requirements as described above. As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results for establishing the scientific and economic feasibility of the proposed work. Work submitted within the feasibility documentation must have been substantially performed by the Offeror and/or the principal investigator (PI).

PHASE II: Prototype testing that can withstand an airborne environment. Obtain a TRL 6 based on Air Force standards and ready to test in an operational environment.

PHASE III DUAL USE APPLICATIONS: Military Application: Fuel flowmeter that reduces aircraft modification times to more efficiently perform the mission. Commercial Application: Rapidly measure fuel flows in petroleum extraction and refining (oil fields), automotive and industrial applications.

REFERENCES:

1. “Ultrasonic Mass Flowmeter for Army Aircraft Engine Diagnostics”,Lawrence C. Lynnworth, Panametrics Incorporated, https://apps.dtic.mil/sti/pdfs/AD0758462.pdf;
2. “Turbine Flowmeter Fuel Flow Calculations, ARP4990”, SAE;

KEYWORDS: turbine-type flow meters in-line with fuel supply lines; OEM fuel supply lines

AF241-D010 TITLE: Wireless Airborne Instrumentation Network (WAIN)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Advanced Computing and Software

OBJECTIVE: Develop a network-based data acquisition system to wirelessly transmit airborne instrumentation data from point A to point B.

DESCRIPTION: Existing instrumentation data system passes data over wires/cables that bend and stretch over lengths up to 50ft. Any solutions must have the following: Capability to transmit 2 signals wirelessly around impediments of various size, shapes and locations with the following figures of merit; 1) BER less than 10^-6. 2) Time correlation per IEEE 1588 Version 2. 3) 1 Sensor/Signal 4) Bit Rate of 1 kHz. 5) Time tagged to an accuracy of 1usec. 6) Comply with Air Force Cyber Security standards. 7) Comply with Air Force Airworthiness standards. 8) Output packets compliant with IRIG-106 Chapters 20-28. The government will provide drawings/sketches of a scale model test fixture.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. Offerors interested in participating in D2P2 must include in their response to this topic "Phase I-type" feasibility documentation that substantiates the scientific and technical merit and "Phase I-type" effort such as developed a concept for a workable prototype or design to address, at a minimum, the basic requirements as described above. As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results for establishing the scientific and economic feasibility of the proposed work. Work submitted within the feasibility documentation must have been substantially performed by the Offeror and/or the principal investigator (PI).

PHASE II: Develop and manufacture an integrated wireless instrumentation system that can withstand airborne environments associated with high performance military aircraft. Obtain a Technical Readiness Level (TRL) of 6 based on Air Force standards and ready to function in an airborne operational environment.

PHASE III DUAL USE APPLICATIONS: 1) Military Application- Wireless instrumentation implementations will reduce aircraft down time for Type-2 Modification installations. 2) Commercial Application- Solutions will be equally useful for commercial aircraft manufacturers to be utilize for flight testing and operational use.

REFERENCES:

1. Torres, O, et.al.; Enabling Wireless Avionics Intra-Communications; NASA Langley, December 2016
2. Collins, D.; Wireless data Acquisition in Flight Test Networks; Curtiss-Wright, May 2016
3. Yedavalli, R; Application of Wireless Sensor Networks to Aircraft Control and Health Management Systems; Ohio State University; October 2010;

KEYWORDS: airborne instrumentation data; signals wirelessly; Wireless data Acquisition in Flight Test Networks

AF241-D011 TITLE: Robotic Electronic Component Replacement and Soldering in a Digital Depot Environment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Research, evaluate, and develop a robotic system to enable automated removal and replacement of through-hole and surface mount electronic components during repair of printed circuit board assemblies with high reliability in low-volume, high-mix environments.

DESCRIPTION: The need for computer controlled fully automated rework stations has increased recently due to increasing difficulties involved in manual rework of printed circuit board assemblies (PCBAs). Current USAF depot rework of printed circuit board assemblies is primarily a manual process for through-hole and surface mount components. One exception is ball grid array parts which require machine aided mounting and inspection for high reliability assembly. Recent developments in robotic control have allowed the number of industrial robotic systems, in sustainment and depot environments to grow significantly. On average three electronic components are replaced per depot repair, with an average time of 15 minutes per component to perform a part replacement. Automated systems would provide vast improvements in safety, quality, agility, and throughput metrics. Ideally, these systems could be scaled across all depot electronics repair facilities. The main issue would be ensuring the system is robust enough to adapt to high-mix, low volume production. As opposed to a factory environment, in the depot environment, repairs and rework happen across many unique circuit card assemblies with varying configurations. There is a continuing need to have a robotic soldering solution with the flexibility of a human to solve the requirements for reducing direct labor costs. The aim of this project is to design and build a proof-of-concept, low-cost prototype robot soldering solution to use as a base for further development, through which a production-worthy system would eventually be reached. This system should be able to handle the flexibility required in the PCBAs that are manually operated on, both in terms of physical maneuverability and a large number of different products. The system shall be constrained to use commercial off-the-shelf (COTS) soldering technology, lead-based and non-lead solder and comply with IPC J-STD-001F, MIL-STD-2000A, and ANSI/ESD STM13.1-2015. While the final system will have more features in material handling and safety, the scope of this effort is limited around the part removal and replacement functionality. Apart from building the robot system, user-friendly software for teaching components must be developed.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. For this Direct-to-Phase II topic, the Government expects that the successful Offeror(s) demonstrate the ability to design and build a low-cost robot electronics component replacement solution and associated software to use as a base for further development. Submitters shall demonstrate the accuracy and integration of this robotic system.

PHASE II: Develop working prototype robotic electronics component replacement solution and associated software to use as a base for further development, through which a production-worthy system would eventually be reached. The design should supply a machine solution capable of directly replacing a reasonable subset of conformal coating removal, desoldering, component removal, component replacement and resoldering in electronics rework. Submitters shall maximize the efficiency of the robotic system by allowing the robot to operate in a real-world depot environment with minimal external safety systems.

PHASE III DUAL USE APPLICATIONS: Refine hardware and software to increase accuracy and reliability. Achieve production-ready state for marketing to the Air Force, other related federal agencies, and private industry.

REFERENCES:

1. Geren, Necdet & Lo, E.K.. (1997). Automated removal and replacement of through-hole components in robotic rework. Components, Packaging, and Manufacturing Technology, Part C, IEEE Transactions on. 20. 236 - 248. 10.1109/3476.649447.
2. Staretu, I. (2021). Robotized application of assembly and soldering – case study. IOP Conference Series: Materials Science and Engineering. 1009. 012056. 10.1088/1757-899X/1009/1/012056.
3. Pop, Emanuela, Emilia Campean, Ion Cristian Braga, and Darius Ispas. (2022). "New Product Development of a Robotic Soldering Cell Using Lean Manufacturing Methodology" Sustainability 14, no. 21: 14057. https://doi.org/10.3390/su142114057;

KEYWORDS: Robotic Soldering, Robotic Desoldering, Printed Circuit Card, Electronics Rework

AF241-D012 TITLE: Mandatory Declassification Review (MDR) Natural Language Processing (NLP) Tool

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Finding a solution to assist AFDO's Mandatory Declassification Review (MDR) program in increasing efficiencies, achieving consistency of line-by-line review and redaction of information to remain classified, and promote cost savings through use of new technologies and industry best practices. A successful solution has potential to become a program of record for the program, upon completion of the appropriate acquisition process, obtaining an Authority to Operate (ATO) via Certification and Accreditation (C&A), with an established funding line, and deployment to an approved host location.

DESCRIPTION: There are six milestones a selected company would need to achieve and gain approval by AFDO, to meet the aforementioned objective:
Milestone 1: Refine and enhance the AI/ML models for line-by-line reviews for cases assigned under the Mandatory Declassification Review program.
Milestone 2: Conduct extensive testing and evaluation of the solution in collaboration with AFDO (MDR) personnel.
Milestone 3: Optimize the solution based on feedback and lessons learned during testing.
Milestone 4: Develop a user-friendly interface and integrate the solution with any potential AFDO workflow system.
Milestone 5: Complete documentation for a deployment plan, addressing security and operational requirements, and any other required documentation.
Milestone 6: Upon approval by AAI Director & AFDO Leadership, ensure compliance requirements are met to deploy tool to specified environment/platform.

PHASE I: ~~This is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made because of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement.~~ As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. Applicants are expected to provide a white paper containing the following information on Artificial Intelligence, Machine Learning such as:
1. Refine and enhancing AI/ML models for line-by-line reviews for cases assigned under Mandatory Declassification Review (MDR).
2. MDR Tool Prototype Outline: AI/ML driven line-by-line review capabilities, highlighting areas requiring classification determination based on relevant SCDGs.
3. Optimization of the solution based on feedback and lessons learned during "Phase-I-type".
AFDO strongly encourages companies to submit Direct-to-Phase II proposals to facilitate a demo and hands-on use of a prototype by the end of the phase. Unlike Phase I submissions, Direct-to-Phase II offers extended time and allocated funds, enabling companies to better meet the Government'sour specific prototype requirements.

PHASE II: AFDO leadership are looking to establish a tool for this organization's newly owned requirement of handling the Department of the Air Force (DAF) Mandatory Declassification Review (MDR) program. MDRs may either be requested direct from a public requestor or referred to DAF (AFDO) for review from another government agency, based on potential Air Force equities. AFDO reviewers must conduct a line-by-line review and provide specific alignment to Executive Order 13526 based on the appropriate exemption selected in Security Classification and Declassification Guides (SCDGs).

With this newly acquired program, there is a large backlog of cases for AFDO to review, task out to other organizations/agencies, all while new cases continue to trickle in. Given the typical content of the requests from the public and other government agencies, the sponsoring organization has a need to:
- Respond to requests in a quicker manner;
- Provide consistency & accuracy during the document review;
- Identify similar topics from previous cases that may apply in the future;
- And identify potential equity of other organizations/agencies during intake of the case.

The sponsoring organization's current process is almost entirely manual, therefore this topic's focus is to truly enhance the review process altogether, while ensuring compliance with mandated standards. Information requested under MDR may still retain its classification, and therefore AFDO must pay close attention to information released, as the impact of releasing current classified information could cause up to exceptionally grave damage to national security.

PHASE III DUAL USE APPLICATIONS: Phase III would incorporate the solution into the daily business processes at AFDO, including:

- Transition of AFDO reviewers to new innovative process and addressing any issues;
- Workflow incorporation, adding in the administrative piece for MDR's initially and upon reviewer decision notification;
- Rule development (adjustment) and management of the tool in-house;
- Training the tool, encompassing continued updates and feeding the tool data sets;
- Full deployment to approved DAF host location.

REFERENCES:

1. Atomic Energy Act of 1954, as amended;
2. 10 CFR Part 1045, Subpart A-D;
3. 32 Code of Federal Regulations (CFR) Parts 2001 and 2003 Classified National Security Information;
4. Executive Order 13256;
5. DoDI 5210.02 Access to and Dissemination of Restricted Data and Formerly Restricted Data;
6. DoDM 5200.01 DoD Information Security Program;
7. DAFMAN 16-1404 Information Security Program;
8. Air Force Declassification Guide for Historical Records;

KEYWORDS: Artificial Intelligence; AI; Machine-Learning; ML; Contextual Search; Natural Language Processing; NLP; Mandatory Declassification Review; MDR; Security Classification Guide; SCG; Declassification Guide; Executive Order 13526; Exemption; Restricted Data; RD; Formerly Restricted Data; FRD; Atomic Energy Act; Exclusion; Line-by-line; Redaction; E.O. 13526 Section 1.4; E.O. 13526 Section 3.3 (b); E.O. 13526 Section 3.3 (h);

AF241-D013 TITLE: Trustworthy Generative Artificial Intelligence (GenAI) to Structure Data and Deliver Accurate Insights of Command, Control, Communication and Computer (C4) Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 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 SBIR Phase II topic is to develop an efficient prototype based on a prior feasibility study to utilize/develop GenAI models (e.g., transformer-based models, variational auto-encoders, generative adversarial networks (GAN)) on C4 systems to structure data, and deliver accurate insights of these systems to explain the decisions made by these models to develop trust between the models and an operator.

According to secretary of the USAF, this SBIR topic follows two of the seven operational imperatives as an urgent need to be developed as below:

- II - Achieving Operationally Optimized Advanced Battle Management Systems (ABMS) / Air Force Joint All-Domain Command & Control (AF JADC2)
- V - Defining optimized resilient basing, sustainment, and communications in a contested environment

DESCRIPTION: Though novel technology like ChatGPT dominated headlines recently based on transformer-based models (i.e., a type of GenAI (a class of machine learning (ML) algorithms that can learn from content such as text, images, and audio to generate new content)), it has not yet gained enough credibility to be used in the DoD systems due to its inability to provide accurate explainable decisions by deciphering the inner-workings of the models [1]. To be straightforward, commanders are not going to trust a tool unless they understand how and what data their system was trained on, and how decisions are made to execute an operation [5]. There are still numerous unresolved inquiries surrounding the enhancement of GenAI's capabilities and operator-friendliness. One such open inquiry: how can we enable explainability, allowing operators to grasp and form a clearer mental model of GenAI? Recent research conducted by Goodfellow et al. [2] and Ross et al. [3] has delved into the development of more explainable GenAI models that align with human-understandable processes. However, a comprehensive perspective on explainability of GenAI model such as ChatGPT is still missing. That begs another question: what does an operator need to understand/trust about a GenAI model easily to achieve his/her goals during operational use? Because of these unanswered questions about the model to build trust and transparency within the warfighters' system usages, it is imperative for the DoD operations to develop a system accordingly [4].

Therefore, this SBIR topic seeks proposals to develop a DoD based trustworthy GenAI (described above) system that will not only provide ChatGPT like information but also perform to structure data effectively and deliver/explain accurate insights/decisions about the system to build trust between an operator and a GenAI model. Additionally, proposal should address which uncertainty they are trying to solve such as epistemic or aleatoric in developing/utilizing GenAI based large language models (LLM).

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement.

A “Phase I-type” feasibility study is needed as minimum threshold to satisfy requirement for this Direct-to-Phase-II (D2P2)solicitation. The candidate applying to this solicitation will provide proof of having at least two or more of having extended, explored, analyzed or used ChatGPT in an applicable/similar case scenario that is being explored in the objective of this topic to utilize/develop GenAI models (e.g., transformer-based models, variational auto-encoders, generative adversarial networks (GAN), deep reinforcement learning (DRL)) on C4 systems to structure data, and deliver accurate insights of these systems to explain the decisions made by these models to develop trust between the models and an operator.

PHASE II: This direct to phase description will seek to directly implement the objective of this topic setforth as to develop an efficient prototype based on a prior feasibility study to utilize/develop GenAI models (e.g., transformer-based models, variational auto-encoders, generative adversarial networks (GAN), deep reinforcement learning (DRL)) on C4 systems to structure data, and deliver accurate insights of these systems to explain the decisions made by these models to develop trust between the models and an operator. Performers will develop design and specifications and implementation to demonstrate a suitable prototype to proof the explainability factor of GenAI models to create trust between the models and an operator.

PHASE III DUAL USE APPLICATIONS: Phase III efforts will focus on transitioning operationally ready technology to a commercial sector or DoD environment. The offeror will identify transition partners. TRL should be at a minimum of a TRL 6. The ChatGPT solution will should have a well developed transition plan to deliver the realization of such technology to the war fighter or commericial sector. The transition plan should work on identifying a program of record where the technology will be reside.

REFERENCES:

1. Sun, Jiao, et al. "Investigating explainability of generative AI for code through scenario-based design." 27th International Conference on Intelligent User Interfaces. 2022;
2. Ian Goodfellow, Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville, and Yoshua Bengio. 2020. Generative adversarial networks. Commun. ACM 63, 11 (2020), 139–144.;

KEYWORDS: ChatGPT;GENAI;explainable GenAI;trustworthy GenAI

AF241-D014 TITLE: Optical Air Data System (OADS)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics

OBJECTIVE: The objective of this project is to test and evaluate the accuracy of Optical Air Data Systems and determine their suitability and utility as flight-test-specific instrumentation and primary aircraft equipment. The proposed effort is focused on maturing the technology to be able to provide additional measurements of ambient temperature, density, angle of attack and sideslip as well as true airspeed on high performance aircraft in regimes faster than the speed of sound.

DESCRIPTION: All aircraft rely on accurate air data measurements to either be used by the pilot, or to be used by more complicated aircraft with flight control systems. These air data measurements typically include altitude, airspeed, ambient temperature, angle of attack (AoA), and angle of sideslip (AoS). Pilots will target altitudes and airspeeds for tasks such as takeoff, approach, and landing. Being at the correct speed ensures safe handling characteristics while being at the correct altitude ensures safe clearance from the ground and obstacles. Flight control systems will schedule inputs based on the flight computer's understanding of the aircraft's airspeed, AoA, and AoS. Whether used by the pilot or the flight control computer, accurate air data measurements are essential to the safe operation of aircraft.

Typical air data systems rely on combinations of probes that extend from the aircraft and flush static ports. Unfortunately, these systems cannot measure the ambient conditions because either the probes, or the aircraft itself distorts the flow. So providing accurate air data measurements by existing means requires careful consideration during the design phase. Even with careful design considerations, the overall flight test campaign still requires costly and dedicated flight test time and techniques to determine the errors associated with their installation.

Optical Air Data Systems (OADS) use lasers to interrogate the air mass without physically disturbing the flow. OADS effectively provide the necessary information free from errors associated with traditional pitot-static or flush air data systems. Several efforts have demonstrated this capability, but only in subsonic environments and none have actually compared the accuracy of OADS to currently accepted methods. Aircraft that travel in the transonic to supersonic regimes create larger disturbances and OADS would have to interrogate packets of air across a shock front.

Initial evaluations of overall accuracy will be performed with the OADS integrated into a flight test pod installed on a specially modified F-16 test aircraft, known as a Pacer, that can make precise air data measurements. Air data measured by the OADS would be compared to the solution provided by the F-16 Pacer. On subsequent test efforts, the OADS would be integrated into a larger bomber type aircraft for evaluations of suitability and utility as flight-test-specific instrumentation and as primary aircraft equipment replacing traditional air data systems.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. Offerors are expected to provide a white paper providing a comprehensive feasibility assessment that outlines the technical viability of using Optical Air Data Systems (OADS) for flight-test-specific instrumentation and primary aircraft equipment at speeds more than the speed of sound and at altitudes up to 50,000 feet.

This assessment should address the suitability of the systems for accurate air data measurements and their potential integration into different aircraft platforms. Additionally, I expect Accuracy Testing, where the contractor conducts initial evaluations of the overall accuracy of the OADS as implemented in wind tunnel environments. Offerors should specify the testing methodologies and procedures to ensure precise air data measurements during the evaluations.

Furthermore, Data Analysis is essential, and I anticipate the Offerors to conduct a thorough analysis and provide meaningful conclusions about the accuracy, suitability, and utility of the OADS as flight-test-specific instrumentation and primary aircraft equipment. Lastly, I also expect a rugged integration of the OADS into the flight test pod, which will be installed on a specially modified F-16. The Offerors should then demonstrate how the system can effectively be integrated into several aircraft design structure and predict its performance in real-flight scenarios.

PHASE II: The proposed effort is focused on maturing the technology to be able to provide additional measurements of ambient temperature, density, angle of attack and sideslip as well as true airspeed on high performance aircraft in regimes faster than the speed of sound. As a result, the Phase II Period of Performance objectives:
1.) Integrate Optical Air Data System into a flight test pod to be carried on an F-16.
2.) Collect flight test data used to evaluate the Optical Air Data System against the Air Force Test Center's specially modified Pacer F-16.
3.) Evaluate the suitability and utility of Optical Air Data Systems to serve as a flight-test-unique truth source of air data measurements.
4.) Evaluate the suitability and utility of Optical Air Data Systems to replace the primary air data system in lieu of traditional pitot-static or flush air data system. Success criteria includes gathering information on the measurement of the following five air data measurements throughout the flight envelope of the flight test pod as installed on an F-16 and through the flight envelope of the large bomber type aircraft.

Air Data Measurements:
1.) True Airspeed
2.) Ambient Pressure
3.) Ambient Temperature
4.) Angle of Attack
5.) Angle of Sideslip
As integrated on to the F-16, operating parameters are from zero to 50,000 feet Pressure Altitude, and zero airspeed up to 1.2 Mach Number. The operating parameters for the large bomber type aircraft will depend on the platform selected.

PHASE III DUAL USE APPLICATIONS: Phase III would transition this type of hardware to be the primary means of measuring air data parameters on aircraft to replace traditional air data installations. Phase II is expected to increase the TRL of this technology to a 7-8 prior to entrance to Phase III. Stealth aircraft and hypersonic platforms would be able to eliminate thousands of hours of design and development on flush air data systems typically used in these applications. Additionally, these aircraft would be able to eliminate required dedicated flight test efforts to calibrate said systems. Additional commercial applications extend to airliners for detecting Clear-Air-Turbulence (CAT). CAT is not typically associated with weather phenomena and is much more difficult to detect and avoid. The National Transportation Safety Board reported 197 turbulence-related accidents between 2009 and 2018, all caused serious injuries. Nearly 30 percent of these accidents were caused by CAT. Optical Air Data Systems can potentially be used to detect CAT with enough advanced notice to avoid the area and prevent accidents.

REFERENCES:

1. NASA/TP-2004-210735, Optical Air Flow Measurements in Flight, Bogue, R. K., and Jentink, H. W., National Aeronautics and Space Administration Dryden Flight Research Center, Edwards AFB, California, December 2004.;

KEYWORDS: Optical Air Data System

AF241-D015 TITLE: Collaborative Airborne Sensor Fusion via Maximizing Information under Constraints

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 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: Collaborative Automatic Target Acquisition (ATA) in munitions is a burgeoning research field with a unique set of challenges. DOD guidance on the use of machine learning/artificial intelligence for safety-of-life applications necessitates that munitions that employ ATA are highly confident and correct in their target classifications. Some viewing angles and perspectives provide better target discrimination than others, depending on the target, the ATA algorithm being used, the type of sensor, and the observations that have already been made by the munitions. The objective of this topic is to investigate and demonstrate algorithms that can determine the next measurement or next “best look” on a set of targets to maximize correct identification/classification by the munitions, while minimizing the total number of measurements/observations and collaborative communication required to achieve that goal.

DESCRIPTION: There are two primary concepts of operation that are supposed by this topic: standalone munitions and swarming munitions. In the case of swarming munitions, each munition would have a different viewing angle/attitude on the target, or “look”. The “best look” algorithm developed under this topic would determine what the next optimal “look” would be, and task the sensor on a munition to gather that observational data. After determining what the most informative data to collect is, communication bandwidth is conserved by choosing to only communicate observations that are both independent of previous observations and from optimal sensor/viewing perspective combinations.

This mathematical determination of observation independence and optimal “look” can also be applied to the case of a single munition. A single munition could be fusing together the predictions from multiple types of onboard sensors to correctly identify a target, and knowing which sensor is providing the best observations at any one time would increase the accuracy of the sensor fusion ATA algorithm. Additionally, the mathematical determination of any given observation’s independence could be used to avoid feeding fusion algorithms multiple iterations of dependent observations, falsely increasing the influence of one “look” on the outcome of a fusion algorithm’s target identification.

Challenges such as enemy anti-air weapons, communication/processing constraints, battery limitation, maneuverability, obscuration, and a multitude of deception methods all impede target identification, and can could be included in as constraints on a “best look” algorithm spawning from this research. These constraints will iteratively be introduced into the “best look” algorithms. An objective goal will be modifying the “best look” algorithms to provide sensor tasking on munitions that increases survivability by avoiding adversarial air defenses and minimizing battery usage.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. For a Offeror to demonstrate that their technology is at an appropriate level for a D2P2 award, the Offeror should have experience developing autonomy algorithms for applications similar to the topic above. Similar applications may include swarming for search and rescue, ISR, or other kinds of drone teaming. The Offeror should also have experience simulating autonomy algorithms with tools such as Airsim, CODE, or Golden Horde Colosseum. Offerors should be capable of simulating the performance of multiple sensors and multiple Automatic Target Recognition (ATR) algorithms while factoring in sensor degradation and object obfuscation.

PHASE II: Given a variety of target types, a set of targets in the environment, and a set of distributed seeker sensors and their associated ATR algorithms, a prototype deliverable should be able to simulate and demonstrate the concept of operations of maximal information measurement fusion, provide the statistics concerning number of looks required, and other statistics such as the percent of correct target classifications as a function of the number of observations. The algorithm should be capable to perform under additional possible constraints. The algorithm should be able to variably set the number and type of targets, the layout of the targets, and the obscuration of the targets. Simulation data may need to be generated as part of the effort, to provide quantitative statistics of in the “best look” algorithm performance under a variety of conditions. Both the single and swarming concept of munitions should be demonstrated and evaluated.

After functional demonstration of the “best look” algorithm in a simulation environment, constraints will be added in to more accurately reflect the operational environment. These constraints may include, but are not limited to, adversarial air defenses against munitions, communication/processing constraints, battery limitation, maneuverability, and obscuration of targets of interest to the ATR algorithm.
Size, weight, and power (SWAP) efficiency metrics will also be used to judge the performance of the “best look” algorithm. Proposers should expect their algorithm to be implementable on a System on Module embedded computer running alongside an ATR algorithm. The training of any machine learning models is not SWAP constrained, but the trained model is.

PHASE III DUAL USE APPLICATIONS: Other potential military applications of this technology in PH III include advances made towards fusing automatic targeting information across other distributed airborne platforms, such as ISR. A PH III could be applied commercially in autonomous aircraft and automobiles, and the sensor input independence research could be applied to a number of commercial fields dealing with real-time statistical analysis.

REFERENCES:

1. K. Saleh, S. Szénási and Z. Vámossy, "Occlusion Handling in Generic Object Detection: A Review," 2021 IEEE 19th World Symposium on Applied Machine Intelligence and Informatics (SAMI), Herl'any, Slovakia, 2021, pp. 000477-000484, doi: 10.1109/SAMI50585.2021.9378657;
2. J. He, S. Yan, J. Hu, and Y. Wang, “Learning-based airborne sensor task assignment in unknown dynamic environments,” Engineering Applications of Artificial Intelligence, vol. 111, May 2022. doi:2022.104747;
3. A. O. Hero and D. Cochran, "Sensor Management: Past, Present, and Future," in IEEE Sensors Journal, vol. 11, no. 12, pp. 3064-3075, Dec. 2011, doi: 10.1109/JSEN.2011.2167964;
4. DoD Directive 3000.09, “AUTONOMY IN WEAPON SYSTEMS”, January 25, 023.;

KEYWORDS: Networked Collaborative Autonomy; Automated Target Acquisition; Automatic Target Recognition; Digital Engineering; Modeling Simulation and Analysis; Sensor Fusion; Loitering Munitions; Distributed Sensing.

AF241-D016 TITLE: Large RF Windows for High-Temperature Seekers

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Advanced 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(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 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 for this effort is to mature window technologies for use in RF seeker systems for extreme hypersonic environments. Specifically, the sponsoring organization seeks to advance the technical and manufacturing maturity of novel materials for large form-factored RF transparent windows that can be conformally mounted in the nose section of a hypersonic vehicle (e.g.: doubly shaped). This challenging mission environment demands technical solutions with specialized thermomechanical properties, structural designs, manufacturing optimizations, and RF performance across a wide range of operational temperatures.

DESCRIPTION: As hypersonic strike systems become more prolific across the DoD munitions community, there is an increasing need to develop, mature, and improve upon the various specialized sensors and associated apertures or windows necessary to strike ground mobile and maritime targets. Conventional legacy sensors and associated apertures or windows do not survive through the extreme thermal environments associated with hypersonic weapons. The art and science of specialized high-temperature seeker RF windows that are manufacturable at scale is still very immature, and this is especially true for large RF windows. This topic aims to address material science, mechanical design, manufacturability, and RF performance challenges towards dramatically increasing the TRL and MRL of large high-temp RF windows.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement.
For this Direct-to-Phase-II topic, the Offeror is expected to have previously demonstrated competence in the design of high-temperature ceramics and/or ceramic matrix composites for RF windows. Offerors should have demonstrated experience in high-temperature materials engineering, testing, and designing for manufacturability.

PHASE II: For this Direct-to-Phase-II topic, the proposer shall design, characterize, prototype, and test an advanced large-form-factor RF window for hypersonic strike applications. Emphasis shall be placed on RF performance, ease of manufacturability, reliability and system safety despite the inhospitable environment, and follow-on production costs. Six prototype large-form-factor RF windows will be delivered. Testing of the prototypes shall include RF performance across the operational thermal profile and across the operational shock/vibration profile. Testing shall also include weather particulate impact assessments.

PHASE III DUAL USE APPLICATIONS: Following successful completion of this Direct-to-Phase-II topic, AFRL and our transition partner will assess any remaining TRL or MRL gaps needed to ready this large-form-factor RF window design for integration with a DoD Prime contractor’s hypersonic seeker system and work to address those gaps via a Phase III contract or other mechanism.

REFERENCES:

1. Properties of large scale ultra-high temperature ceramic matrix composites;
2. D. Sciti, P. Galizia, T. Reimer, A. Schoberth, C.F. Gutiérrez-Gonzalez, L. Silvestroni, A. Vinci, L. Zoli;
3. Composites Part B: Engineering Volume 216, 01 Jul 2021, 108839;
4. Dielectric and mechanical properties of hypersonic radome materials and metamaterial design: A review;
5. T. Kenion, N. Yang, C. Xu;
6. Journal of the European Ceramic Society, Volume 42, Issue 1, Jan 2022, Pages 1-17.;

KEYWORDS: Keywords: High-temp materials; hypersonics; RF seekers; seekers; manufacturability; CMC; RF windows; RF apertures.

AF241-D017 TITLE: Augmented Reality Enhanced Corrosion Control Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

OBJECTIVE: To develop an integrated suite of Augmented Reality (AR) technology to address Corrosion Control

DESCRIPTION: Aircraft maintenance maintainers have identified an opportunity to increase efficiency, lower cost, and increase safety of Corrosion Control professionals by enhancing existing corrosion control detection and measurement systems with wearable Commercial-Off-the-Shelf Augmented Reality technology to provide data as a visual overlay within the user's field of view, tag measurement data in Three Dimensional Space to specific aircraft, save data for future use and users, and export data and live video to additional users and digital twins. Aircraft maintainers envision enhancement of two systems: one which measures the thickness of paint on a metal or composite substrate and one which serves as an Eddy Current Non-destructive Testing system.

Corrosion Control professionals use a variety of systems (e.g., Eddy Current, Ultrasound, X-ray) to detect problems, but these systems do not share a common interface, cannot save results associated to a particular aircraft, and can be unwieldy to handle while scanning and recording results manually. Most systems cannot export data; they only show video on other monitors. There is limited ability for remote experts to support maintainers without traveling to site.

Aircraft maintainers estimate an AR-integrated Paint Scanning system would increase aircraft maintenance production efficiency by 15-25% and throughput of additional aircraft per year per system to a similar degree, directly improving readiness of aircraft fleet. The NDI Eddy Current integrated system is estimated to deliver 15-25% increase in efficiency, 10% or more improvement in detection accuracy, 10% or more improvement in end user safety, and cost savings.

Aircraft maintainers' grand vision for such an integration approach is to arm the maintainer, supervisors, and quality personnel with a suite of AR-enabled corrosion control detection and measurement systems, each with data associated to the aircraft tail number and available at all times for review through the AR headset, enabling an unparalleled capability to toggle through data to fully understand the current and historical corrosion profile of the individual aircraft as well as inform larger analyses of recurring issues and corrosion trends across the fleet.

PHASE I: FEASABILITY DOCUMENTATION. As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. For this Direct-to-Phase II topic, evaluators are expecting that the submittal firm demonstrate the ability to have proven feasibility of importing data (not just video) from multiple detection systems into an AR platform, present data, and store data.

PHASE II: Contractor will integrate a minimum of three Corrosion Control systems with a single AR platform, tag scan data in 3D space to a particular tail number, enable features by user type (maintainer, supervisor, etc.), and toggle through results without rebooting or reorienting the system. User interface will be simple and intuitive. Applications will share a common look and feel. Data will be exported to a digital twin on a phone, tablet, and/or PC. Live data from the AR system can be shared with other users. AR platform displays data for entire aircraft, not individual parts.

PHASE III DUAL USE APPLICATIONS: Contractor will operationalize the Phase II prototype, obtaining Authority to Operate, developing an API or Plug-in to allow additional Corrosion Control system integrations, productizing AR and enabling components into a kit and obtaining National Stock Number(s), and offering sustainment options. Contractor will integrate additional Corrosion Control systems. AR platform can show scans for individual parts.

REFERENCES:

1. AFRL-RX-WP-TR-2008-4373 RECOMMENDED PROCESSES AND BEST PRACTICES FOR NONDESTRUCTIVE INSPECTION (NDI) OF SAFETY-OF-FLIGHT STRUCTURES, John Brausch, Lawrence Butkus, David Campbell, Tommy Mullis, and Michael Paulk;
2. Ladwig P., Geiger C. (2019) A Literature Review on Collaboration in Mixed Reality. In: Auer M., Langmann R. (eds) Smart Industry & Smart Education. REV 2018. Lecture Notes in Networks and Systems, vol 47. Springer, Cham. https://doi.org/10.1007/978-3-319-95678-7_65;
3. Brown, L.J.: Professional reflection – mixed reality to augment the next generation of aviation professionals. In: Kearns, S.K., Mavin, T.J., Hodge, S. (eds.) Engaging the Next Generation of Aviation Professionals, pp. 163–180. Routledge, New York, NY (2020);

KEYWORDS: Augmented Reality; Non-destructive Inspection; Corrosion Control

AF241-D018 TITLE: Long Range Strike System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 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 loitering munition capable of being air launched that can carry a payload appropriate for lightly armed vehicles and a small sensor gimbal of the 6 or 8 inch class.

DESCRIPTION: Moving targets, similar to lightly armed personnel carriers, have always presented challenges to the Department of Defense from a targeting and strike perspective. There is an ongoing need for a loitering munition capable of striking such mobile targets.

Mobile targets present different challenges than standard fixed targets as they require the munition to account for rapid movements up to the moment of strike. A loitering munition can also provide further increased capabilities around the ability for the munition to wait for an appropriate time to make the strike, whether for intelligence, collateral damage, or better effect on target reasons.

Another key benefit of loitering munition is that they can be air launched and greatly increase the capability of the launching system. Common Launch Tubes (CLTs) are one way to launch payloads like loitering munitions, but they can also be dropped from hard mounts on the wings, or launched from an internal payload bay of the launching system.

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 that the small business would have accomplished the following in a Phase I-type effort via some other means (e.g. IRAD, or other funded work). As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. 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 meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the Offeror 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: Develop a new method or system that is air launched and can loiter and strike and disable a lightly armored moving (up to 80km/h) target while carrying a small sensor payload

i. Develop and demonstrate a system that is capable of safely separating and transitioning to flight when launched from a King Air or similar aircraft

ii. Develop and demonstrate a system that is capable of transiting up to 20km when launched from 5kft AGL at speeds from 80-130 TAS

iii. Develop and demonstrate system that can carry a warhead powerful enough to destroy lightly armored personnel carriers and a small sensor gimbal of the 6″ or 8″ class.
iv. Develop and demonstrate a system that can strike a vehicle moving down a road at up to 80 km/hr
v. Develop matrix of operational tradeoffs relating to employing the new system
vi. Generate Interface Control Document (ICD) and overview descriptions in parallel with the system development.
vii. System needs to be self-contained and easily integrated onto a variety of aircraft
viii. System needs to be based on an open architecture to allow for integration of various sensors
Complete the design of the system, demonstrate performance of a prototype system through field testing, and deliver the prototype for subsequent evaluation by the government.

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to existing defense applications. Solution has further applications in ISR missions with the capability of swapping out the warhead for other payloads.

REFERENCES:

1. Department of the Air Force Operational Imperatives, https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf;
2. Liebhardt, B., Pertz, J. (2022). Automated Cargo Delivery in Low Altitudes: Business Cases and Operating Models. In: Dauer, J.C. (eds) Automated Low-Altitude Air Delivery. Research Topics in Aerospace. Springer, Cham. https://doi.org/10.1007/978-3-030-83144-8_4;
3. Dauer, J.C., Dittrich, J.S. (2022). Automated Cargo Delivery in Low Altitudes: Concepts and Research Questions of an Operational-Risk-Based Approach. In: Dauer, J.C. (eds) Automated Low-Altitude Air Delivery. Research Topics in Aerospace. Springer, Cham. https://doi.org/10.1007/978-3-030-83144-8_1;

KEYWORDS: Loitering munition, long range, Group 1, Group 2, Group 3, warhead, mobile target engagement, moving target

AF241-D019 TITLE: Low-Cost Long-Range Airdrop Delivery

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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(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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate an expendable system capable of being airdropped and delivering a 20 lbs. payload, 200 nautical miles from the drop, which can be procured at a low cost.

DESCRIPTION: Government and industry both have experienced considerable challenges in delivering necessary supplies to the ground assets that need them. These challenges are compounded for the military, where standoff range and safety are imperative to protect both ground and air assets. Current methods used by the Department of Defense are capable but too expensive to proliferate in the force.

To allow use anywhere in the world, the system needs to be capable of being airdropped from both the C-130 and CV-22. Airdrop will require solutions for the structure of the air vehicle to survive the forces undergone during safe separation. This will also require the airdrop package or other delivery method to meet relevant safe separation standards and be capable of fitting within the cargo areas of both aircraft. The autopilot should provide the ability to set or change the coordinates by loadmasters onboard the aircraft prior to the deployment. The system will not be controlled or updated once launched and does not require anti-jam capabilities.

Long standoff ranges allow higher operational safety for both the aircraft and receiving party. Any system to be considered should be appropriate for normal airdrop missions for CV-22 and C130s and capable of performing the mission in light winds.

To be considered, proposals must make every effort to reduce unit cost. The threshold is $30k per unit for 100 units with an objective of $10k for 100 units. This low-cost goal allows for proliferation in mission sets where current capabilities simply would not make sense for one-time-use delivery assets. Any system to be considered must provide accurate cost proposals detailing how their unit cost is calculated and achievable.

In order to align with Operational Imperative 7 (See Ref 1), Readiness to Deploy and Fight, a system need to be developed that allow for transportation with preexisting support systems. This could include the 463L half pallet system and the Joint Modular Intermodal Container (JMIC) (See Ref 2).

PHASE I: This is a Direct to Phase 2 (D2P2) topic. Phase I ~~1 like~~ proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a “Phase I-type” effort via some other means (e.g. IRAD, or other funded work). As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. 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 meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the Offeror 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: Develop and demonstrate a system capable of airdrop and delivery of small payloads at low cost

i. Develop and demonstrate an delivery system capable of airdrop from the cargo envelope of C-130s and CV-22s

ii. System must fly 200 nautical miles from airdrop point

iii. System must be capable of delivering a 20 lbs payload with a volume of 480 in3 notionally 8 in × 20 in × 3 in.

iv. System must be capable of a delivery accuracy within a circle with a diameter of 200 meters

v. Threshold unit cost of $30k per system with an objective $10k unit cost

vi. Develop matrix of operational tradeoffs relating to employing the new system

vii. System must be capable of transport with existing cargo support equipment

viii. System must be able to exfil away from drop zone or support rapid destruction and disposal on the ground

Complete the design of the system, demonstrate performance of a prototype system through field testing, develop detailed per unit cost data and production cost projections, and deliver the prototype for subsequent evaluation by the government.

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to for use in military application, but the system could also find further applications in the field of search and rescue and disaster support.

REFERENCES:

1. Department of the Air Force Operational Imperatives, https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf;
2. MIL-STD-3028: Joint Modular Intermodal Container https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=276692;

KEYWORDS: contested logistics, austere operations, airdrop, air delivery, cargo delivery, package delivery

AF241-D020 TITLE: Counter-UAS Long Bow

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Integrated Sensing and Cyber; Directed Energy (DE); Microelectronics; Integrated Network System-of-Systems; Advanced Materials; Human-Machine Interfaces

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a system that can detect, ID, track, and defeat UAS up to 100lbs and 100knots at a scale of 10-15 threat UAS, beyond the fence line and using low collateral methods (No High explosives) and minimizing effects on military installations (no significant FOD on runways).

DESCRIPTION: Improvised and near peer UAS operations continue to evolve and morph. Active UAS combat in various parts of the world provide lessons learned and new tactics for UAS and Counter UAS operations teams to experiment with. Tactics include silent flight, mass attack, complex diversion and simple swarming. More dynamic smart swarming employed manually by human control or machine piloting is beginning to emerge and will continue to increase in complexity over the next few years. Many Counter UAS solutions have attributes that allow adversaries to game them and still complete their mission of disrupting DoD military operations or causing loss of life or military equipment. This topic is focused on developing modern concepts that can detect multiple UAS outside the wire and stop them using techniques that are independent of threat speed, altitude, flight path, PNT and inter swarm coordination techniques. These concepts can include air and ground sensors, ground and air launched effectors and air surveillance outside of the wire.

There are significant complexities in all phases of the kill chain and not all these problems can be solved under this topic. This effort is focused on effect on adversary operations and how those effects can evolve or morph throughout an engagement to prevent an adversary from successfully adjusting their tactics (speed, altitude, autonomy) to complete their mission.

PHASE I: This is a Direct-to-Phase 2 (D2P2) topic. Phase I proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a “Phase I-type” effort via some other means (e.g. IRAD, or other funded work). As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. 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 meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the Offeror 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: Develop a system that can detect, ID, track, and defeat UAS being employed in autonomous and complex ways against US military entities world-wide. It is permissible to propose only part of the complete solution, as long as defeat is included. If detect, ID, and/or track are not included as a part of your proposed solution, it is necessary to address which technologies and interfaces are required to augment your proposed system. In other words, your proposed defeat should account for the complexities of detect, ID, and track.

i. Develop and demonstrate a real or emulated tracking system for up to 15 UAS up to 100lbs, 100knots and with highly dynamic flight paths
ii. Integrate an appropriate UAS tracking system into an effector management system
iii. The system should be as autonomous as possible but able to be manually controlled based on policy
iv. The system should be able to deal with threats on many sides of an area up to 10km,while minimizing the number of ground or air assets
v. Develop and demonstrate UAS defeat inside and outside the wire with minimal collateral effects to the area of operation
vi. System should be designed to stop 2-3 distinct attacks without significant reload or reset
vii. System will be required to keep human operators aware of the status of each target and where they are in the kill chain
viii. System will provide information on the disposition of targets to support Battle Damage Assessment (BDA)

Complete the design of the system, demonstrate performance of a prototype system through flight experimentation and demonstration.

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to provide airfield security, but it could also be used for National Airspace (NAS) policing, commercial UAS fleet management and UAS awareness for commercial use

REFERENCES:

1. Army Planning Demo of Systems to Counter Group 3 UAS, https://www.defensedaily.com/army-planning-demo-of-systems-to-counter-group-3-uas/army/;
2. Pentagons Counter Drone Boss tackles rising threat https://www.defensenews.com/unmanned/2023/03/10/pentagons-counter-drone-boss-tackles-rising-threat/;
3. Layered Defense is the best option https://insideunmannedsystems.com/for-counter-uas-layered-defense-is-the-best-option/;

KEYWORDS: Intelligence, Surveillance and Reconnaissance (ISR), Unmanned Aircraft Systems (UAS), Counter Unmanned Aircraft Systems (C-UAS), Ground Target Moving Indicator (GTMI), Dynamic Targeting (DT), Mobile Ad-Hoc Networking (MANET), Low Collateral Effects Interceptors (LCEI), Ground to Air weapons, Air to Air Weapons, UAS Traffic Management (UTM), Tipping and cueing, Infrared designation, EO/IR UAS tracking, UAS Radar, C-UAS False Alarm Mitigation (CFAM), Vertical Take Off and Landing (VTOL), Position Navigation and Timing (PNT), Counter PNT and Battle Damage Assessment (BDA).

AF241-D021 TITLE: In-Place Heat Treat for Incrementally Formed Parts

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Research, evaluate, and ultimately deploy the ability to heat treat incrementally formed sheet metal parts directly on the forming equipment without removing the part.

DESCRIPTION: Metal is typically formed in a soft state. After forming, the part is typically heat treated to make it harder and applicable for use on an aircraft. The process of heat treating tends to warp the part, requiring the part to be placed back in/on the forming machine (called re-striking).

Robotic incremental metal forming provides a perfect use case to heat treat the metal in place directly after the forming process. This eliminates requiring the part to travel to another shop and another piece of equipment and greatly simplifies the re-striking process. Additionally, sourcing certain sheet metal stock with the appropriate starting heat-treated state can be challenging, increasing the associated lead times to form parts and have them installed on aircrafts.

In-place heat treat capability, given that it allows for the heat treat state of the sheet stock to also be manipulated prior to forming, can mitigate this issue. Comprehensively considered, an in-place heat treat capability would make operations more efficient, effective, and safe. These attributes would be realized through a much-lessened logistical footprint, on-time attention per part, and utility input per part. The additional process would also greatly enhance net capacity to produce in surge production and other potential scenarios.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. For this topic, evaluators are expecting that the submittal firm demonstrate the ability to detect warpage and re-strike the part as required.

PHASE II: Characterize the temperature-time profile of the metal as a function of heat treat parameters and test the mechanical behavior of the treated parts. Evaluate and ultimately pick a heating technology that meets the needed requirements. Develop working prototype to heat treat the part on the existing robotic incremental forming equipment at WR-ALC.

PHASE III DUAL USE APPLICATIONS: Refine hardware and software to increase accuracy and reliability. Achieve production-ready state for marketing to the Air Force, other related federal agencies, and private industry.

REFERENCES:

1. Kalveram, Sandra – “Induction heat treatment of sheet-bulk metal formed parts”, Feb 26, 2016, https://www.advancedsciencenews.com/induction-heat-treatment-sheet-bulk-metal-formed-parts/
2. Merklein, M, Johannes, M. Lechner, M. Kupper, A. – “A review on tailored blanks—Production, applications and evaluation.” J. Mater. Process. Technol. 2014, 214, 151–164. https://www.sciencedirect.com/science/article/abs/pii/S0924013613002653;
3. R Waggott, DJ Walker, RC Gibson, RH Johnson – “Transverse flux induction heating of aluminum alloy strip” Metals Technology 9.1 (1982): 493-498. https://www.tandfonline.com/doi/abs/10.1179/030716982803285954?journalCode=ymst19;

KEYWORDS: Incremental Metal Forming, Industrial Robots, Heat Treating

AF241-D022   TITLE: Microelectronics Inoculation

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Space Technology; Integrated Sensing and Cyber

OBJECTIVE: The end-state would be a full demonstration of the technology for military use cases. In addition, any tools and process utilized for microelectronics inoculation are fully documented. Develop a plan for scaling the delivery of the solution to military and commercial systems.

DESCRIPTION: Demonstrate capability to detect, protect and defend against hardware insertion against malware and cyber-attack. This should include in an embedded network and as a means of securing the supply chain (should they be different). Develop and demonstrate the tools and process steps used to inoculate the microelectronics. Ensure that this is documented in a user's manual. Provide a plan for deploying the solution to military and civilian systems.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. The potential Offeror should have a minimum viable product (MVP) available. The Offeror should articulate the military use case that it intends to support. Evidence of commercialization is required, to include dual-use solutions. . This can include but not limited to company funding that has been received for the MVP or further development of the MVP.

PHASE II:
TASK 1: Develop plan to demonstrate the capability to detect, protect and defend against hardware insertion (Trojan), network malware and cyber-attacks (including root kits, DOS, ransomware and device destruction) during all lifecycle phases.
Expected Delivery: Award + 1 month
Deliverable: Provide plan + MVP, TPOC will review and accept plan.

TASK 2: Execute plan and demonstrate a capability to detect, protect and defend against both hardware insertion (Trojan) and network malware, and cyber-attacks (including root kits, DOS, ransomware, and device destruction).
Expected Delivery: Award + 6 month
Deliverable: Document outcomes (video, test report, etc) of the demonstration to include recommendations for findings and future research that may be needed.
Acceptance Criteria: The TPOC will witness and accept successful demonstration and report.

TASK 3: Develop a methodology that is practical and can scale the delivery of the solution to DoD and commercial systems.
Expected Delivery: Award + 9 months.
Deliverable: Documented methodology.
Acceptance Criteria: The TPOC will review and accept report.

TASK 4: Fully document tools and processes used to detect, protect, defend microelectronics in DoD systems.
Expected Delivery: Award + 12 months.
Deliverable: Provide the tools and instructions for use. Provide recommendations for tool improvement.
Acceptance Criteria: The TPOC will review and accept tools, documentation, and instructions.

PHASE III DUAL USE APPLICATIONS: TRL6 would be expected at the end of the Phase II. Further, if the Phase II project is successful, there is interest from the Weapons PEO. The TPOC is a SME from the Weapons PEO and will be in the best position to determine if additional work is needed and the appropriate weapons program office that could transition the work. In addition, there is interest in assured and trusted microelectronics as documented in the recent AF/ST study requested by Congress. With a successful demonstration of technology additional agencies can be contacted for interest and possible adoption of the technology.

REFERENCES:

1. 15 U.S.C. §638;
2. Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Program Policy Directive (Oct 2020);
3. 5 C.F.R. §2635.702(c), Exception (1);

KEYWORDS: Microelectronics Inoculation

SF241-D023 TITLE: Automated MBSE Model Generation of Space Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software

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 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, develop, and demonstrate SysML model generation techniques to automate the creation of new models of systems using static text-based design documentation.

DESCRIPTION: The Department of Defense vision for digital engineering is to modernize how the Department designs, develops, delivers, operates, and sustains systems. The United States Space Force (USSF) uses Model-Based Systems Engineering (MBSE) approaches to acquire new systems, including the delivery of System Modeling Language (SysML) format of architectures and designs. The USSF is also building digital ecosystems and Live, Virtual, Constructive (LVC) capabilities to simulate the employment of space systems through the use of digital models. The USSF needs new model-generation solutions to automate and standardize the creation of new digital models from existing static-based documentation of legacy systems that are not already represented in model-based formats. This will enable the integration of diverse Space Platforms in a common digital environment for warfighting simulation to predict and evaluate the Space Order of Battle.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. As part of the "Phase I-type" feasibility demonstration, Offerors shall provide evidence of their firms' experience developing SysML models and AI/ML applications that can perform similar tasks. Phase I-type efforts include: developing SysML models of DoD space systems, simulating the employment of DoD systems within an integrated simulation framework, modeling new systems using a Government Reference Model (GRM) for a DoD system, and employing Artificial Intelligence techniques to automate the generation of information from existing documentation.

PHASE II: Develop and deliver an AI capability that will be hosted on a government system and used to automate the generation of SysML models from existing system documentation. Demonstrate the ability to use digital threads to integrate newly generated models with an integrated simulation framework. Develop techniques to include a Government Reference Model as a reference for the newly generated models. Demonstrate the ability to generate SysML models of a space system from text-based documentation. GFE is not anticipated.

PHASE III DUAL USE APPLICATIONS: Develop a strategy to transition prototype capabilities for digital transformation across USSF commands and organizations. Develop and support a strategy to adapt model generation from a government-provided GRM to align with evolving MBSE standards across the USSF. Generate the necessary documentation to train engineers to effectively use the AI application to generate new models for various purposes. Support activities to ensure the training of users and sustainment of the application on government information systems. Assist the government in quantifying the operational impact of model-based design, development, operations, and sustainment.

REFERENCES:

1. Department of Defense Digital Engineering Strategy, Office of the Deputy Assistant Secretary of Defense for Systems Engineering, Washington, D.C., 2018. Accessed: July 5, 2023, [Online]. Available: https://ac.cto.mil/wp-content/uploads/2019/06/2018-Digital-Engineering-Strategy_Approved_PrintVersion.pdf.;

KEYWORDS: Artificial Intelligence; Digital Engineering; Digital Thread; MBSE; Warfighting Simulation

SF241-D024 TITLE: 15 SPSS Path to Production Development for Electro-Optical Sensor Scheduling Software Modernization

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Integrated Sensing and Cyber; Directed Energy (DE); Integrated Network System-of-Systems; Space Technology

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 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 optimize telescope mount and sensor usage for contributing Space Domain Awareness (SDA) operations, R&D, mission partner campaigns, maintenance, upgrades and associated personnel. Develop a DevOps path to production for capabilities that support Squadron business functions. Develop a DevOps path to production for mission capabilities to include Development/Test/Production environments for GEODSS and R&D Operations. Build and deliver a 15 SPSS Portal - marketing/advertising, scheduling, statusing, optimization, assessment, metrics/dashboard, SITREPs/MISREPs.

DESCRIPTION: Host a kickoff meeting with the Government led Product Team, dev team, engineer team and associated stakeholders. Conduct a discovery and findings to address technical and programmatic needs including; re-use of existing tools/code, evaluation of potential platforms and opportunities to deliver new capabilities to the 15 SPSS.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement.

In order to demonstrate the feasibility that would have otherwise been demonstrated during Phase I performance, the Government expects Offerors to demonstrate a technical solution for an initial software deployment of an app that tracks telescope mount usesage requests, scheduled downtime due to maintenance, sensor usage, and human resources required for all of the above.

PHASE II: Develop a Path to Production for space sensor resource scheduling prototype. Prototype shall be required to deploy in both laboratory and operational environments.

PHASE III DUAL USE APPLICATIONS: Phase III will continue to provide the same criterium as Phase II but will include more site infrastructure software modernization.

REFERENCES:

1. Department of Defense Software Modernization Implementation Plan Summary-March 2023;

KEYWORDS: DevOps; DevSecOps; Path to Prod; SDA; Digital Transformation; Software Modernization; SaaS; IaaS; PaaS; Cloud

SF241-D025 TITLE: Alternative Position, Navigation, and Timing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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 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 provide resilient, multi-source, continuous, high quality, navigation and timing information by providing alternative, GPS-independent, navigation augmentation sources of positioning, navigation, and timing (PNT) data for the warfighter, civil and commercial user. Alt-PNT can augment GPS or serve as a short/medium-term alternative to GPS if access to GPS signals is denied or degraded.

DESCRIPTION: Military/Civil/Commercial users require resilient, integrated, high-precision PNT information in contested environments for vehicle autonomy and other emerging fields. This Alt-PNT effort seeks to leverage both government and commercial investments to develop and demonstrate technology to provide resilient navigation and timing information, either from novel sources or by integrating PNT information from existing sources in novel ways to enhance resilience. The scope of this effort includes provision of Alt-PNT services, hardware, software, and associated enabling technologies and approaches. This solicitation seeks proposals at the level of: Systems-of-Systems, System, Critical Item, and/or Device, which lead to Alt-PNT capability. Proposals may include Alt-PNT technologies and implementations needed within the domains of Alt-PNT Control systems, Space Segments, and User Equipment.

There are many Alt-PNT implementations that can provide PNT information independent of GPS, including (but not limited to): non-GPS space-based RF systems including global navigation satellite systems (GNSS), self-contained inertial navigation systems (INS), celestial navigation, computer vision-based approaches, network-based timing approaches, PNT-over-communications, signals of opportunity, and other land-based RF augmentation systems.

Several recent commercial efforts provide opportunities to increase PNT resilience through Alt-PNT. Those developments include: low cost proliferated LEO (pLEO) communication mega-constellations, low cost reusable launch vehicles, machine learning and artificial intelligence, quantum sensing, low cost high data-rate space laser crosslink networks, chip scale atomic clocks, very high density reconfigurable field programmable gate arrays, Graphical Processing Units, as well as the convergence of satellite communications and 5G/6G cell networks. These developments provide an overarching technological opportunity to enable all new alternative navigation services, completely independent of existing MEO GNSS systems.

Alt-PNT enablers are also of interest, including: low-cost, zero-trust, long-range, space-space networks, GNSS Situational Awareness, Integrity/Authentication Monitors, provision of GNSS Hot-Start data, global timing synchronization, and resilient C2 capability for PNT systems. These enabling capabilities address how Alt-PNT systems can be integrated with future heterogenous, multi-tier, highly integrated space assets to provide the resilient PNT.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement.

This feasibility demonstration should encompass the evaluation of scientific and technical merit and feasibility of ideas with commercial potential. Additionally, it must validate the product-market between the proposed solution and the USSF customer. The feasibility study should identify the prime potential USSF end users for the Defense-modified commercial offering, describe integration feasibility and costs with current mission-specific products, and explore the potential use by other DoD or Governmental customers. Offeror Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Prior work to demonstrate feasibility must meet the minimum technical and scientific merit specified in this description. Work submitted with the feasibility demonstration must have been substantially performed by the Offeror and/or the Principal Investigator.

PHASE II: The emphasis will shift from study/analysis and technology development/selection towards end-to-end capability demonstration. Alt-PNT Phase-II proposals addressing System-of-System, System, and integration of Critical Items will be accepted, with priority placed on proposals that provide the most technically achievable, integrated MGNSS + Alt-PNT, end-to-end, user solutions.

Successful Phase-II proposals and awards will provide an end-to-end capability demonstration in a relevant laboratory operational environment, including initial field testing to prove that the proposed Alt-PNT capability is prepared to move in to limited production and limited operational field testing. The successful Phase-II Alt-PNT capability shall achieve TRL-5 (Threshold) or TRL-6 (Objective), as documented in a final report with laboratory and field demonstration.

PHASE III DUAL USE APPLICATIONS: "Finally, during Fiscal Year 2026 (Threshold) or earlier (Objective), a Phase-III down-select will occur to the most viable Alt-PNT candidates. Technology development should be complete, teaming arraignments should be complete, production details should be complete. All outstanding cyber, integration, and operational details will have been resolved. During Phase-III limited low rate production of sufficient sub-systems will be conducted to enable limited operational demonstration in the actual operational environments. All aspects of Alt-PNT control, space segment, user equipment, integration and operation needed for successful demonstration will be conducted. The successful Phase-III Alt-PNT capability shall achieve TRL-6 (Threshold) or TRL-7 (Objective) as documented in a final report with limited production and operational demonstration.
The Alt-PNT capability sought to be developed under this program will directly benefit the warfighter, civil user, and potentially create a new class of pay-for-use commercial PNT user."

REFERENCES:

1. "PNT Advisory Board (PNTAB) https://gps.gov
2. Protect, Toughen, Augment (PTA) https://www.gps.gov/governance/advisory/subcommittees/#pta
3. DoD Technology Readiness Level Definitions: https://acqnotes.com/acqnote/tasks/technology-readiness-level
4. Stanford GPS Laboratory. https://gps.stanford.edu/
5. https://gps.stanford.edu/research/current-and-continuing-gpspnt-research/multi-constellation-gnss/navigation-commercial-leo
6. Reid, T. G. R.,Neish, A. M. Walter, T., and Enge, P. K. “Broadband LEO Constellations for Navigation,” J Inst Navig, 65: 205–220.https://doi.org/10.1002/navi.234
7. F. Menzione and M. Paonni, ""LEO-PNT Mega-Constellations: a New Design Driver for the Next Generation MEO GNSS Space Service Volume and Spaceborne Receivers,"" 2023

IEEE/ION Position, Location and Navigation Symposium (PLANS), Monterey, CA, USA, 2023, pp. 1196-1207, doi: 10.1109/PLANS53410.2023.10140052.
8. F. Rothmaier, Y. -H. Chen, S. Lo and T. Walter, ""A Framework for GNSS Spoofing Detection Through Combinations of Metrics,"" IEEE Transactions on Aerospace and Electronic Systems, vol. 57, no. 6, pp. 3633-3647, Dec. 2021, doi: 10.1109/TAES.2021.3082673.
9. Neish A, Walter T, EngeP. "Quantum-resistant authentication algorithms for satellite-based augmentation systems," NAVIGATION. 2019;
10. 66:199–209.https://doi.org/10.1002/navi.287
11. Babcock-Chi, Jade, Trapani, Lucca, Akos, Dennis, ""Timekeeping with a Chip Scale Atomic Clock in GPS Denied Environments,"" Proceedings of the 2023 International Technical Meeting of The Institute of Navigation, Long Beach, California, January 2023, pp. 34-52.
12. https://doi.org/10.33012/2023.18589

KEYWORDS: Alt-PNT; hybrid user equipment; blended PNT solutions; PNT situational awareness; commercial PNT services; prototypes; hosted payloads; hosting payloads; resilient PNT; GPS resilience; "PNT as a service"; commercial PNT; alternate timing distribution; Open Systems Architecture; GPS; GNSS; Anti-Jam; Anti-Spoof; Complementary PNT; Alternate PNT; inertial; celestial; magnetic; gravimeteric; terrain mapping; Signals of Opportunity; LEO; MEO; GEO; signal processing; antennas; signals; compact atomic clocks; Situational Awareness; M-Code; atomic clocks; machine vision; constellation; cislunar; agile; NAVWAR; absolute nav; relative nav; scalable; multi-tier MGNSS; secure processing; assured PNT; quantum sensing; MGNSS User Equipment; Software Defined MGNSS; certifiable software define radios; comm-PNT convergence; zero trust; post-quantum; authentication; cryptography; key management; ML; AI;

SF241-D026 TITLE: Digital Spaceport of the Future

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Integrated Sensing and Cyber; Integrated Network System-of-Systems; Space Technology; Advanced Materials; Human-Machine Interfaces; Renewable Energy Generation and Storage

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 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 main objective of this proposal is to foster a collaborative partnership with SpaceWERX and small businesses, advancing digital transformation, hardware modernization, and operational enhancement of our future spaceports. This is to be achieved through strategic seeding of innovative small businesses, aiming to develop technological solutions that align with the Assured Access to Space (AATS) vision. The ultimate goal is to leverage the agility, ingenuity, and adaptability of small businesses to revolutionize spaceport operations and services, thereby actualizing the Spaceport of the Future (SOTF).

DESCRIPTION: The Assured Access to Space (AATS) Chief Technology & Innovation office is seeking to partner with SpaceWERX in order to seed small businesses that can develop transformative technologies aimed at the realization of the Spaceport of the Future (SOTF) vision. This strategic investment in small businesses is envisioned to expedite the digital transformation of USSF bi-coastal spaceport operations, augment launch operational efficiency and capacity, and promote standardization, thereby revolutionizing the delivery of launch services. To that end, AATS is interested in making technological investments in the following four strategic areas: (1) Digital Transformation & Legacy Hardware Modernization: Looking for small businesses with expertise in cloud computing, DevSecOps, data analytics, cybersecurity, and especially modernizing legacy range hardware to aid in achieving our vision of being a digital-first service. (2) Agility & Capacity Enhancement Solutions: Seeking technologies that can improve the adaptability of our spaceports, streamline launch data analysis, and facilitate the capability for concurrent launch operations. (3) Data Management & Transport Layer Technologies: Interested in solutions that enable real-time data sharing, comprehensive spaceport health assessment, and secure data transport layers to augment our data-centric operational approach. (4) Standardization Technologies: Looking for innovations that support standardization across both eastern and western launch range operations to enhance user experiences and reduce our logistics footprint.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement.

This feasibility demonstration should encompass the evaluation of scientific and technical merit and feasibility of ideas with commercial potential. Additionally, it must validate the product-market between the proposed solution and the USSF customer. The feasibility study should identify the prime potential USSF end users for the Defense-modified commercial offering, describe integration feasibility and costs with current mission-specific products, and explore the potential use by other DoD or Governmental customers.

Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Prior work to demonstrate feasibility must meet the minimum technical and scientific merit specified in this description.

Work submitted with the feasibility demonstration must have been substantially performed by the Offeror and/or the Principal Investigator.

PHASE II: AATS is interested in making technological investments in the following four strategic areas: (1) Digital Transformation & Legacy Hardware Modernization: Looking for small businesses with expertise in cloud computing, DevSecOps, data analytics, cybersecurity, and especially modernizing legacy range hardware to aid in achieving our vision of being a digital-first service. (2) Agility & Capacity Enhancement Solutions: Seeking technologies that can improve the adaptability of our spaceports, streamline launch data analysis, and facilitate the capability for concurrent launch operations. (3) Data Management & Transport Layer Technologies: Interested in solutions that enable real-time data sharing, comprehensive spaceport health assessment, and secure data transport layers to augment our data-centric operational approach. (4) Standardization Technologies: Looking for innovations that support standardization across both eastern and western launch range operations to enhance user experiences and reduce our logistics footprint. Successful Phase-II proposals and awards will provide an end-to-end capability demonstration in a relevant laboratory operational environment, including initial field testing to prove that the proposed capability is prepared to move in to limited production and limited operational field testing. The successful Phase-II capability shall achieve TRL-6 or higher, as documented in a final report with laboratory and field demonstration.

PHASE III DUAL USE APPLICATIONS: Phase III efforts generated out of this Specific Topic will be executed by PEO AATS to further operationalize and sustain the prototyped capabilities.

REFERENCES:

1. Spaceport of the Future (SOTF) Strategic Guidance Memorandum;
2. Delta-V Capability Needs Statement;

KEYWORDS: Spaceport Operations, Assured Access to Space (AATS), Digital Transformation, Launch Data Management, Launch Operations Standardization, Cybersecurity, DevSecOps, Cloud Computing, Real-time Data Sharing, Spaceport Health Assessment

Defense Health Agency (DHA)
2024.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Health Agency (DHA) SBIR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

The Defense SBIR/STTR Innovation Portal (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. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Only Government personnel will evaluate proposal with the exception of the technical personnel from Cherokee LLC who will provide technical analysis in the evaluation of proposals submitted against DHA topic:

- Rapid Manufacturing of Personalized Braces and Splints for Musculoskeletal Injury

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DHA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Specific questions pertaining to the administration of the DHA SBIR Program and these proposal preparation instructions should be directed to:

DHA SBIR Program Management Office (PMO) Email: usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.mil

For technical questions about a topic during the pre-release period, contact the Topic Author(s) listed for each topic in the BAA. To obtain answers to technical questions during the formal BAA period, visit the Topic Q&A: https://www.dodsbirsttr.mil/submissions/login.

PHASE I PROPOSAL GUIDELINES

Technical Volume (Volume 2)

The technical volume is not to exceed **20 pages** and must follow the format and content requirements provided in the DoD SBIR Program BAA. Do not duplicate the electronically-generated Cover Sheet or put information associated with the Technical Volume in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically-generated Cover Sheet and Cost Volume are excluded from the 20-page limit. Technical Volumes that exceed the 20-page limit will be deemed non-compliant and will not be evaluated.

Cost Volume (Volume 3)
The Phase I Base amount must not exceed $250,000 over a 6-month period of performance. Costs must be clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Please review the updated Percentage of Work (POW) calculation details included in the DoD Program BAA. DHA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement Officer.

Travel must be justified and relate to the project needs for direct Research Development Test & Evaluation (RDT&E) Technology Readiness Level (TRL) increasing costs. Travel costs must include the purpose of the trip(s), number of trips, origin and destination, length of trip(s), and number of personnel.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by DHA during proposal evaluations.

Supporting Documents (Volume 5)
All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

Fraud, Waste and Abuse Training (Volume 6)

DIRECT TO PHASE II PROPOSAL GUIDELINES
DHA Direct to Phase II Proposals are different than traditional DHA SBIR Phase I proposals. The chart below explains some of these differences.

	STANDARD DHA SBIR PROCESS	**DHA D2P2 PROCESS**
PHASE 1 TYPICAL FUNDING LEVEL	$250,000	None
PHASE 1 TECHNICAL *POP DURATION	6 months	None
PHASE 2 TYPICAL FUNDING LEVEL	$1,300,000	$1,300,000
PHASE 2 TECHNICAL *POP DURATION	24 months	24 months

*POP= Period of Performance

Direct to Phase II proposals must include all volumes, not to exceed maximum page limit, mentioned below, and must follow the formatting requirements provided in the DoD SBIR Program BAA.

A. DoD Proposal Cover Sheet (Volume 1)

B. Technical Volume (Volume 2):

   a. Part 1: Phase I Justification (20 Pages Maximum)

   b. Part 2: Phase II Technical Proposal (40 Pages Maximum)

C. Cost Volume (Volume 3)

D. Company Commercialization Report (Volume 4)

E. Supporting Documents (Volume 5)

F. Fraud, Waste, Abuse (Volume 6)

Technical Volume (Volume 2):

Phase I Justification: Offerors are **required** to provide evidence that the scientific and technical merit and feasibility have been established as described in the topic's description and Phase I.

Technical Proposal:

1. Results of current work – Discuss the objectives of your effort, the research conducted, findings or results, and estimates of technical feasibility.
2. Technical objectives and approach – List the specific technical objectives of the Direct to Phase II research and describe the technical approach in detail to be used to meet these objectives.
3. Work plan – The plan should indicate what is planned, how and where, a schedule of major events, and the final product to be developed.
4. Related work – Describe significant activities directly related to the proposed effort, including those conducted by the Principal Investigator, the proposing firm, consultants, or others. Report how the activities interface with the proposed project and discuss any planned coordination with outside sources. The proposers' awareness of the state-of-the art in the technology and associated science must be demonstrated.
5. Relationship with future research or Research and Development – State the anticipated results of the proposed approach if the project is successful. Discuss the significance of the effort in providing a foundation for a Phase III research or research and development effort.
6. Technology transition and commercialization strategy – Describe your company's strategy for converting the proposed SBIR research into a product or non-R&D service with widespread commercial use – including private sector and/or military markets. Note: The commercialization strategy is separate from the Commercialization Report. The strategy addresses how you propose to commercialize this research, while the Company Commercialization Report covers what you have done to commercialize the results of past awards.
7. Key personnel – Identify key personnel, including the Principal Investigator, who will be involved in the effort. List directly related education and experience and relevant publications (if any) of key personnel. A concise resume of the Principal Investigator(s) must be included.
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. Proposing small business concerns 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. A proposal may be deemed nonresponsive if the requested information is not provided. Therefore, proposing small business concerns 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 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 – Justify items of equipment to be purchased (as detailed in the cost proposal), including Government Furnished Equipment (GFE). All requirements for government furnished equipment or other assets, as well as associated costs, must be determined and agreed to during contract negotiations. State whether 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. Consultants – Involvement of university, academic institution, or other consultants in the project may be appropriate. If such involvement is intended, it should be described in detail and identified in the Cost Volume.

Cost Volume (Volume 3):
The Cost Volume must contain a budget that does not exceed $1,300,000 for the entire 24-month Direct to Phase II period. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in the Cost Volume (Volume 3).

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DHA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement Officer.

Travel must be justified and relate to the project needs for direct Research Development Test & Evaluation (RDT&E) Technology Readiness Level (TRL) increasing costs. Travel costs must include the purpose of the trip(s), number of trips, origin and destination, length of trip(s), and number of personnel.

Company Commercialization Report (Volume 4):
Completion of the CCR of the proposal submission in DSIP is required. Information contained in the CCR will be considered by DHA during proposal evaluations. Please refer to the DoD SBIR Program BAA for full details on this requirement.

Supporting Documents (Volume 5):
All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

<u>Fraud, Waste and Abuse Training (Volume 6)</u>

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees. Phase II is the demonstration of the technology found feasible in Phase I. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the DHA SBIR PMO typically in month five of the Phase I contract.

Due to limited funding, the DHA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. Small businesses submitting a proposal are required to develop and submit a Commercialization Strategy describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal. This plan shall be included in the Technical Volume.

The Cost Volume must contain a budget for the entire 24-month Phase II period not to exceed the maximum dollar amount of $1,300,000. Budget costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site) and shall be presented side-by-side on a single Cost Volume Sheet.

DHA SBIR Phase II proposals have six volumes: Proposal Cover Sheets, Technical Volume, Cost Volume, Company Commercialization Report, Supporting Documents, and Fraud, Waste, and Abuse.

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. Technical Volumes that exceed the 40-page limit will be deemed non-compliant and will not be evaluated.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DHA SBIR Program does not participate in the Technical and Business Assistance (formerly the Discretionary Technical Assistance Program). Contractors shall not submit proposals that include Technical and Business Assistance.

The DHA SBIR Program has a Transition Lead who provides technical and commercialization assistance to small businesses that have Phase I and Phase II projects.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

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. Non-selected companies may request feedback within 15 calendar days of the non-select notification. The Corporate Official identified in the firm's proposal shall submit the feedback request to the SBIR Office at usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.mil. Please note feedback is provided in an official PDF via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral feedback will 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 feedback request.

NOTE: Feedback is not the same as a FAR Part 15 debriefing. Acquisitions under this solicitation are awarded via “other competitive procedures”. Therefore, offerors are neither entitled to nor will they be provided FAR Part 15 debriefs.

Refer to the DoD SBIR Program BAA 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:

Ms. Samantha L. Connors SBIR/STTR Chief, Contracts Branch 8
Contracting Officer
U.S. Army Medical Research Acquisition Activity
Email: Samantha.l.connors.civ@health.mil

AWARD AND CONTRACT INFORMATION

Phase I awards will total up to $250,000 for a 6-month effort and will be awarded as Firm-Fixed-Price Purchase Orders.

Direct to Phase II awards will total up to $1,300,000 for a 24-month effort and will typically be Firm-Fixed-Price contracts. If a different contracting type is preferred, such as cost-plus, the rational as to why must be included in the proposal.

Phase I/Phase II awardees will be informed of contracting and Technical Point of Contact/Contract Officer Representative upon award.

ADDITIONAL INFORMATION

RESEARCH INVOLVING HUMAN SUBJECTS, HUMAN SPECIMENS/DATA, OR ANIMAL RESEARCH

Prior to contract award when an IRB is indicated, proposers must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human subjects, human specimens, or research with animals. If necessary, approvals are not obtained within two months of notification of selection, the decision to award may be terminated.

Offerors are 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 (USAMRDC) Animal Care and Use Review Office (ACURO). Written authorization to begin research under the applicable protocol(s) proposed for this award will be issued in the form of an approval letter from the USAMRDC ACURO to the recipient. Modifications to previously approved protocols require re-approval by ACURO prior to implementation.

Research under this award involving the use of human subjects, to include the use of human anatomical substances or human data, shall not begin until the USAMRDC’s Office of Human and Animal Research Oversight (OHARO) provides formal authorization. Written approval to begin a research protocol will be issued from the USAMRDC OHARO, under separate notification to the recipient. Written approval from the USAMRDC OHARO is required for any sub-recipient using funds from this award to conduct research involving human subjects. If the Offeror intends to submit research funded by this award to the U.S. Food and Drug Administration, Offerors shall propose a regulatory strategy for review.

*NOTE: Exempt animal or human research use shall also reflect ‘yes’ on the proposal coversheet for USAMRDC ACURO and OHARO records.

Non-compliance with any provision may result in withholding of funds and or termination of the award.

WAIVERS

The DHA SBIR Program highly discourages offerors from proposing a federal facility use waiver during Phase I due to the significant lead time required to prepare documentation and secure approval, which could substantially delay the performance of the Phase I award.

In rare situations, the DHA SBIR Program allows for a waiver to be incorporated allowing federal facility usage for testing/evaluation. A waiver will only be permitted when it has been determined that no applicable U.S. facility has the ability or expertise to perform the specified work. The DHA SBIR Program has the right of refusal. If approved, the DHA SBIR Program will assist in establishing the waiver for approval. If approved, the proposer will subcontract directly with the federal facility and not a third-party representative.

Transfer of funds between a company and a Military Lab must meet the following APAN 15-01 requirements (the full text of this notice can be found at https://usamraa.health.mil/SiteAssets/APAN%2015-01%20Revised%20Feb%202018.pdf):

> (1) The DoD Intramural Researcher must obtain a letter from his/her commanding officer or Military Facility director authorizing his/her participation in the Extramural Research project. This letter must be provided to the Extramural Organization for inclusion in the proposal or application.
>
> (2) The DoD Intramural Researcher must also coordinate with his/her local Resource Manager Office (or equivalent) to prepare a sound budget and justification for the estimated costs. Where there are no DoD-established reimbursement rates [e.g., institution review board (IRB) fees, indirect cost rates, etc.], the Military Facility's RM office (or equivalent) must provide details of how the proposed rates were determined. The DoD Intramural Researcher must use the budget and justification form enclosed in APAN 15-01 when developing the estimated costs and provide it to the Extramural Organization for inclusion in the proposal or application.
>
> (3) The Extramural Research proposal or application must include a proposed financial plan for how the Military Facility's Intramural Research costs will be supported [i.e., directly funded by DoD, resources (other than award funds) provided by the Awardee to the Military Facility, or award funds provided by the Awardee to the Military Facility (in accordance with the requirements below)].
>
> (4) The DoD Intramural Researcher should also coordinate with his/her technology transfer office.

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 nonprofit 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, such as Phase III, if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

DHA SBIR 24.1 Topic Index

DHA241-001 TITLE: Psoralen-UV-A Irradiation Based High-throughput Pathogen Inactivation Device

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Infectious Diseases

OBJECTIVE: Develop and validate a high-throughput psoralen/ultraviolet A(UV-A) based pathogen inactivation device capable of inactivating pathogens at a wide range of volumes (from 0.01 L to 50 L). The solution can facilitate rapid development of vaccines against any emerging infectious threats to protect civilian and military personnel against infectious diseases and reduce lost duty days.

DESCRIPTION: Emerging pathogens with epidemic and pandemic potential are a significant threat to US Forces that defend the homeland and US interests abroad. Historically, highly pathogenic novel viruses have impacted continuity of operations of US Forces with grave consequences. Recently, the COVID-19 pandemic has impacted operations, training, and military readiness across all services and has introduced quarantine and isolation challenges to the US Fleet carrying out freedom of navigation operations in the Pacific. It is imperative to develop, validate, and field an agile vaccine platform that can be rapidly adapted to produce a preventative countermeasure for the next emerging disease threat to US forces. To that end Naval Medical Research Command (NMRC) has developed a psoralen/UV-A based whole virus inactivation method in laboratory scale [1, 2]. NMRC has also developed and optimized a two-step chromatographic method to obtain highly purified psoralen inactivated whole virus vaccine candidates in large quantities to conduct preclinical immunogenicity and efficacy evaluations. We have prepared highly purified monovalent and tetravalent psoralen-inactivated dengue virus vaccines (DENV PsIVs) and a psoralen-inactivated SARS-CoV-2 (SARS-CoV-2 PsIV) vaccine candidate and evaluated their immunogenicity, efficacy and safety in animal models [3, 4]. Psoralen-UV-A based inactivation method can be easily adapted to develop whole cell inactivated vaccines against any pathogen including bacteria, viruses, and parasites, and has a great potential as an agile vaccine platform to rapidly develop vaccines against emerging infectious threats. Based on the preclinical immunogenicity data NMRC is currently working on establishing a contract with a commercial manufacturing organization to make SARS-CoV-2 PsIV under cGMP conditions to conduct a first in human Phase 1 clinical trial. However, our efforts to manufacture the GMP product is hampered by lack of a suitable psoralen/UV-A inactivation device for effectively inactivating pathogens at large enough volumes (10 mL – 50 L batches) under cGMP conditions. The prototype device developed in this SBIR topic should have the capability to inactivate pathogens in 10 mL to 50 L volume using psoralen and UV-A irradiation and the ability to adjust and optimize the parameters such as flow rate of the pathogen solution into and out of the UV-A irradiation chamber, time of UV-A irradiation and the total UV-A energy applied to the pathogen solution for achieving a complete pathogen inactivation without degrading the antigenic proteins. Availability of such a high-throughput psoralen-inactivation device for manufacturing the GMP product will significantly advance the psoralen-inactivated whole cell vaccine platform as an agile vaccine platform against emerging infectious diseases. This pathogen inactivation device can also be used for rapid inactivation of pathogens requiring high containment (BSL-3 and BSL-4 laboratories) without degrading their surface proteins and antigens before bringing them out of the BSL-3 or BSL-4 lab for antigen discovery and characterization.

PHASE I: The main goal of Phase I is a feasibility study towards developing a prototype high throughput UV-A irradiation device capable of handling 10 mL to 50 L volume of pathogens at high titers (greater than 1011 PFU or CFU per mL) while uniformly delivering the UV-A energy to the pathogen solution to achieve complete inactivation of the pathogen. NMRC Tech Transfer office and NMRC legal will work with the small business to license or otherwise distribute prior technology findings from NMRC to awardees at no cost. The proposed psoralen-UV-A irradiation should be a flow through inactivation device with inlets for pumping psoralen/pathogen mixtures into to the UV-A-irradiation chamber with a control the flow rate, and capable of uniformly delivering the UV-A energy to the entire psoralen/pathogen mixture as it flows within the UV-A chamber, and an outlet from the UV-A irradiation chamber to collect the psoralen/UV-A processed inactivated pathogen into an appropriate bioprocessing container for downstream vaccine development processes. The prototype device should include the software and control switches necessary to regulate/adjust all the parameters including flow rate, stop and start flow, amount of UV-A energy applied (microjoules/second/cm2), and the time of application of UV-A energy. The design should include selection of tubing and materials that are low binding to ensure minimal loss of biological material during the inactivation process. Device design should allow for adjusting the total inactivation volumes of pathogens as required.

Phase I deliverables:

- Data demonstrating flow-through inactivation of 10 mL – 5 L of a virus, using psoralen-UV-A irradiation-based pathogen inactivation method/device.

PHASE II: The main objective of Phase II is to develop and produce a fully functional prototype high throughput UV-A irradiation device that is capable of handling 10 mL to 50 L volume of pathogens at high titers (greater than 1011 PFU or CFU per mL) while uniformly delivering the UV-A energy to the pathogen solution to achieve complete inactivation of the pathogen. The major components of the device should include a) an inlet to add specific amount of psoralen derivative to the entire volume of the pathogen, b) an inlet to the UV-A-irradiation chamber and a pump to control the flow rate, c) the UV-A irradiation chamber capable of uniformly delivering the UV-A energy to the entire pathogen solution contained within the UV-A chamber, d) control switch to regulate/adjust the amount of UV-A energy applied to the pathogen solution, and an outlet from the UV-A irradiation chamber to collect the psoralen/UV-A processed inactivated pathogen into an appropriate bioprocessing container for downstream vaccine development processes. The prototype device should include the software and control switches necessary to regulate/adjust all the parameters including flow rate, stop and start flow, UV-A energy applied (microjoules/second/cm2), and the time of application of UV-A energy.

Phase II deliverables:

- One fully functional prototype psoralen-UV-A irradiation-based pathogen inactivation device with data demonstrating complete inactivation of 50 L of Dengue virus.

PHASE III DUAL USE APPLICATIONS: The main target of this high throughput psoralen/UV-A irradiation-based pathogen inactivation device is the GMP vaccine manufacturers who will be making the whole cell inactivated vaccines. Whole virus inactivated vaccines occupy a large proportion of the global viral vaccines market since they elicit a broad range of immune responses and have several advantages including safety and relatively low production cost. The global inactivated vaccines market is expected to increase by more than 10% from 2022 to 2027 (https://www.globalmarketestimates.com/market-report/inactivated-vaccine-market-3754). Formaldehyde and β-propiolactone, the chemicals currently used for making whole virus inactivated vaccines, are less than optimal since they alter the immunogenic proteins and are considered carcinogenic. Psoralen compounds on the other hand do not affect the immunogenic proteins and have been shown to be safe for use in biopharmaceutical applications. Therefore, after successfully delivering the prototype device and completing this SBIR phase II, the vision is for the small business to make a commercially viable psoralen/UV-A-based inactivation device by partnering with vaccine manufacturers. This device can be marketed for making psoralen-inactivated vaccines against a broad range of diseases caused by viruses including influenza, poliovirus, hantavirus and rabies virus. Availability of such a high-throughput psoralen-inactivation device for manufacturing the GMP product with a basic instrument manual with operating instructions to regulate/adjust the device parameters and anticipated troubleshooting guidelines (in accordance with FDA guidelines) will significantly advance the psoralen-inactivated whole vaccine platform as an agile vaccine platform against emerging infectious threats. This pathogen inactivation device can also be marketed for rapid inactivation of contaminants during biopharmaceuticals production such as recombinant proteins and other therapeutic agents. It can also be marketed to academic and environmental scientists for inactivating high containment (BSL-3 and BSL-4 laboratories) pathogens without degrading their surface proteins and antigens before bringing them out of the BSL-3 or BSL-4 lab for antigen discovery and characterization. A basic instrument manual with operating instructions to regulate/adjust the device parameters and anticipated troubleshooting guidelines.

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KEYWORDS: Psoralen inactivation of pathogens, UV-A irradiation, Psoralen-inactivated pathogen, Whole virus inactivated vaccine, Emerging infectious diseases, Agile vaccine platform

DHA241-002 TITLE: Development of a Junctional Tourniquet

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casualty Care

OBJECTIVE: To rethink the form factor and engineering approach of existing junctional tourniquets, providing reliable control of junctional hemorrhage. Such a solution must be readily accessible at the point of injury and designed to be user-friendly and intuitive, enabling use by non-medical personnel for self-aid and buddy care scenarios.

DESCRIPTION: Exsanguination from massive blood loss accounts for more than 80% of potentially survivable battlefield deaths [1]. A junctional tourniquet solution would address the 32% of these fatalities that arise from uncontrollable extremity and junctional bleeding [2]. Junctional tourniquets apply external compression to stop blood flow in the groin and axilla, i.e., at the junction of the trunk and the appendages. Junctional indication demands precise placement and, ideally, single-point pressure. The tourniquet design must ensure user accuracy in high-stress situations. Currently, four designs meet FDA approval and have shown effectiveness in occlusion under controlled conditions [3]. This topic seeks a form factor that allows for fast and easy application by non-medical personnel with minimal training.

When proposing a technology, consider the following factors:

- The device should be able to control a junctional bleed within about one minute as operated by a trained user.
- Ideally, a well-designed junctional tourniquet can replace the use of an extremity tourniquet.
- The total weight of the device should be under 1.5 lbs. The stored volume should be no more than 500 cubic inches to remain minimal for transport and individual warfighter use.
- The design should be amenable to one handed use.
- Engineer the device to efficiently manage both upper and lower junctional hemorrhage through compression of axillary and femoral arteries, respectively.
- Ensure the device's availability at the point of injury, i.e., it must be able to be commonly carried.
- Use of the device shall be simple with minimal steps. Anatomical knowledge should not be required for operation of the device. Device shall not require more than 2 hours of standardized training.
- The tourniquet design should address stability over time, including factors such as physiological response to hemorrhage, type of uniform, surface conditions (blood or rain) and transport.
- The materials should have the ability to withstand dirt/dust/sand, UV exposure, fresh and salt water, hot and cold temperatures, requiring minimal special storage conditions.
- Engineering solutions should require minimum logistical/technical support.

PHASE I: Phase I feasibility will be demonstrated through evidence of: a completed proof of concept/principal or basic prototype system; definition and characterization of framework properties/technology capabilities desirable for both Department of Defense/Government and civilian/commercial use; and capability/performance comparisons with existing state-of-the-art technologies/methodologies (competing approaches).

Phase I-type effort: conduct a study to determine the technical feasibility (as demonstrated through clinical data, benchtop testing, etc.), end-user human factors testing and an initial design of a junctional tourniquet.

PHASE II: During this phase, the offeror will advance the system towards TRL 4, refining it from a proof-of-concept. The design should be optimized for efficacy and qualitative and quantitative hemorrhage control outcomes should be demonstrated to include metrics such as the time to apply to occlusion and percentage of successful occlusion attempts (i.e., how does the tourniquet fit different anthropomorphic types). Testing and evaluation of the prototype to demonstrate operational effectiveness in simulated stressful environments should be demonstrated. Stability of the product over time (to include considerations for physiological response to hemorrhage, type of uniform, surface conditions (bloody or wet) and transport) and survivability of the materials under extreme conditions (heat, cold, wet, UV and dirt/dust) should be demonstrated. Draft application instructions, procedures, technical specifications, and training materials should be provided for technical and end-user evaluation. A major criteria for acceptance by the end-user will be a favorable form factor in order for the device to be carried at all times. The offeror should plan to deliver fifteen example prototypes at the end of the Phase II effort for Government evaluation. The offeror shall articulate the regulatory strategy and provide a clear plan on how FDA clearance will be obtained.

PHASE III DUAL USE APPLICATIONS: The goal of this phase is to secure an FDA approved device and demonstrate effectiveness and usability for the military and civilian end-user. Funding from either a non-SBIR Government source (e.g., Navy Advanced Medical Development, U.S. Army Medical Materiel Development Activity's Warfighter Expeditionary Medicine and Treatment Project Management Office, Marine Corps System Command, Joint Warfighter Medical Research Program), the private sector, or both should be investigated to develop the prototype into a viable product for sale in military and/or private sector markets. Civilian end-users can include police, fire and medical first responders, hospitals, air ambulance and evacuation, recreational medical services such as lifeguards and ski patrol, and emergency management agencies. Scenarios requiring junctional tourniquets can include automobile and motorcycle accidents, industrial accidents, mass shootings, terrorist incidents and natural disasters.

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KEYWORDS: Hemorrhage Control, Tourniquet, Combat Casualty Care, En Route Care, Mass Casualty, Prolonged Field Care, Trauma, Junctional, Extremity, Care Under Fire, Buddy Care

DHA241-D001 TITLE: Rapid Manufacturing of Personalized Braces and Splints for Musculoskeletal Injury

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: This topic is intended for technology proven ready to move directly into Phase II and is accepting Direct to Phase II proposals only. To develop a manufacturing framework to rapidly produce personalized, human-usable braces and splints with no-to-minimal manual intervention. The solution can accelerate musculoskeletal injury recovery, reduce the need for medical evacuation, and facilitate Warfighter readiness, while mitigating the impact on logistics and storage limitations in military environments and medical treatment facilities.

DESCRIPTION: The DoD lacks the capability to rapidly manufacture rehabilitation devices and equipment in areas where space and/or storage requirements are minimal. Musculoskeletal injuries (MSKIs) are the largest burden of injury for the U.S. military [1]; with 85% of service members medically evacuated following an MSKI not returning to theater [2]. Rehabilitative braces and splints are commonly used to manage and rehabilitate MSKIs. Braces and splints provide partial rigidity to protect and stabilize an injury, while still allowing some movement where needed. Current off-the-shelf braces and splints come in various sizes and designs for different body parts, sides, and injuries. The quantity potentially needed presents a significant challenge for adequately stocking these items where, when, and for whom they are needed. Currently, specific braces are manufactured, selected, transported, and stored, based on anticipation of how many of each type of brace will be required. This is of particular concern in military environments, particularly deployed and maritime care settings, where space may be limited, and the need exists to improve the medical readiness of someone with minor injuries. There is currently no role of care requirements; however, this technology is envisioned in a Role of Care 2/en route care setting.

Additive manufacturing can reduce the logistical burden of transporting and storing an array of medical supplies. Currently, applications of 3D printed technology are growing in popularity within medicine [3], with applications in orthopedics being used for personalized implants and customized prostheses [4]. As 3D printing advances, it may provide innovative solutions, such as becoming a more personalized and accessible option than off the shelf bracing/splinting [4]. The desired end stage product/system will be able to rapidly manufacture personalized braces and splints onsite and on-demand for MSKI to accelerate recovery, reduce the need for medical evacuation, and facilitate Warfighter readiness. Desired products contain both flexible and semi-rigid elements, depending on the nature of the injury. Moreover, the ideal solution should have the potential to provide an array of bracing/splinting products across various MSKIs to promote Warfighter return to duty.

PHASE I: This topic is intended for technology proven ready to move directly into Phase II. Therefore, the offeror must be able to demonstrate and provide documentation to substantiate that the scientific and technical merit and feasibility described in Phase I has been met and describes the potential commercial applications. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results.
Completed Phase I efforts should demonstrate research and development towards a rapid fabrication solution for personalized bracing or splinting technology that requires minimal manual intervention. Feasible and practical solutions have the potential to combine the rigidity of personalized 3D-printed elements with flexible textiles, garments, or similar materials. Completed efforts should additionally demonstrate research and development towards a solution that can be customized based on user anthropometrics for braces/splints to be worn for lower and/or upper extremity musculoskeletal injuries. The fabrication framework is expected to minimize the logistical footprint and be used within a setting with access to power.

PHASE II: Design and develop the practical implementation of the system that incorporates the previously completed Phase I methodology toward a technology that can rapidly, and optimally generate personalized braces or splints with minimal manual intervention. Product development can be an innovation of existing technologies. Semi-rigid elements combined with textiles or soft materials and fastening or securing materials make up the key design elements. Designs should be capable of personalization to user size and anthropometrics, injury location, right/left side. They should also be capable of personalization based on requirements for mobility (e.g. semi-flexible to semi-rigid). Input requirements (manual measurements, scans, etc.) are not pre-defined. Testing and implementation should be relevant to Warfighters who have sustained an upper and/or lower extremity MSKI. The framework/system begins with a scan or computer-based inputs and the output is the final brace/splint. The user inputting the data or scans may be a clinician. The end recipient is the injured patient. The test-case for the output of this Phase II will be a single ankle brace/splint and hand/wrist brace/splint as a proof of concept, with a request for a physical prototype. The Phase II development should focus on a clinician interface for personalization inputs and the rapid-manufactured, personalized bracing/splinting solution outputs for human-usable production. Technical specifications should focus on a framework that can fit (dimension and weight-wise) on a table/desk and are expected to produce a product in an operational environment. Material selection considerations for environmental exposure during hot and cold weather operations should be considered. Frameworks that have the potential to interface with additive manufacturing systems that are multi-purpose are desirable. Systems can expect to be supplied by a standard 120V/60Hz outlet. The offeror shall articulate the regulatory strategy and provide a clear plan on how FDA clearance will be obtained.

PHASE III DUAL USE APPLICATIONS: The goal of this phase is to secure an FDA approved device and demonstrate effectiveness and usability for the military and civilian end-user. Finalization and validation of the prototype and terminal system involves producing comfortable, durable, and easily applied braces/splints that adhere to similar biomechanical outcomes as off-the-shelf models. The target market should be the commercial market for sustainability. The final commercialized product will likely integrate into a clinical practice setting, account for coding/billing requirements, complete cost/benefit analyses, identify training/education requirements (if needed), and account for socialization/broader outreach. Expected dual use of the end-product may extend to the needs of civilians and individuals post-military, such as orthopedic and VA rehabilitation facilities, urgent care centers with limited overhead, remote care settings, mobile care units, sports medicine, and other physical medicine situations. Thus, procurement by the government is likely post-commercialization by industry.

MSKIs are an immense burden in global healthcare and present a significant challenge to military readiness; therefore, innovative technology that has the potential to provide a rapid, personalized brace/splint to accelerate recovery and shorten the period in which a Warfighter can return to duty is desirable.

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KEYWORDS: Rehabilitation, Brace, Injury, Musculoskeletal, Individualized Medicine; Additive manufacturing

DHA241-D002 TITLE: Wireless, Wearable Personal Metabolic Sensor

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: This topic is intended for technology proven ready to move directly into Phase II and is accepting Direct to Phase II proposals only. A low-cost sensor that accurately measures oxygen consumption (VO2) and carbon dioxide production (VCO2) and provides immediate feedback that Service Members can use to improve fitness, refueling practices, body composition and readiness. If fielded, may require additional security measures. Designs that limit connectivity to Bluetooth (BT) are discouraged.

DESCRIPTION: The wide prevalence of metabolic dysfunction, emanating from low physical fitness, low physical activity, and obesity, is a public health concern and a national security issue across all service branches and phases of a military career, including recruitment, retention, training, deployment, and retirement from service [1,2]. The military needs new ways to optimize metabolic health of the nondeployed force and ensure sufficient and consistent warfighter fitness levels.
Athletes tailor their daily diet and physical activity routines to optimize metabolic health, body composition and physical performance [3]. Service members could do likewise, guided by actionable information provided by a personal non-invasive metabolic measurement and tracking device. Such a device would use a classic technique known as indirect calorimetry where volumetric rates of oxygen consumption (VO2) and carbon dioxide production (VCO2) are measured, and metabolic energy expenditure and metabolic fuel selection (fats versus carbohydrates) determined.

Providing service members with and easy-to-use device, capable of on-demand measurements of respiratory gas exchange and determination of energy expenditure and metabolic fuel mix, would enable individuals, small military units, and the groups that support them, to design and implement personalized diet and exercise regimens. This individualized metabolic feedback would directly support at-risk military personnel who need to meet professional standards for body composition and physical fitness and avoid the consequences of failure which can extend to separation from service.

Existing wearable systems capable of respiratory gas exchange measurements outside of a laboratory are (a) too large, heavy (~1kg), and challenging to operate, and too expensive for routine day-to-day use by large groups of minimally trained individuals, or (b) are small and simple to use but inaccurate and/or have limited capabilities (e.g., only measure VO2, only make resting measurements). However, new research and improvements in O2 and CO2 sensor technology suggest a compact, accurate, simple-to-use, cost-effective and scalable metabolic measurement device for use by individuals is achievable.

PHASE I: This topic is accepting Direct to Phase II (DPII) proposals ONLY. Therefore, the offeror must provide documentation to substantiate that the scientific and technical merit and feasibility described above and in Phase I has been met and describes the potential commercial applications.
Proof of feasibility includes a wireless, wearable, low-cost personal metabolic device prototype is sought to enable hands-free on-demand VO2 and VCO2 measurements, data recording, and wireless streaming to a platform-agnostic hand-held device of data to include derived metrics (e.g., metabolic energy expenditure (EE), fuel substrate mix, respiration rate). The body-worn device should be light-weight (<300g), compact, simple to use, tolerant of rain and ambient temperatures above freezing, and capable of confirming system device gas sensor calibration by referencing ambient air O2 and CO2 concentrations. Battery life should support at least 14 h of on-demand measurements. Errors of <10% in measurement of VO2 and VCO2 from rest to high intensity exercise is desired. A rigorous case and supporting data for technical and commercial viability must be presented. Evidence that the proposed solution will be viable, with adequate risk-mitigation. A proof-of-concept breadboard or early prototype with key components identified and accuracy quantified by means of a metabolic simulator (e.g., mechanical breath simulator

with injectable gas mixtures) is desirable. This Phase shall include a detailed discussion of the approach and feasibility of producing a prototype sensor for follow-on lab and human testing.

PHASE II: Expected military users of the technology are both individuals desiring to track impact of diet and exercise on metabolic health and performance as well as small-to-medium military units engaged in training or mission-planning activities. Ease of use in field environments is an important characteristic of the desired technological solution. The developed technology should be durable and readily applicable in resource-limited field conditions, be designed for at least 14 hours of use before recharging of battery. Gas sensor calibration accuracy must be able to be confirmed using ambient air reference. The offeror should consider final procurement cost as well as system operation and maintenance costs, creation of instruction manuals, definition of replacement/warranty policies, and training requirements for users. A user manual is desirable.Offeror will design, fabricate, integrate and test at least two prototype wireless, body-worn personal- use metabolic devices, and demonstrate accuracy of measured (e.g., O_2, CO_2, respiration) and derived parameters (e.g., Respiratory Exchange Ratio (RER), EE) using a mechanical lung simulator and injection of certified dry gas mixtures. The device must be suitable for use in field training environments where user(s) can stream data from the device, and record meta data (e.g., events) on the device, via Bluetooth Low Energy (BLE). The device shall be: 300g or less; attachable to standard Army MOLLE webbing; capable of sampling breath without headgear removal; capable of making measurements from rest (peak flow < 15 L/min) to intense exercise (peak flow > 350 L/min) with a respiratory burden <2” H_2O; capable of simple field gas calibration check and recalibration; capable of detecting onset of breathing and storing all raw data measured; and capable of accurately measuring VO_2 and VCO_2 with average EE and RER errors of <10% and <15%, respectively, over a RER (VCO_2:VO_2) range of 0.7-to-1.2. Documentation should include, but is not limited to, technical reports, test data, prototype designs/models, and performance goals/results.

If experimentation with human test volunteers is planned, the offeror must provide a detailed plan for compliance with all applicable rules and regulations regarding the use of human subjects, to include Institutional Review Board approval(s). Specifically, the proposed experimentation with human test volunteers must be reviewed for compliance with Federal, Department of Defense (DoD), and Army human subjects protection requirements and receive approval by the Office of Human and Animal Research Oversight (OHARO) Office of Human Research Oversight (OHRO) prior to implementation; this requirement derives from DoDI 3216.02 and the Defense Federal Acquisition Regulation Supplement requirement for Human Research Protection Official (HRPO) review of DoD-supported human subjects research.

Prototype Requirements: Offeror will provide two physical prototypes that include the following features and specifications: body-worn; accurate O_2 and CO_2 measurement of expired air; accurate volumetric measurement of inspired and expired air; calculation of accurate parameters (Respiratory Exchange Ratio and Energy Expenditure); demonstration of successful Bluetooth connectivity; demonstration of adequate device storage for up to 14 hours of minute-by-minute metabolic data collection; demonstration of adequate battery life for up to 14 hours of operation; weight of less than 300 grams; demonstration of accurate measurements ranging from rest to vigorous exercise; demonstration of ease of use; demonstration of simple calibration techniques. Error rates for measurements must be < 10% for energy expenditure (EE) and < 15% for respiratory exchange ratio (RER).

PHASE III DUAL USE APPLICATIONS: Phase III will include manufacturing planning. Markets envisioned include commercial and recreational entities responsible for performance and metabolic health with a particular emphasis on the impact of diet on metabolic fuel substrate, body glycogen (carbohydrate) stores and body composition. For both military and civilian applications the device will provide individuals with guidance regarding body weight management. optimized nutrition, and training for endurance and strength events. If the derived metrics include any diagnostic capabilities, all applicable Federal Drug Administration review and certification requirements must be met.

Commercial applications would target the clear gap between very expensive research-grade metabolic sensor systems, and inexpensive but less-capable systems with a low-cost easy-to-use metabolic sensor that provides immediate feedback to individuals seeking to improve their health and quality of life through improved physical fitness, dietary practices, and body muscle and fat mass management. The metabolic sensor would be a key new lightweight user-friendly resource for use in fitness facilities by personal trainers designing and monitoring specialized training and weight reduction programs. Additionally, the metabolic sensor would be used by athletes and sports teams across a wide range of sporting disciplines and age. It is expected that athletes from high school to professional would benefit from a device that provides individualized feedback to maximize training and performance. The individuals that could benefit range from athletes [3] to the large group of Americans who are either prediabetic (96 million) or diabetic (37.3 million) [2].

Military physical training programs across the Joint services are potential beneficiaries of this product. Likely end users of the metabolic sensor are the Armed Forces Wellness Centers (AFWC), which provide programs and services that improve and sustain health, performance, and readiness of military personnel. The AFWC staff are active users of sophisticated wearable metabolic monitoring systems, but have a clear need for more cost-effective, accurate, and easy-to-use indirect calorimeter systems. Another example of where metabolic sensor systems could be used by the DoD is in support of the US Army's Holistic Health and Fitness (H2F) program.

Armed Forces Wellness Centers:
https://phc.amedd.army.mil/topics/healthyliving/al/Pages/ArmyWellnessCenters.aspx
US Army's Holistic Health and Fitness (H2F) program:
https://usacimt.tradoc.army.mil/ACFTGuidance.html

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KEYWORDS: Metabolic energy expenditure, indirect calorimetry, personal metabolic sensor, metabolic health, diet, exercise, aerobic fitness, body fat management.

Defense Logistics Agency (DLA)
24.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Logistics Agency's (DLA) mission has three lines of effort the DLA Small Business Innovation Program (SBIP) supports. They include supporting the **NUCLEAR ENTERPRISE** by maintaining nuclear systems readiness, qualifying alternate sources of supply, improving the quality of consumable parts, and increasing materiel availability. **FORCE READINESS & LETHALITY** through improvements to life cycle performance through technological advancement, innovation, and reengineering, mitigate single points-of-failure that threaten the readiness of weapons systems used by our Warfighters. **SUPPLY CHAIN INNOVATION & ASSURANCE** through improved lead times, reduced lifecycle costs, maintaining a secure and resilient supply chain, providing opportunities for the small business industrial base to enhance supply chain operations with technological innovations. Lastly supply chain assurance securing the microelectronics supply chain, development of a domestic supply chain for rare earth elements, the adoptions of industrial base best practices associated with counterfeit risk reduction.

Proposers responding to a topic in this Broad Agency Announcement (BAA) must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DLA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Specific questions pertaining to the administration of the DLA Program and these proposal preparation instructions should be directed to:

Defense Logistics Agency
Small Business Innovation Program (SBIP) Office DLA/J68
Email: DLASBIR2@DLA.mil

This release contains an open topic. As outlined in section 7 of the SBIR and STTR Extension Act of 2022, innovation open topic activities—

(A) Increase the transition of commercial technology to the Department of Defense.
(B) Expand the small business nontraditional industrial base.
(C) Increase commercialization derived from investments of the Department of Defense; and
(D) Expand the ability for qualifying small business concerns to propose technology solutions to meet the needs of the Department of Defense.

Unlike conventional topics, which specify the desired technical objective and output, open topics can use generalized mission requirements or specific technology areas to adapt commercial products or solutions to close capability gaps, improve performance, or provide technological advancements in existing capabilities.

A small business concern may only submit one (1) proposal to each open topic. If more than one proposal from a small business concern is received for a single open topic, only the most recent proposal to be certified and submitted prior to the submission deadline will receive an evaluation. All prior proposals submitted by the small business concern for the same open topic will be marked as nonresponsive and will not receive an evaluation.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (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. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA. https://www.dodsbirsttr.mil/submissions/login

Technical Volume (Volume 2)

DLA's objective for the Phase I effort is to determine the merit and technical feasibility of the concept. The technical volume is not to exceed 20 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages submitted beyond the 20-page limit within the Technical Volume (Volume 2) will not be evaluated. If including a letter(s) of support, they should be included in Volume 5, and they will not count towards the 20-page Volume limit. Any technical data/information that should be in the Volume 2 but is contained in other Volumes will not be considered.

Content of the Technical Volume

Refer to the instructions provided in the DoD Program BAA.

Cost Volume (Volume 3)

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. Refer to the topic for cost and duration structure. Proposers must utilize the excel cost volume provided during proposal submission on DSIP.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DLA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement officer.

Company Commercialization Report (CCR) (Volume 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD Program BAA for full details on this requirement. Information contained in the CCR will be considered by DLA during proposal evaluations.

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).

All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

Additional DLA-specific supporting documents:

- Optional, A qualified letter of support is from a relevant commercial or government agency procuring organization(s) working with DLA, articulating their support for the technology (i.e., what DLA 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.

The standard formal deliverables for a Phase I are the:

- 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 Post Award Conference (PAC).
- The Technical Point of Contact (TPOC) and the Program Manager (PM) will determine a meeting schedule at the PAC. Phase I awardees can expect monthly (or more frequent) project reviews.
- 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).
- Applicable patent documentation.
- Other deliverables as defined in the Phase I Proposal.
- Phase II Proposal is optional at the Phase I Awardee's discretion (as applicable).

DIRECT TO PHASE II PROPOSAL GUIDELINES

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY.

This allows the Department of Defense to make an award to a Small Business Concern (SBC) under Phase II of the SBIR Program with respect to a project, without regard to whether the small business concern received an award under Phase I of an SBIR Program with respect to such project.

DLA is conducting a "Direct to Phase II" implementation of this authority for this SBIR Announcement. This pilot does not guarantee DLA will offer any future Direct to Phase II opportunities.

PROJECT DURATION and COST:

Direct to PHASE II: – Cost not to exceed $1,000,000.

PERIOD OF PERFORMANCE: The Direct to Phase II period of performance is not to exceed 24 months total.

INTRODUCTION

Direct to Phase II proposals must follow the steps outlined in the following statements.

1. Offerors must provide documentation that satisfies the Phase I feasibility requirement*.
   - This documentation will comprise the first twenty pages of Volume 2 (Technical Volume) of the Direct to Phase II proposal.
2. Offerors must submit a complete Phase II proposal using the DLA Phase II proposal instructions below.

* NOTE: Offerors are required to provide information demonstrating that the scientific and technical merit and feasibility. DLA will not evaluate any Phase II proposal if it determines that the offeror has failed to demonstrate the establishment of technical merit and feasibility.

PROPOSAL SUBMISSION

Submit the complete proposal electronically at https://www.dodsbirsttr.mil/submissions/login

Complete proposals must include all the following:

a. Volume 1: DoD Proposal Cover Sheet, Produced in the DSIP System by your company profile.
b. Volume 2: Technical proposal
   Part 1: Phase I Justification (20 Pages Maximum)
   Part 2: Phase II Technical Proposal (40 Pages Maximum)
c. Volume 3: Cost Volume (Excel spreadsheet upload)
d. Volume 4: Company Commercialization Report
e. Volume 5: Additional Documents (Optional)
f. Volume 6 FWA Training Certificate is required for proposal submission.

Phase II proposals require a comprehensive, detailed submission of the proposed effort. DLA SBIR Direct to Phase II periods of performance are 24 months. Commercial and military potential of the technology under development is extremely important. Successful proposals will emphasize applicability to specific DOD programs of record as well as dual- use applications and commercial exploitation of resulting technologies,

2. Direct to Phase II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

PROPOSAL FORMAT (60 pages maximum)

A. **Cover Sheet**. This is completed using the DSIP Portal on the Submission Site. This is a compilation of company data as well as specific information regarding the proposed project. Include a brief description of the problem or opportunity, objectives, effort, and anticipated results. Summarize the expected benefits, as well as any government or private sector applications of the proposed research. OSD and SBA will post the Project Summary of selected proposals with unlimited distribution. Therefore, the summary should not contain any classified or proprietary information.

B. Technical Volume

- Phase I Justification (20 Pages Maximum). Offerors are required to provide information demonstrating the establishment of the scientific and technical merit and feasibility.

- Phase II Technical Objectives and Approach (40 Pages Maximum). List the specific technical objectives of the Phase II research and describe the planned technical approaches used to meet these objectives.

- Phase II Work Plan**.** Provide an explicit, detailed description of the Phase II approach. The plan should indicate how and where the firm will conduct the work, a schedule of major events, and the final product to be developed. The Phase II effort should attempt to accomplish the technical feasibility demonstrated in the justification, including potential commercialization results. Phase II is the principal research and development effort and is expected to produce a well-defined deliverable product or process.

- Related Work. Describe significant activities directly related to the proposed effort, including those conducted by the Principal Investigator, the proposing firm, consultants, or others. Report how the activities interface with the proposed project and discuss any planned coordination with outside sources. The proposers must demonstrate an awareness of the state- of-the-art in the technology and associated science.

- Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. Discuss the significance of the Phase II effort in providing a foundation for a Phase III research or research and development effort.

- Technology Transition and Commercialization Strategy**.** Describe your company's strategy for converting the proposed SBIR research, resulting from your proposed Phase II contract, into a product or non-R&D service with widespread commercial use -- including private sector and/or military markets. Note that the commercialization strategy is separate from the Commercialization Report described in Section 4.L below. The strategy addresses how you propose to commercialize this research, while the Company Commercialization Report covers what you have done to commercialize the results of past Phase II awards. Historically, a well- conceived commercialization strategy is an excellent indicator of ultimate Phase III success. The commercialization strategy must address the following questions:

  - What DoD Program and/or private sector requirement does the technology propose to support?
  - What customer base will the technology support, and what is the estimated market size?
  - What is the estimated cost and timeline to bring the technology to market to include projected funding amount and associated sources?
  - What marketing strategy, activities, timeline, and resources will be used to enhance commercialization efforts??
  - Who are your competitors, and describe the value proposition and competitive advantage over the competition?

- Key Personnel. Identify key personnel, including the Principal Investigator, who will be involved in the Phase II effort. List directly related education and experience and relevant publications (if any) of key personnel. Include a concise resume of the Principal Investigator(s).

- Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase II effort. Justify the purchase of any items or equipment (as detailed in the cost proposal) including Government Furnished Equipment (GFE). All requirements for government furnished equipment or other assets, as well as associated costs, must be determined and agreed to during Phase II contract negotiations. State whether the proposed work facilities will be performed meet environmental laws and regulations of federal, state (name) and local governments. This includes, but is not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal, and handling and storage of toxic and hazardous materials.

- Consultants**.** Involvement of university, academic institution, or other consultants in the project may be appropriate. If the firm intends to involve these types of consultants, describe these costs in detail in the Cost Volume.

C. **Cost Volume**. Download, complete, and upload the Spreadsheet. Some items in the cost volume template may not apply to the proposed project. Provide enough information to allow the DLA evaluators to assess the proposer's plans to use the requested funds if DLA were to award the contract.

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

- Special Tooling, Test Equipment, and Materials Costs:
- Special tooling, test equipment, and materials costs may be included under Phase II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed; and
- The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate it directly to the specific effort.
- Cost for travel funds must be justified and related to the needs of the project.

D. **Commercialization Report.** Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. This required proposal information does not count against the 60-page limit. Please refer to the DoD Program BAA for full details on this requirement. Information contained in the CCR will be considered by DLA during proposal evaluations.

E. **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).

All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

SELECTION AND EVALUATION (Direct to Phase II only)

A. **Evaluation Criteria**. DLA will review all proposals for overall merit based on the evaluation criteria published in the DoD SBIR Program BAA:

CONTRACTUAL CONSIDERATIONS

A. Awards. The number of Direct to Phase II awards will depend upon the quality the Phase II proposals and the availability of funds. Each Phase II proposal selected for award under a negotiated contract requires a signature by both parties before work begins. DLA awards Phase II contracts to Small Businesses based on results of the agency priorities, scientific, technical, and commercial merit of the Phase II proposal.

B. Reports**.** For incrementally funded Direct to Phase II projects an interim, midterm written report maybe required (at the discretion of the awarding agency).

C. Payment Schedule. DLA Phase II Awards are Firm Fixed Price / Level of Effort contracts. Base monthly invoices on the labor hours recorded **PLUS** the monthly costs associated with the project.

D. Markings of Proprietary Information. In accordance with DoD SBIR Program BAA, section 5.3. DLA does not accept classified proposals. All Final Reports are marked with CUI // SBIZ// FEDONLY, and the Initial Project Summary as well as the Final Project Summary should reference compliance with FOR PUBLIC RELEASE.

E. Copyrights, Patents and Technical Data Rights. DLA handles all Copyrights, Patents, and Technical Data Rights in accordance with the guidelines in the DoD SBIR Program BAA.

DISCRETIONARY 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.

PHASE II PROPOSAL GUIDELINES
Per SBA Policy Directive SBIR Phase II Proposal guidance, all Phase I awardees are permitted to submit a Phase II proposal for evaluation and potential award selection, without formal invitation. Details on the due date, format, content, and submission requirements of the Phase II proposal will be provided by the DLA SBIP Program Management Office (PMO) on/around the midway point of the Phase I period of performance. Only firms who receive a Phase I award may submit a Phase II proposal.

DLA will evaluate and select Phase II proposals using the same criteria as Phase I evaluation. Funding decisions are based upon the results of work performed under a Phase I award, the Scientific & Technical Merit, Feasibility, and Commercial Potential of the Phase II proposal; Phase I final reports may 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, DLA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

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.

EVALUATION AND SELECTION (Phase I and Phase II)

Use of Support Contractors in the Evaluation Process

Only government personnel with active non-disclosure agreements will officially 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 DLA 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 "FEDONLY." Pursuant to FAR 9.505-4, DLA 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, DLA 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 DLA SBIP 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 organizations may require access to proprietary information contained in the offerors' proposals.

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. DLA 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.

- DLA reserves the right to award none, one, or more than one contract under any topic.
- DLA is not responsible for any money expended by the offeror before award of any contract.
- Due to limited funding, DLA reserves the right to limit awards under any topic.
- Only proposals considered to be "Highly Acceptable" as determined by DLA will be funded.

Please note that potential benefit to the DLA 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.

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 the DoD SBIR BAA. Once the initial evaluations are complete, all offerors will be notified as to whether they were selected to present the slide deck portion of their proposal within 60 days of the BAA close date. Only proposals receiving a "Highly Acceptable" rating will receive an invitation to present orally.

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. This presentation will be evaluated by a panel against the criteria listed above and your overall presentation. DLA will evaluate the presentation for Business Acumen, and Core Business Capabilities (Customer Engagement / Presentation Skills). The rating of the presentation will be a Go/No-Go rating.

Notification of the Go/No-Go rating decision will occur within 5 days of the presentation. 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.

The SBIP PMO will distribute selection and non-selection email notices to all firms who submit a SBIR/STTR proposal to DLA. The email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet. DLA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission. DLA will distribute the selection and non-selection notifications to all offerors within 90 days of the BAA close date.

DLA will provide written feedback to unsuccessful offerors regarding their proposals on the non-selection notification. Only firms that receive a non-selection notification are eligible for written feedback.

AWARD AND CONTRACT INFORMATION

Typically, the contract period of performance for Phase I should be up to 12 months and the award should not exceed $100,000. However, each topic may have a different threshold. The DLA Contracting Office utilizes a Firm Fixed Price (FFP) Contract for DLA Phase I Projects

The expected budget for Phase II should not exceed $1,000,000 unless approved by the DLA Program Manager, and the duration should not exceed 24 Months. Proposals more than $1,000,000 will not be considered without written PM approval. The DLA Contracting Office utilizes a Firm Fixed Price Level of Effort (FFP/LOE) Contract for DLA Phase II Projects.

Proposals not conforming to the terms of this Announcement will not be considered. DLA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DLA will be funded.

DLA reserves the right to withdraw from negotiations at any time prior to contract award.

Post Award, DLA may terminate any award 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 DLA 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.

USE OF FOREIGN NATIONALS (also known as Foreign Persons), GREEN CARD HOLDERS AND DUAL CITIZENS

If proposing to use foreign nationals (also known as foreign persons), they must be green card holders, and/or dual citizens. (No Student or Temporary Visa holders will be approved). The offeror must identify the personnel they 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.

You will be asked to provide additional information during negotiations 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).

DLA 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 DLA 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 DLA 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.

CLAUSE H-08 PUBLIC RELEASE OF INFORMATION (Publication Approval)

Clause H-08 pertaining to the public release of information is incorporated into all DLA SBIR contracts and subcontracts without exception. Any information relative to the work performed by the contractor under DLA SBIR contracts must be submitted to DLA 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 DLA's review for approval.

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:

1) DLA clause H-08 (Public Release of Information),
2) DFARS 252.204-7000 (Disclosure of Information),
3) DFARS clause 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting), and
4) DFARS clause 252.204-7020 (NIST SP 800-171 DoD Assessment Requirements). Your proposal submission confirms that any proposed subcontract is in accordance with the clauses cited above and any other clauses identified by DLA in any resulting contract.
5) DFARS Clause 252.223-7999 Ensuring Adequate COVID-19 Safety Protocols for Federal Contractors.

OWNERSHIP ELIGIBILITY
Prior to award, DLA 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 DLA, 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 DLA may result in the offeror's ineligibility for further consideration for award.

ADDITIONAL INFORMATION

Classified Proposals
Classified proposals **ARE NOT** accepted under the DLA SBIR Program. The inclusion of classified data in an unclassified proposal is grounds for the agency to determine the proposal as non-responsive and the proposal not to be evaluated.

Contractors currently working under a classified 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 DLA SBIR/STTR contracts will require security clearances. If a DLA SBIR/STTR contract develops into or identifies classified work, the offeror must have a facility clearance, appropriate personnel clearances to perform the classified work and coordinate the DD254 with the Contract Officer and the service owning the classified data.

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 DLA SBIR/STTR PMO will originate from the DLASBIR2@DLA.mil email address. Please white list this address in your company's spam filters to ensure timely receipt of communications from our office.

All attachments sent via email require encryption. The firm will have to purchase External Certificate Authority (ECA) certificates to send and receive encrypted email if they do not have a Common Access Card (CAC) or Personal Identity Verification (PIV) issued. The cost is approximately $100 per year per user. This will be a Cybersecurity Maturity Model Certification CMMC requirement for all future contracts.

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.

(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.

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 DLASBIR2@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.

DLA SBIR 24.1 Topic Index

DLA241-P01 TITLE: Phase I Open Call for Small Business Closing Supply Chain Gaps for Aging Weapon Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Mission Readiness & Disaster Preparedness; Nuclear; Sustainment & Logistics

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 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 expand and develop new Small Business Manufacturer (SBM) industrial base partners to grow participation in support of manufacturing parts managed by DLA and the Services for Aging Weapon Systems in support of DLA's mission described in Ref. 1.

DESCRIPTION: DLA SBIR Program has a legacy of success in the advancement of critical manufacturing technologies that support our national security, along with a growing small business manufacturing network that fortify DLA supply chains. These efforts together with our Service partners are helping the DLA to build a resilient SBM base to reduce the acquisition and supportability costs of defense weapons systems, reduce manufacturing and repair cycle times across the life cycles of such systems, and transition manufacturing research and development processes into production. Competitive proposals should originate from small business manufacturing firms and include their process for manufacturing a National Stock Number (NSN) or component for specific weapon platform. Proposals with software or integrated manufacturing solutions will not be evaluated.

Projects of this open topic can develop in several ways:
a) SBMs can identify NSNs on the DLA Internet Bid Board System (DIBBS). More details are available at Ref. 2. JCP Certification required as described in Ref. 3.
b) SBMs can identify NSNs through partnerships with the Air Force, Navy, Army or Marine Corps or Original Equipment Manufacturer (OEM).
c) SBMs can propose advanced manufacturing methods for existing NSNs to improve cost, reduce lead time and/or improve quality.

None of these projects can proceed without appropriate sponsorship from the DLA or one of the military Services. Identify specific partnerships and points of contact to strengthen your proposal. A specific NSN must be identified to participate in the open topic through independent SBM research. NSN's will not be provided. The Offeror must fully understand the path to becoming an approved source for the proposed NSN and describe it in their proposal.

PROJECT DURATION and COST: Proposals exceeding these limits will not be evaluated.
PHASE I: Not to exceed a duration of 6 months and cost of $50,000.
PHASE II: Not to exceed a duration of 24 Months and cost of $1,000,000.

DLA intends to make 5-10 awards against this topic. A small business concern may only submit one (1) proposal to this open topic. If more than one proposal from a small business concern is received for this open topic, only the most recent proposal to be certified and submitted prior to the submission deadline will receive an evaluation. All prior proposals submitted by the small business concern for this open topic will be marked as nonresponsive and will not receive an evaluation.

PHASE I: The project schedule should plan to perform all tasks necessary to become an approved source including but not limited to completing the TDP if applicable and/or Source Approval Request (SAR) within the period of performance.

The goal of phase I is for the SBM to develop the appropriate documentation to qualify as a source of supply for a DLA managed NSN which will demonstrate their capability to be added to a list of DLA SBIR SBM network. In this phase, manufacturers will submit a Technical Data Package and/or Source Approval Request via DLA to the applicable Engineering Support Activity (ESA), as required, for approval. The benefit to the SBM for qualifying for DLA's SBM network is eligibility for non-competitive SBIR Phase II awards and DLA NSN procurements.

All Phase I Proposals should demonstrate an understanding of the NSN and the general challenges involved in their manufacture. Proposals that fail to demonstrate knowledge of the NSN will be rejected. JCP Certification is required to access Government drawings and data. Please see reference 2. A review of references 4, 5, and 6 is highly recommended.

PHASE II: Typically, Phase II advances the project into production when representative articles are required to support validation and/or testing for source approval. Secondly, if a complete solution is not apparent by the end a Phase I, additional research may be required and funded in Phase II. Finally, in some cases the path to Low-Rate Initial Production may require funding for pre-production, test equipment and/or test services. The goal being to transition the NSN to a program or record as an approved manufacturing source.

PHASE III DUAL USE APPLICATIONS: A successful Phase III is an award(s) from DLA or the Services for the NSN proposed.

PHASE III DUAL USE APPLICATIONS: This NSN or related technology and manufacturing processes developed under this award could be used in a broad range of military and commercial applications.

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 Strategic Plan 2021-2026: https://www.dla.mil/Info/Strategic-Plan/
2. Access the web address for DIBBS at https://www.dibbs.bsm.dla.mil, then select the "Tech Data" Tab and Log into c-Folders.
3. JCP Certification: https://www.dla.mil/Logistics-Operations/Services/JCP/
4. DLA Aviation SAR Package instructions. DLA Small Business Resources: http://www.dla.mil/Aviation/Business/IndustryResources/SBO.aspx
5. DLA Small Business Innovation Programs web site: http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms
6. DLA Aviation Repair Parts Purchase or Borrow (RPPOB) Program: https://www.dla.mil/Aviation/Offers/Services/AviationEngineering/Engineering/ValueEng.aspx

KEYWORDS: Manufacturing, National Stock Number, Commercialization, Weapon System, Reverse Engineering, Technical Data Package

DLA241-002 TITLE: Engaging the Manufacturing Industrial Base in Support of DLA's Critical Supply Chains

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Mission Readiness & Disaster Preparedness; Nuclear; Sustainment & Logistics

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 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) website, (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 DLA SBIP website, (Reference 4).

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) or Surplus 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 or Surplus available is when the NSN will be provided as Government Furnished Material (GFM) if available from the ESA or one of our Service customers post award. In this case, contact the TPOC to discuss the availability of the NSN prior to starting the proposal.

Typically, a competitive SBM will have relevant experience in producing a similar item which will enable them to propose without a representative article. 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: Proposals exceeding these limits will not be evaluated.
PHASE I: Not to exceed a duration of 12 Months and a cost of $100,000. The project schedule should plan to complete the TDP and SAR in the first six months.
PHASE II: Not to exeed a duration of 24 Months and a cost of $1,000,000.

The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer 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.

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 “SBIR241A”. If the data is incomplete, or not available, the effort will require reverse engineering.

PHASE I: Not to exceed - 12 months - $100,000
The goal of phase I is for the Small Business Manufacturer 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), as 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.
JCP Certification is required to access Government Drawings and Data

PHASE II: Not to exceed - 24 months - $1,000,000
The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer 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.

The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation, engineering and manufacturing capability and the availability of appropriate requirements and funding. 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.
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 "SBIR241A"
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

DLA241-003 TITLE: Novel Metal and Ceramic Based Coatings for Military Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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(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 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 Defense Logistics Agency (DLA) seeks to provide responsive, best value supplies of related materials consistently to our Department of Defense (DoD) customers and other DoD stakeholders. DLA continually investigates diverse coating technologies for new or improved materials, more efficient means of their production, and more competitive domestic supply chains which would lead to higher levels of innovation in current and future systems combined with benefits to other commercial and government technology applications. In an effort to reduce costly foreign reliance and/or single points of failure, DLA is looking for domestic capability that could deposit novel metal, ceramic and organomettalic based coatings for various mililtary applications such as hypersonics, gun barrels, missile launchers, and others that could improve fleet operations and sustainment. The end goal of the project would be for the development of a domestic source that would produce industrial quantities of high corrosion and wear resistance, self-lubricating, low friction, thermallly stable coatings with a fully domestic or friendly supply chain. New and novel ideas that would allow for competitive pricing with domestically deposited coatings with novel feedstocks will have preference. Ideally, the production process would be modular and scalable.

Advanced technology demonstrations for increasing production capacity, affordability and supply chain resiliency for coating techniques and processing are of high interest to DoD. These areas of materials and manufacturing technology provide potential opportunities toward achieving breakthrough advances for national defense. Proposed efforts funded under this topic may encompass diverse feedstock and processing at any level that will result in increasing production capacity, affordablity, and supply chain resiliency.

Research and Development (R&D) efforts selected under this topic shall demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts must be judged to be at a Technology and/or Manufacturing Readiness Level (TRL/MRL) 6 or less, but greater than TRL/MRL 3 to receive funding consideration.
TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: The Department Of Defense (DoD) has a need for robust metal or ceramic based coatings to support operational requirements for warfighter. To this end DLA is looking for domestic capabilities and capacity to produce various different kinds of coatings including but not limited to cold spray, plasma electrolytic oxidation (PEO), diamond-like carbon (DLC), amorphous carbide, etc for advanced weapons manufacturing. Novel techniques that increase the domestic availability of technology for supply chain resiliency of coating materials will have preference. The ideal production process will be both modular and easily scalable.

PROJECT DURATION and COST: Proposals exceeding these limits will not be evaluated.

PHASE I: Not to exceed a duration of 12 months and cost of $100,000.
PHASE II: Not to exceed a duration of 18 months and cost of $1,000,000.

PHASE I: Phase I will consist of a full process flow including deposition technique, availability of feedstock and coating characterization. Thus delivering a solid proof of concept. . A preliminary economic review must be carried out evaluating the cost vs. currently available products as well as determining the cost of production when using traditional deposition techniques. An alignment or collboartion with a relavant DoD Component organzation/supplier (e.g., DoD lab, defense system program office or prime contractor) and one or more relavant DoD weapon system supply chain participants or other suitable organization is highly desirable.

PHASE II: Phase II will consist of making a pilot/low-rate deposition process of coatings used in at least two weapon systems. Coatings deposited will be characterized for purity, phase, thickness, adhension, wear and tear, etc. Two (2) or more sources of coating materials will be identified and tested in this process. A lab-scale process should be used to confirm the estimates and provide preliminary cost and pricing data. A business case will be generated using both DoD and commercial markets. Collaboration with a relavant DoD Component organzation/supplier (e.g., DoD lab and/or prime contractor) and one or more relavant DoD weapon system supply chain participants or other suitable organization is required Identify commercial benefit or application opportunities of the innovation. Innovative processes should be developed with the intent to readily transition to production in support of DoD and its supply chains.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Relationships developed and progress made in Phase I and Phase II projects should result in the ability to produce to DoD orders and organic growth of business from there.

REFERENCES:
1. Sunil Pathak, Gobind C. Saha, Development of Sustainable Cold Spray Coatings, and 3D Additive Manufacturing Components for Repair/Manufacturing Applications: A Critical Review, Coatings 2017, 7(8), 122.
2. Sheikh Farooq, Ankush Raina, Sanjay Mohan, Ramachandra Arvind Singh, Subramanian Jayalakshmi, and Mir Irfan Ul Haq, Nanostructured Coatings: Review on Processing Techniques, Corrosion Behavior and Tribological Performance, Nanomaterials, 2022 Apr; 12(8), 1323

KEYWORDS: Cold Spray, Coatings, Amorphous Carbide, PEO, DLC, Thermal Stability

DLA241-004 TITLE: Utilizing Large Language Model (LLM)/Generative AI to Develop Energy Calculation Tool for Manufacturing Processes

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software, Advanced Infrastructure & Advanced Manufacturing, Trusted AI, and Autonomy

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 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: Energy cost has a direct impact on the cost of production. DLA, as a procurement agent for DoD and all of government, understanding the cost elements are essential. Given that DLA procures more than $40 billion worth of items annually, a small percentage reduction in energy consumption can translate to substantial monetary savings.

Manufacturing, a cornerstone of modern economies, broadly encompasses two primary domains: discrete and continuous. Discrete manufacturing refers to the production of items such as weapons, military uniforms, etc. In contrast, continuous manufacturing involves non-stop processes producing goods like chemicals, fuels, and certain consumables. Regardless of the category, energy remains a pivotal input, significantly influencing the cost, efficiency, and environmental footprint of the production process.
TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: Central to the discourse on energy efficiency in manufacturing is the concept of value added (VA) and non-value added (NVA) processes. Value-added processes directly contribute to the product's transformation, whereas non-value-added ones, although often essential, don't enhance the product's inherent value from a customer's perspective. By dissecting the energy usage into these two categories and employing precise quantification mechanisms, manufacturers and DoD can achieve a deeper understanding and, subsequently, higher operational efficiencies.

This research is based on the following hypotheses:
(1) Energy used to add value (product transformation) could be modeled analytically (either physics or chemistry based),
(2) Nonvalue added energy would be a function of value-add and it could be derived either from the total energy and value-add energy or allocated using empirical techniques.

There are several databases and peer reviewed journal papers are available that shows the total energy required for various manufacturing processes. See References section for examples of where one could get the total energy required for various manufacturing processes.

Since the value-added energy in manufacturing is based on physics or chemistry-based equations, one could make use of Large Language Model (LLM)/Generative AI to identify the representative equations, and then use the same LLM/generative AI to develop the python code. Relying on the vast knowledge reservoir of the LLM/generative AI, the architecture of IT could deliver continuous refinement. This adaptability ensures that it remains relevant, accommodating emerging manufacturing methodologies and integrating the freshest insights from physics and chemistry. Also, using GitHub, one could get support/assistance from other developers to improve the accuracy of the code.

PROJECT DURATION and COST: Proposals exceeding these limits will not be evaluated.
PHASE I: Not to exceed a duration of 12 months and cost of $100,000.
PHASE II: Not to exceed a duration of 18 months and cost of $1,000,000.

PHASE I: Phase I will consist of delivering a TRL level 3 proof of concept that will include the design of an IT system that calculates value-add, non-value-add, and the total energy for a minimum of 15 discrete manufacturing processes. In addition to calculating the energy required for various manufacturing processes, it should include the greenhouse gas emissions from the energy use during value-add and non-value add processes. This system should plan to meet all the DoD physical and cybersecurity requirements.

Collaboration with a relavant DoD Component organzation/supplier (e.g., DoD lab and/or prime contractor) and one or more relavant DoD weapon system supply chain participants or other suitable organization is reccomended.

PHASE II: Phase II will build a working prototype system based on the Phase I design. The prototype should address the identified discrete manufacturing processes from Phase I. Furthermore, it should be used to confirm the estimates and provide preliminary cost and pricing data. A business case will be generated using both DoD and commercial markets.

Collaboration with a relavant DoD Component organzation/supplier (e.g., DoD lab and/or prime contractor) and one or more relavant DoD weapon system supply chain participants or other suitable organization is required.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Relationships developed and progress made in Phase I and Phase II projects should result in the ability to produce to DoD orders and organic growth of business from there.

REFERENCES:

1. https://publications.anl.gov/anlpubs/2010/10/68288.pdf
2. https://us-west-1-02900067-inspect.menlosecurity.com/safeview-fileserv/tc_download/beb9a1d4aeb1d8ce2d2fdfb4fb637f52e8537f85f3ac8225281c2e67de92cdbc/?&cid=NC949DF232947_&rid=53a12180f385ba1d5ce1e51c044cdc97&cl=9LEI8II9B3b&file_url=http%3A%2F%2Fweb.mit.edu%2Febm%2Fwww%2FPublications%2F9_Paper.pdf&type=original

KEYWORDS: discrete manufacturing, energy use, value and non-value add, IT system, Large Language Model (LLM), Generative AI

DLA241-D05 TITLE: Domestic Sourced or Manufactured Coal Tar Pitch to Meet Military Requirements

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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(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 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 Defense Logistics Agency (DLA) seeks to provide responsive, best value supplies consistently to our customers. DLA continually investigates diverse technologies for manufacturing which would lead to the highest level of innovation in the discrete-parts support of fielded weapon systems (many of which were designed in the 1960's, 1970's and 1980's) with a future impact on both commercial technology and government applications. As such, advanced technology demonstrations for affordability and advanced industrial practices to demonstrate the combination of improved discrete-parts manufacturing and improved business methods are of interest. All these areas of manufacturing technologies provide potential avenues toward achieving breakthrough advances. Proposed efforts funded under this topic may encompass any specific discrete-parts or materials manufacturing or processing technology at any level resulting in a unit cost reduction.

Advanced technology demonstrations for increasing production capacity, affordability and supply chain resiliency for coating techniques and processing are of high interest to DoD. These areas of materials and manufacturing technology provide potential opportunities toward achieving breakthrough advances for national defense. Proposed efforts funded under this topic may encompass diverse feedstock and processing at any level that will result in increasing production capacity, affordablity, and supply chain resiliency.

Research and Development efforts selected under this topic shall demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts must be judged to be at a Technology Readiness Level (TRL) 6 or less, but greater than TRL 3 to receive funding consideration.
TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: DLA R&D is looking for a domestic capability to address the lacking viable domestic source of defense grade coal tar pitch solid. Coal tar pitch is a pre-cursor material for a variety of military applications, including tactical munitions, strategic rockets and missiles, and large, advance-launch systems, and hypersonic veichles. The United States has been dependent on foreign sources or a single domestic source of coal tar pitch. Verifying a domestic manufacturing production process for coal tar pitch meets military reuqirements would elimate the costly foreign alliance for this material.
R&D tasks include qualifying domestically manufactured or sourced coal tar pitch meets militrary requirements, and qualify the material on military applictions.

PHASE I: This topic is accepting Direct to Phase II proposals ONLY.
The successful proposal will submit documetation demonstrating the projet proposal is at the (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept level (TRL 3). Develop

applicable and feasible process demonstration for the approach described, and demonstrate a degree of commercial viability.

PHASE II: Not to exceed a duration of 24 Months and a cost of $1,750,000. Proposals exceeding these limits will not be evaluated.

Phase II will consist of making a pilot/low-rate Validate that domestically sourced coal tar pitch pre-cursor materials for the coal tar pitch material can be utilized. Validation would include, but not be limited to, prototype quantities, data analysis, and labortaory tests. A lab-scale process should be used to confirm the estimates and provide preliminary cost and pricing data. A business case will be generated using both DoD and commercial markets. Collaboration with a relavant DoD Component organzation/supplier (e.g., DoD lab and/or prime contractor) and one or more relavant DoD weapon system supply chain participants or other suitable organization is required

Identify commercial benefit or application opportunities of the innovation. Innovative processes should be developed with the intent to readily transition to production in support of DoD and its supply chains.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Relationships developed and progress made in Phase I and Phase II projects should result in the ability to produce to DoD orders and organic growth of business from there. Validate the prouction process can manufature coal tar pitch can meet property specifications of previously used coal tar pitch for military applications. Validation would include, but not be limited to, production quantities, data analysis, and labortaory tests. Qualify the coal tar pitch material on military applications.

REFERENCES:

1. https://apps.dtic.mil/sti/pdfs/ADA542014.pdf

KEYWORDS: Coal tar pitch

Defense Microelectronics Activity (DMEA)
2024.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Microelectronics Activity (DMEA) SBIR/STTR Program is implemented, administrated, and managed by the DMEA Office of Small Business Programs (OSBP). Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DMEA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Specific questions pertaining to the administration of the DMEA SBIR/STTR Program, and these proposal preparation instructions should be directed to the DMEA Acting SBIR/STTR Program Manager (PM), Mr. Tien Dang, at osd.mcclellan-park.dmea.list.smbus@mail.mil.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (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. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

DMEA intends for Phase I to be only an examination of the merit of the concept or technology that still involves technical risk, with a cost not exceeding $197,283.00. The technical period of performance for the Phase I effort should be no more than six (6) months.

A list of the topics currently eligible for proposal submission is included in this section followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time. The topics are directly linked to DMEA's core research and development requirements.

Please ensure that your e-mail address listed in your proposal is current and accurate. DMEA cannot be responsible for notification to companies that change their mailing address, e-mail address, or company official after proposal submission.

PROPOSAL VOLUMES:

Proposal Cover Sheet (Volume 1)

Required per the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed twenty (20) pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Technical volumes exceeding twenty (20) pages will be deemed non-compliant and will not be evaluated.

Content of the Technical Volume

Read the DoD SBIR Program BAA for detailed instructions on proposal format and program requirements. When you prepare your proposal submission, keep in mind that Phase I should address the feasibility of a solution to the topic. Only UNCLASSIFIED proposals will be accepted.

DMEA will evaluate and select Phase I proposals using the evaluation criteria contained in Section 6.0 of the DoD SBIR Program BAA. Due to limited funding, DMEA reserves the right to limit awards under any topic, and only proposals considered to be of superior quality will be funded.

Cost Volume (Volume 3)

The Phase I Base amount must not exceed $197,283.00. DMEA will conduct a price analysis to determine whether cost proposals, including quantities and prices, are fair and reasonable. Contractors should expect that cost proposals will be negotiated. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

The on-line cost volume for Phase I and Phase II proposal submissions must be at a level of detail that would enable DMEA personnel to determine the purpose, necessity, and reasonability of each cost element. Provide sufficient information (a. through h. below) on how funds will be used if the contract is awarded. Include the itemized cost volume information (a. through h. below) as an appendix in your technical proposal. The itemized cost volume information (a. through h. below) will not count against the page limit on Phase I and II proposal submissions.

a. Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD Component; unless it is determined that transfer of the title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.

b. Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, price, and where appropriate, purposes.

c. Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, costs incurred in obtaining temporary use of specialized equipment. Proposals, which include leased hardware, must provide an adequate lease versus purchase justification or rationale.

d. Direct Labor: Identify key personnel by name if possible or by labor category if specific names are not available. The number of hours, labor overhead and/or fringe benefits and actual hourly rates for each individual are also necessary.

e. Travel: Travel costs must relate to the needs of the project. Break out travel cost by trip, with the number of travelers, airfare, and per diem. Indicate the destination, duration, and purpose of each trip.

f. Cost Sharing: Cost sharing is permitted. However, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal.

g. Subcontracts: Involvement of university or other consultants in the planning and/or research stages of the project may be appropriate. If the offeror intends such involvement, describe the involvement in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases, or usage fees and other subcontract or purchase agreements may not exceed one-third of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer. Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e., Cost Volume). At the very least, a statement of work with a corresponding detailed cost volume for each planned subcontract must be provided.

h. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

Please review the updated Percentage of Work (POW) calculation details included in the DoD Program BAA. DMEA will not accept any deviation to the POW requirements.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by DMEA during proposal evaluations.

Supporting Documents (Volume 5)
All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:
1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees. Phase II is the prototype/demonstration of the technology that was found feasible in Phase I. DMEA encourages, but does not require, partnership and outside investment as part of discussions with DMEA sponsors for potential Phase II efforts.

The Technical Volume is not to exceed forty (40) pages and consists of a single PDF file with your firm name, topic number, and proposal number in the header of each page. All documentation should use no smaller than 10-point font on standard 8.5" X 11" paper with one-inch margins and not be in two-column format. Do not include blank pages.

Phase II proposals may be submitted for an amount not to exceed $1,315,219.00. The technical period of performance for the Phase II effort should be no more than twenty-four (24) months.

Phase I awardees may submit a Phase II proposal without invitation not later than sixty (60) calendar days following the end of the Phase I contract. The Phase II proposal submission instructions are identified in the Phase I contract, Part I – The Schedule, Section H, Special Contract Requirements, “SBIR Phase II Proposal Submission Instructions”.

All Phase II proposals must have a complete electronic submission per the Proposal Volumes area listed in Phase I. Your proposal must be submitted via the submission site on or before the DMEA-specified deadline or it will not be considered for award.

Due to limited funding, DMEA’s ability to award any Phase II, regardless of proposal quality or merit, is subject to availability of funds. Please ensure that your proposal is valid for 120 days after submission. Any extension to that time period will be requested by the Contracting Officer.

A Phase II contractor may receive up to one additional, Sequential Phase II award for continued work on a project. The additional, Sequential Phase II award has the same guideline amounts and limits as an initial Phase II award. Sequential, Phase II proposals shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by the Acting DMEA SBIR/STTR Program Manager in advance.

DMEA SBIR PHASE II ENHANCEMENT PROGRAM
To encourage transition of SBIR into DoD systems, DMEA has a Phase II Enhancement policy. DMEA’s Phase II Enhancement program requirements include up to one-year extension of existing Phase II and up to $657,610.00 matching SBIR funds. Applications are subject to review of the statement of work, the transition plan, and the availability of funding. DMEA will generally provide the additional Phase II Enhancement funds by modifying the Phase II contract.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
DMEA does not provide Discretionary Technical and Business Assistance (TABA).

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA 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.

Refer to the DoD SBIR Program BAA 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:

DMEA Acting SBIR/STTR Program Manager (PM):
- Name: Mr. Tien Dang
- Email: osd.mcclellan-park.dmea.list.smbus@mail.mil

DMEA SBIR 24.1 Topic Index

DMEA241-001 TITLE: Robotic Leak Repair for Cyclotron Vacuum Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics, Space Technology, Trusted AI and Autonomy, Nuclear

OBJECTIVE: Develop a robotic system for leak location and repair of high-vacuum systems in cyclotrons and similar particle accelerators.

DESCRIPTION: Particle accelerators such as cyclotrons form a crucial link in enabling microelectronics in hostile radiation environments. Few facilities are available for Heavy Ion Single Event Effect testing in particular, which causes a bottleneck in the fielding of space systems and other programs with radiation environment requirements. These facilities are aging and heavily tasked, leaving little time and few resources for invasive repairs. Impacts to availability from insufficient maintenance or downtime for extensive repairs threaten limited and inelastic supply of beam time at these facilities. A major contributor to maintenance issues is leaks in the high-vacuum systems of the accelerators. Leak locations are frequently buried underneath other sensitive assemblies and in tightly confined spaces, particularly in the Radio Frequency tank and acceleration region of the cyclotron. Finding the location of these leaks if often invasive to the sensitive system, time consuming, and unreliable. Once found, leaks are difficult to repair with lasting solutions due to the mentioned access difficulties. Radioactivity in the vacuum components due to accelerator operation further slows and complicates maintenance actions, while representing a hazard to personnel. An innovative solution is proposed in the development of a robotic system capable of locating and repairing leaks in the high-vacuum system with greater speed, accuracy, and durability than possible using current manual methods. Further benefits would include reduction in invasive maintenance to the sensitive facilities and reduction in radiation hazard to personnel. Feasible solutions would need to be able to operate in the radiation environment of the accelerator vacuum, navigate the small inner dimensions of the vacuum system, locate and image leaks in the predominately copper systems, weld or otherwise enact lasting repairs to the located leaks, and reliably self-extract from the vacuum system while leaving no debris and only trace gasses in the vacuum system. The vacuum system would not need to be evacuated during operation of the robotic system. Key parameters are prioritized as follows:

1. Number of 90 degree bends the solution can tolerate for extraction after loss of robotic power or control
2. Minimum diameter the solution can traverse
3. Distance the solution can traverse through evacuated piping
4. Efficacy of sensors for locating leaks. Minimum detectable leak flow rate, minimum leak length/width for detection, or similar metric.
5. Ability to flag or map location of leaks without damage to vacuum system
6. Ability to enact durable repairs on located leaks
7. Estimated Total Ionizing Dose (TID) radiation tolerance of any non-exchangeable microelectronics, cabling, and material components inserted into the accelerator vacuum system. Any TID tolerance over 15 krad(SiO_2) may be stated as ‘over 15 krad(SiO_2)’ or similar language.

PHASE I: Perform a feasibility study on a robotic system for leak location and repair of high-vacuum systems in cyclotrons and other particle accelerators. Blockage or damage to the accelerator vacuum system by the proposed solution would be unacceptable. Emphasis will be placed on ensuring full recovery of the robotic system from the accelerator vacuum system in case of loss of power or control. Overall goal is to maximize the percent by length of the accelerator vacuum system serviceable with leak location and, separately, repair; while remaining fully recoverable and without posing danger to the vacuum system. The Lawrence Berkeley National Laboratory (LBNL) 88-inch cyclotron will be used as the baseline case for evaluating success. The feasibility study shall:

1. Describe a system capable of traversing a portion the vacuum system of the LBNL 88-inch cyclotron
2. Describe recovery mechanism for the system under loss of robotic power or control
3. Describe mechanisms for leak location
4. Describe mechanisms for mapping or marking located leaks
5. Describe mechanisms for durable repair of located leaks
6. Analyze the described solution against the key parameters from the above description
7. Provide a report including all all generated files (e.g., CAD drawings) and a program plan for system development

PHASE II: Phase II will result in building, testing and delivering a fully functional prototype of the solution developed in phase I. Testing shall include trials on piping models with attention to the parameters described in the description above. The prototype shall demonstrate recovery under simulated power and control loss scenarios from mock piping models. The prototype shall demonstrate location of a simulated vacuum leak. The prototype shall demonstrate non-destructive marking or mapping of located leaks. The prototype shall demonstrate durable repair of simulated leaks. Only after trials and demonstrations on mock piping models may any test be conducted on accelerator vacuum systems. Demonstration on actual accelerator vacuum systems is the goal of phase II testing, however, any access to accelerator vacuum systems is entirely at the discretion of LBNL or other facility.

PHASE III DUAL USE APPLICATIONS: Particle accelerator use is dominated by medical applications and scientific applications which outnumber and outspend the immediate DoD interest of Single Event Effect testing for microelectronics. Such facilities have similar vacuum systems and face similar challenges with their maintenance that could offer a market for robotic systems or services. Solutions to this proposal are also applicable to a wide variety of high vacuum facilities in various industries including advanced spectroscopy and microscopy, epitaxy growth and deposition facilities such as in the semiconductor industry, and science facilities such as gravitation wave detectors.

REFERENCES:

1. J. Benitez et al., “88-Inch Cyclotron Upgrades for Improved 20 MeV/nucleon Cocktail Beam Delivery,” 2023 Single Event Effects Symposium & Military And Aerospace Programmable Logic Devices Combined Workshop, La Jolla, California, USA, 2023.
2. M. K. Covo et al., "88-Inch Cyclotron: The one-stop facility for electronics radiation testing," 2017 IEEE International Workshop on Metrology for AeroSpace (MetroAeroSpace), Padua, Italy, 2017, pp. 484-488, doi: 10.1109/MetroAeroSpace.2017.7999622.

KEYWORDS: Heavy Ion particle accelerators, cyclotron, Ultra-High Vacuum systems, Single Event Effects, Robotics, Leak repair

DMEA241-002 TITLE: Development of Versatile Wafer Probe System for High Power Devices

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 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 wafer probe systems (WPSs) for high voltage (HV) devices, e.g. metal-oxide semiconductor field-effect transistors (MOSFETs), diodes, and insulated-gate bipolar transistors (IGBTs) of wide-band gap (WBG) semiconductors such as silicon carbide (SiC). The system must include a wafer chamber, probes, electronics, environmental controllers, safety systems, and software. The WPS must be able to handle high voltage up to 40 kV with a current of 10 A (500A pulsed) through a wafer chuck and probes and must offer a versatile environment, including a vacuum and a wide range of temperatures. In addition, the WPS should also have the capability to perform accurate and reliable measurements of various electrical parameters.

DESCRIPTION: WBG semiconductors such as SiC are the most promising materials to develop high-power devices used in a variety of industries, including automobiles, home appliances, power applications, as well as aerospace and defense [1]. As the power electronics market and needs are growing rapidly, more powerful devices allowing more voltage and current are being developed, and this effort has accompanied the evolution of WPS, including source-meter units (SMUs) [2]. For the HV wafer level tests using WPSs, the moisture around wafers must be suppressed by environmental control to protect devices and to avoid early breakdown due to arcing or a strong electric field. To safely operate at HV, Fluorinert liquid has been introduced [3]. However, the application of liquid for electrical testing limits the ability to incorporate optical and/or thermal testing. Commercial manual wafer probers for high-power devices are available to handle up to 20 kV in air or fluorinated bath [4]. A WPS for HV under vacuum is also available [5]. However, WPSs for > 20 kV under vacuum and a wide-range of temperature are not available because of limited technological maturity. The proposed topic seeks to integrate hardware and software to handle 40 kV/10 A DC (500A pulsed) in a vacuum and a wide range of temperature. The final product must include a vacuum chamber with 6”-8” chuck (including cooling and heating system), probes, vibration isolation table, electrical system, software, and safety system.

PHASE I: Conduct a feasibility study and investigate the existing technique of HV WPS. Deliver the proposed design, circuits, simulation results, and parts list of a HV WPS that will be used to build a Phase II prototype. Propose sample types for the breakdown testing at 40 kV. The design must assure a high voltage of 40 kV and a high current of 10 A DC (500A pulsed) to test various characteristics of vertical SiC MOSFETs and diodes. The wafer chuck must be able to handle the high voltage and current. The sample chamber must provide a vacuum environment to minimize arcing and for low-temperature operation. The optical window must transmit a wide range of wavelengths, from ultraviolet (UV) to infrared (IR) . The proposed specifications of WPSs are below:

- Chamber:
    - Chuck must handle 6" – 8” wafers and 40kV/10A (500A pulsed)
    - Semi-automatic or full-automatic system
- Chuck automatic motion covering whole wafer range
- Probes may be manual for the semi-automatic system

    - Wafer/chuck temperature: ~77K – ~700K
- Must be able to continuously tune wafer temperature from ~77K to ~700K
- Must have a heater assembly and liquid nitrogen cooling/transfer capability; proportional–integral–derivative controller (PID) temperature control
    - Vacuum tight chamber: mechanical and turbo pumps for ~1E-5 Torr
    - Optical window
- Transmission wavelength: ~0.2um – >2 um
- Must have a blanket option to block the window
    - Microscopy with charge-coupled device (CCD) or complementary metal–oxide–semiconductor (CMOS) sensor
- Probes
    - 3 (three) probes with 4 (four) vacuum feedthroughs; 1 (one) additional vacuum feedthrough (blanked)
    - Probe tips/connectors/cables capable of handling 0–40 kV/0–10 A DC (500A pulsed) or more and a temperature of ~77K – ~700K
- Vibration isolation table
- Electrical system
    - Power supply capable of 0–40 kV
- Consider reverse bias for diode breakdown testing
- Capable of characterizing 3rd quadrant
- Capable of measuring body current across wafers
    - Arcing monitor/detector
- Software
    - Labview control; measurement control with analytical and mathematical operations
    - In-situ data visualization/plotting; data saving
    - Capable of characterizing current and voltage properties in the 3rd quadrant of HV vertical devices
    - Capable of controlling equipment (power supply, source-meter units, vacuum, temperature)
- Safety system
    - Interlock; arc monitor; operator safety physical shielding/keep-out/encloser

PHASE II: Build, test, and deliver a fully functional HV WPS prototype based on the design developed in Phase I. The prototype WPS will undergo rigorous testing to ensure its functionality and safety. This includes conducting various experiments to evaluate its performance under different conditions and scenarios. The final report will provide comprehensive technical documentation, including detailed drawings, circuit diagrams, part lists, and specifications, to facilitate the manufacturing process and address any challenges that were encountered during development. Once completed, the fully functional prototype WPS will be delivered to DMEA for further evaluation and implementation. Consider Underwriters Laboratories (UL)/International Electrotechnical Commission (IEC) regulation at this stage for future commercialization. UL/IEC regulatory certification ensures that the advanced system meets the necessary safety standards and guidelines, which is vital for its successful commercialization.

PHASE III DUAL USE APPLICATIONS: There may be opportunities for further development of this system for use in a specific military or commercial application. The Phase II effort aims to improve the testing capability of HV devices, which have various military applications, such as high-power microwave (HPM) pulse generators, electronic safety and arm devices, ignition safety devices, and flight termination systems. This enhancement will pave the way for Phase III, where a new generation of HV WPSs will be constructed. This advanced system will enable the characterization and testing of 40 kV WBG devices at the wafer-level, benefiting both military and commercial industries in multiple areas.

REFERENCES:

1. Krishna Shenai, Future Prospects of Widebandgap (WBG) Semiconductor Power Switching, IEEE Trans. Elec. Dev. 62, 248 (2015)
2. Miguel Hinojosa, et al., Evaluation of high-voltage, high-power 4H-SiC insulated-gate bipolar transistors, 2014 IPMHVC
3. Anant K. Agarwal, et al., 1.1 kV 4H-SiC power UMOSFETs, IEEE Elec. Dev. Lett. 18, 586 (1997)
4. https://signatone.com/high-power-stations/
5. https://www.lakeshore.com/products/categories/material-characterization-products/cryogenic-probe-stations

KEYWORDS: High Voltage, High Power, Wafer Probe System, Characterization, Reliability

DMEA241-003 TITLE: Ultra-High Voltage Reliability Test System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an ultra-high voltage package-level reliability test system to conduct High Temperature Gate Bias (HTGB), High Temperature Reverse Bias (HTRB), High Humidity High Temperature Reverse Bias (H3TRB), and Accelerated Life Test High Temperature Reverse Bias (ALT-HTRB) testing for wide bandgap semiconductor devices. The package-level reliability test system shall be suitable for wide bandgap devices possessing a blocking voltage up to 40kV, including metal-oxide-semiconductor field effect transistors (MOSFETs), insulated gate bipolar transistors, (IGBTs), thyristors, and diodes.

DESCRIPTION: The growing popularity of high voltage, high power electronics in the commercial and defense industry is driving the need to perform reliability and qualification testing at ultra-high voltage and power levels. While many standards exist (i.e., JEDEC, IEC, MIL-STD, etc.) [2, 3], package-level reliability test systems capable of meeting the environmental and power requirements are commercially unavailable [4, 5].

For discrete wide bandgap devices, HTGB, HTRB, H3TRB, and ALT-HTRB are some of the primary reliability tests industry has adopted for qualifying device robustness. These tests require a temperature-humidity test chamber capable of maintaining a specified temperature and relative humidity continuously, while providing electrical connections to the devices under test in a specified biasing configuration. The chamber must be capable of providing controlled conditions of temperature and relative humidity during ramp-up to, and ramp-down from, the specified test conditions [2, 3].

Currently, a package-level reliability test system capable of conducting HTGB, HTRB, H3TRB, and ALT-HTRB up to 40kV is not commercially available. Laboratories conducting these tests at high voltage levels must piece together measurement hardware and develop custom control software, leading to an increase in development costs and time [1].

The proposed package-level reliability test system seeks to integrate the required power supplies, measurement hardware, and control software into one cohesive system. To facilitate high volume testing, the proposed test system shall be capable of testing 80 devices simultaneously. The proposed package-level reliability test system shall be suitable for wide bandgap devices possessing a blocking voltage up to 40kV and gate threshold voltage (when applicable) of ±50V. The test system shall provide temperature control from 25C to 200C, and relative humidity control from 15% to 85%. The test system shall be capable of providing electrical connections to the devices under test for various high voltage packaging schemes.

PHASE I: Perform a feasibility study on the package-level reliability test system architecture as it relates to the requirements outlined in the preceding section of this document. The end product of Phase I is a feasibility study report, which demonstrates the proposed techniques for achieving the test system requirements and justification for utilizing the proposed techniques. The report will explicitly address the following items:

1. Voltage Requirement: The feasibility study shall describe the proposed technique for achieving a target voltage rating of 40kV.
2. Temperature Requirement: The feasibility study shall describe the proposed technique for achieving a temperature-controlled environment of 25C to 200C.
3. Humidity Requirement: The feasibility study shall describe the proposed technique for achieving a humidity-controlled environment of 15% to 85%.
4. Package Adaptability: The feasibility study shall describe the proposed technique for adapting various high voltage packaging schemes into the test environment.
5. Control Software Requirement: The feasibility study shall describe the proposed technique for implementing the control software. The control software shall include programmable settings such as applied reverse voltage, gate voltage, stress time, current compliance, voltage compliance, and measurement readout options (e.g., threshold voltage Vth and leakage current).
6. Modular Design Requirement: The feasibility study shall describe the proposed technique for enabling a modular design, where components are swappable for replacement as equipment wears out.
7. Safety Requirements: The feasibility study shall describe the proposed technique for integrating high voltage interlock features and ensuring operator safety.

Respondents shall deliver a report that satisfies all of the requirements outlined in Phase I. If any of the above items cannot be fully addressed in the Phase I feasibility report, the report must include relevant research and justification for their inapplicability.

PHASE II: Phase II will result in the delivery of a fully functional prototype developed in Phase I. The prototype shall undergo rigorous testing to ensure its functionality and safety. This includes various experiments to evaluate its performance under different temperature and humidity conditions.
The complete test system architecture shall be documented into a final report. The final report must contain sufficient technical details on the system architecture, including circuit diagrams, schematics, bill of materials, and specifications. In addition, the final report must include details on the control software, its implementation, and a user guide. Finally, the final report must include details on the mitigated challenges that occurred during the development of the test system. Once completed, the fully functional prototype shall be delivered to DMEA for evaluation of the completed test system.
In addition to the fully functional prototype, a technical manual for operator-level maintenance and support shall constitute a deliverable. The technical manual shall include details for performing routine maintenance and debugging common issues.

PHASE III DUAL USE APPLICATIONS: : Phase III will conclude with the delivery of a fully developed and verified pre-production Ultra-High Voltage Reliability Test System capable of meeting all the performance specifications described in the preceding sections of this document. During the Phase III program, offerors may refine the performance of the test system. A pre-production unit with any and all refinements must be provided for evaluation.

During the Phase III program, offerors shall seek the appropriate regulatory certification to ensure product safety requirements are met. Offerors shall consider UL/IEC regulation at this stage for future commercialization. UL/IEC regulatory certification ensures that the test system meets the necessary safety standards and guidelines, which is vital for successful commercialization.

REFERENCES:

1. D. Berning, A. Hefner, J. M. Ortiz-rodriguez, C. Hood and A. Rivera, "Generalized Test Bed for High-Voltage, High-Power SiC Device Characterization," Conference Record of the 2006 IEEE

Industry Applications Conference Forty-First IAS Annual Meeting, Tampa, FL, USA, 2006, pp. 338-345, doi: 10.1109/IAS.2006.256543.
2. JEDEC, “Steady-State Temperature-Humidity Bias Life Test”, JESD22-A101D.01, JEDEC Solid State Technology Association, 2022, https://www.jedec.org/standards-documents
3. JEDEC, “Temperature, Bias, and Operating Life”, JESD22-A108G, JEDEC Solid State Technology Association, 2021, https://www.jedec.org/standards-documents
4. https://accelrf.com/solutions/htrb-multi-channel-test-system/
5. https://qualitau.com/category/special-applications/high-voltage-htrb-h3trb/

KEYWORDS: Silicon Carbide; SiC; HTRB; HTGB; Ultra-High Voltage; UHV; Package Test System; Reliability

Missile Defense Agency (MDA)
24.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

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/Small Business Technology Transfer (STTR) Program Management Office (PMO), located within the Innovation, Science, & Technology (DV) directorate.

Offerors responding to a topic in this Broad Agency Announcement (BAA) must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. MDA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Specific questions pertaining to the administration of the MDA SBIR Program and these proposal preparation instructions should be directed to:

Missile Defense Agency
SBIR/STTR Program Management Office
MDA/DVR
Bldg. 5224, Martin Road
Redstone Arsenal, AL 35898

Email: sbirsttr@mda.mil

PLEASE NOTE: It is possible that proposals not conforming to the terms of this announcement will not be considered for negotiation and/or award. 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, but not limited to, 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#policy-directive to read the SBIR/STTR Policy Directive issued by the Small Business Administration.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Offerors are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

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 may not be considered.

MDA's objective for Phase I is to determine the merit and technical feasibility of the concept. The contract period of performance for Phase I is six months.

Proposal Cover Sheet (Volume 1)
On DSIP at https://www.dodsbirsttr.mil/submissions, prepare the Proposal Cover Sheet.

Technical Volume (Volume 2)
The technical volume is not to exceed 15 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages submitted beyond the 15 page limit will not be evaluated.

Content of the Technical Volume
For technical volume format guidance, please refer to the "Format of Technical Volume" section within the DoD SBIR 23.1 BAA.

If including a letter(s) of support and/or Technical and Business Assistance (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.

Cost Volume (Volume 3)
The Phase I Base amount must not exceed $150,000 or not to exceed $155,000 if TABA is included. MDA does not utilize the Phase I Option.

MDA will not accept any deviation to the POW requirements

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by MDA during proposal evaluations.

Supporting Documents (Volume 5)
All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

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 additional documentation included as part of Volume 5 WILL NOT be considered.

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees. Details on the due date, format, content, and submission requirements of the Phase II proposal will be provided by the MDA SBIR/STTR PMO during the fourth month of the Phase I period of performance.

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.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The SBIR/STTR Policy Directive allows agencies to enter into agreements with suppliers to provide technical assistance to SBIR and 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 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.

A 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.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. Selections will be based on best value to the Government considering the evaluation criteria listed in the DoD SBIR Program BAA which are listed in descending order of importance.

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.

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.

AWARD AND CONTRACT INFORMATION

The MDA SBIR/STTR PMO will distribute selection and non-selection email notices to all firms who submit an MDA SBIR proposal. 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 email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet and will originate from the sbirsttr@mda.mil email address. MDA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission.

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. Firms that receive a non-selection notification are eligible for written feedback. Refer to the DoD SBIR Program BAA for procedures to protest the announcement.

As further prescribed in Federal Acquisition Regulation (FAR) 33.106(b), FAR 52.233-3, Protests after award should be submitted to Candace Wright via email: sbirsttr@mda.mil.

The MDA will issue all contract awards. The cognizant Government Contracting Officer is the only Government official authorized to enter into any binding agreement or contract on behalf of the Government.

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 registered with Supplier Performance Risk System https://www.sprs.csd.disa.mil/ prior to award.

Ownership Eligibility

Prior to award, MDA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR/STTR 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 offeror 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.

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 SBIR/STTR Program BAA.

References to Hardware, Computer Software, or Technical Data

In accordance with the SBIR/STTR Policy Directive, the work within the SBIR/STTR contracts are to conduct feasibility-related experimental or theoretical Research/Research and Development (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 rights in your 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 (if applicable) 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 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.

ADDITIONAL INFORMATION

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.

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 Identification number to be used for submissions at any of the 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.

Organization Conflicts of Interest (OCI)

The basic OCI rules for Contractors that support development and oversight of SBIR topics are covered in 9.505-1 through FAR 9.505-4 as the means of avoiding, neutralizing, or mitigating organizational conflicts of interest.

All applicable rules under the FAR 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.

In addition, FAR 3.101-1 states that "Government business shall be conducted in a manner above reproach and, except as authorized by statute or regulation, with complete impartiality and with preferential treatment for none." The general rule is to avoid strictly any conflict of interest or even the appearance of a conflict of interest in Government-contractor relationships. An appearance of impropriety may arise where an offeror may have gained an unfair competitive advantage through its hiring of, or association with, a former Government official if there are facts indicating the former Government official, through their former Government employment, had access to non-public, competitively useful information. (See *Health Net Fed. Svcs*, B-401652.3; *Obsidian Solutions Group*, LLC, B-417134, 417134.2). The existence of an unfair competitive advantage may result in an offeror being disqualified and this restriction cannot be waived.

It is MDA policy to ensure all appropriate measures are taken to resolve OCI's arising under FAR 9.5 and unfair competitive advantages arising under FAR 3.101-1 to prevent the existence of conflicting roles that might bias a contractor's judgment and deprive MDA of objective advice or assistance, and to prevent contractors from gaining an unfair competitive advantage.

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 un-cleared 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.

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 ITAR and/or EAR, your company may be required to submit a Technology Control Plan (TCP) during the contracting negotiation process.

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. All proposed universities will need to provide written acceptance of the Flow-Down Clauses in both SBIR and STTR proposals.

MDA Clause H-08 Public Release of Information (Publication Approval)

MDA 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 all MDA SBIR contracts must be submitted to the Procuring Contracting Officer (PCO) for review and approval prior to its release to the public. This mandatory clause also includes subcontractors, who shall provide their submission through the prime contractor for MDA's approval for release.

a. In addition to the requirements of 32 Combined Federal Regulation, Part 117 National Industrial Security Program Operations Manual, all foreign and domestic contractor(s) and its subcontractors are required to comply with the following:

> 1) Any official MDA information/materials that a contractor/subcontractor intends to release to the public that pertains to any work under performance of this contract, MDA will perform a prepublication review prior to authorizing any release of information/materials.

2) At a minimum, these information/materials may be technical papers, presentations, articles for publication, key messages, talking points, speeches, and social media or digital media, such as press releases, photographs, fact sheets, advertising, posters, videos, etc.

b. Subcontractor public information/materials must be submitted for approval through the prime contractor to MDA.

c. Upon request to the MDA PCO, contractors shall be provided the "Request for Industry Media Engagement" form (or any superseding MDA form).

d. At least 45 calendar days prior to the desired release date, the contractor must submit the required form and information/materials to be reviewed for public release to MDAPressOperations@mda.mil, and simultaneously provide courtesy copy to the appropriate PCO.

e. All information/materials submitted for MDA review must be an exact copy of the intended item(s) to be released, must be of high quality and are free of tracked changes and/or comments. Photographs must have captions, and videos must have the intended narration included. All items must be marked with the applicable month, day, and year.

f. No documents or media shall be publically released by the contractor without MDA Public Release approval.

g. Once information has been cleared for public release, it resides in the public domain and must always be used in its originally cleared context and format. Information previously cleared for public release but containing new, modified or further developed information must be re-submitted.

Rights in Noncommercial Technical Data and Computer Software – SBIR Program (DFARs 252.227-7018 Class Deviation 2020-O0007 Revision 1)
Use this link for full description of Data Rights:
https://www.acq.osd.mil/dpap/policy/policyvault/USA001352-23-DPC.pdf

Fraud, Waste, and Abuse
All offerors must complete the fraud, waste, and abuse training (Volume 6) that is located on 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.

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: DoDSBIRSupport@reisystems.com.

It is recommended that potential offerors email topic authors to schedule a time for topic discussion during the pre-release period.

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 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).

MDA SBIR 24.1 Topic Index

MDA241-001 TITLE: Deployable Directional Plasma Sensor

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics

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 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: Detect photons emitted from small volumes of high temperature plasmas with sufficient directional data to locate the source.

DESCRIPTION: A directional sensor for photons emitted from high temperature plasmas would improve remote object identification and location capabilities by providing data to existing sensor suites that would significantly reduce the quantity, in both time and computational resources, of effort necessary to identify remote objects, increase the confidence of the object's identity, and increase the range at which the object is both identified and located with confidence.

PHASE I: Establish the technical basis of the solution, with possible small scale validation and theoretical analysis of the effectiveness. Initial Deployable Directional Plasma Sensor design studies, to include existing navy Launchers, that have the potential to provide over-the-horizon tracking and targeting capabilities to the Aegis Weapons System.

PHASE II: Develop and field test initial prototype Deployable Directional Plasma Sensor design that could be installed on either an in-service DDG-51 class destroyer, or the Navy's Self Defense Test Ship for:
• Evaluation of Space, Weight, and Power – Cooling (SWaP-C)
• Demonstrate successful launch and flight of UAV from ship at sea
• Evaluate existing UAV in-flight guidance and control capabilities aboard ship at sea
• Based on Phase I results, demonstrate integration with Mk 53 Nulka DLS or better launcher option

PHASE III DUAL USE APPLICATIONS: The solution would be utilized in relevant test environments, through collaboration with OEMs or whoever the next higher tier user would be. The technology would be further developed for commercial applicability.

REFERENCES:
1. Introduction to Plasma Physics - Univ of Texas Austin.pdf chapter 2 August 2, 1997 https://web2.ph.utexas.edu/~iheds/Plasma%20Sensor/sensor%202%20(introduction).pdf
2. MIT Researchers 3D Print Precise Plasma Sensors for Satellites. https://scitechdaily.com/mit-researchers-3d-print-precise-plasma-sensors-for-satellites

KEYWORDS: Plasma; Sensor; Detect Photons; Directional Data

MDA241-002 TITLE: Material Solution for Lightning Survivability

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Advanced 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(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 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: Identify materials and/or coatings to add lightning survivability capability to missiles without significant change to size, weight, or power requirements, and without impact to missile performance.

DESCRIPTION: Lightning protection is a component of an MDA core standard, MIL-STD-464. Atmospheric lightning discharge can be triggered during fly-outs (launch timing not discretionary) and reflect decrement to missile reliability. Coatings and other lightweight materials for lightning protection represent a potentially low cost method to mitigate this liability. Focusing on SM-3 Block IIA, evaluate innovative materials and techniques for improving the survivability of existing missiles when exposed to the effects of direct and indirect lightning. Identify materials that could be applied to existing missile structures and are resistant to damage from typical handling and fixtures that are used with missiles. A key focus of the study is to ensure that likely lightning attachment points, which are expected to occur on a missile in flight, would move aft quickly and not result in damage to underlying features. Ability to apply coating for lightning protection without extensive hardware re-qualification of existing components.

PHASE I: Establish the technical basis of the solution, with small scale validation and theoretical analysis of the effectiveness. The effort might include independent testing on small scale coupons and materials testing.

PHASE II: Down select any competing technologies and provide more extensive testing. If the solution purposes new apparatus, prototypes would be developed for technology demonstration.

PHASE III DUAL USE APPLICATIONS: The solution would be utilized in relevant test environments, through collaboration with OEMs or whoever the next higher tier user would be. The technology would be further developed for commercial applicability.

REFERENCES:
3. Lightning Protection Guidelines for Aerospace Vehicles https://ntrs.nasa.gov/citations/20000004589
4. Lightning strike protection strategies for composite aircraft https://www.compositesworld.com/articles/lightning-strike-protection-strategies-for-composite-aircraft

KEYWORDS: lightning protection, missile flight, novel materials, survivability, lightweight

MDA241-003 TITLE: AI/ML Augmentation of Cyber Risk Reduction

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software

OBJECTIVE: Develop and implement an innovative artificial intelligence / machine learning (AI/ML) algorithm development/data analysis solution to enhance MDA Defense Industrial Base (DIB) Cyber Risk Management (DCRM) Operations to detect and help thwart cyber threats in the MDA DIB, protect MDA Controlled Unclassified Information, and help defend emerging Missile Defense System technology developed in MDA DIB.

DESCRIPTION: MDA DCRM conducts cyber risk reduction operations in the MDA DIB to detect and help defeat evolving and expanding cyber risks and threats facing the MDA DIB. The increasing agility, overwhelming number, and capability of cyber threat actors requires MDA DCRM to implement effective AI/ML solutions to augment and modernize its risk reduction operations and help safeguard MDA emerging technologies and controlled unclassified information in the MDA DIB.

Challenge/Problem: Relatively small data sets (approximately 1.5TB/mission captured on average and up to 90TB/year) and the disparate nature of the data captured (data is of various formats and captured on up to 60 unique and unrelated networks per year).

PHASE I: Conduct modeling and simulation that would provide proof of concept for recognizing actionable patterns within existing data sets; clustering the patterns in order to detect deviations from the norm and possible security incidents leading to advanced analysis.

PHASE II: Optimize the simulation tools and demonstrate effectiveness for detecting cyber-attacks.

PHASE III DUAL USE APPLICATIONS: Commercialize modeling tool and provide it to governmental organizations with cyber threat hunting programs.

REFERENCES:
1. Department of Defense Instruction 5205.13, Defense Industrial base (DIB Cybersecurity (CS) Activities) https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodi/520513p.pdf
2. 2016 NDAA; MDA Director's Memorandum for all MDA Contractors Through Cognizant Contracting Officers; SUBJECT: Missile Defense Agency Cyber Assistance Team Program Participation, Dated July 28, 2022. https://supplychain.gsfc.nasa.gov/sites/supplychain/files/docs/2018/6-James-SC2018.pdf

KEYWORDS: cyber risk management; artificial intelligence; machine learning; security and incident event management; data sets; clustering; deviations; low and slow; port and protocol abuse; emerging cyber threats; malware beaconing; disparate data sets

MDA241-004 TITLE: Insider Threat Risk Calculator

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

OBJECTIVE: Develop a tool that would ingest leads from various sources, synthesize the leads with all other available information regarding a Possible Threat Actor (PTA), assign a risk level to the PTA, and notify Counter-Insider Threat (C-InT) analysts of the risk level.

DESCRIPTION: Defense Agencies, along with C-InT Programs across the entire U.S. Government, collect leads on PTA's through multiple sources, some of which include: User Activity Monitoring (UAM), Information Technology professionals, and Agency reporting tools. Unfortunately, few if any C-InT programs have the workforce needed to adequately screen each lead, compare it with available other collected data, and assign a risk level to the PTA. The two main reasons for this is that screening thousands of leads each month requires a cost-prohibitive number of analysts, and the enormous volume of leads fatigues analysts, resulting in missed warning signals. Automating the lead screening process and leveraging Artificial Intelligence (AI) to assign risk levels to PTAs would enhance analysts' abilities to recognize potential threats and increase the time available for leaders to interdict and mitigate unfavorable behaviors.

PHASE I: Demonstrate ability to ingest leads and collect from automated sources, written reports, and on-line reporting sources such as social media. Collections could include written documents, images, or video feeds.

PHASE II: Demonstrate ability to fuse and synthesize the collected data and assign appropriate risk levels. The system should store in such a way that analysts could access and review the collected artifacts. Risk levels should appear as a percentage threat value with zero percent meaning no threat, and 100 percent meaning imminent threat. The risk level should also come with an associated write-up explaining how the system arrived at the risk level.

PHASE III DUAL USE APPLICATIONS: Demonstrate ability to create human interface technologies that would allow Counter-Insider Threat analysts the ability to interpret the data collected and the risk levels assigned. The system should be capable of presenting all collected data, risk levels, and explanations of findings in an easily readable, intuitive human interface, such as an "analyst workbench" or other similar interface.

REFERENCES:
1. DoD Instruction 5205.16, The DoD Insider Threat Program. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/520516p.pdf
2. National Insider Threat Task Force Maturity Framework https://www.dni.gov/files/NCSC/documents/nittf/20181024_NITTF_MaturityFramework_web.pdf

KEYWORDS: Insider Threat; Risk assessment; Risk Scoring

MDA241-005 [TOPIC REMOVED]

MDA241-007 TITLE: Benchmarking Simulations for Missile Defense System Analysis

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software

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 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 ways to evaluate how close model performance is to benchmark data and ways to calibrate model performance to improve benchmark results.

DESCRIPTION: The Missile Defense Agency (MDA) has high-fidelity digital simulation models of the Missile Defense System (MDS) that provide very accurate results. This level of fidelity is achieved by modeling the elements in the MDS with a very high degree of realism including physics-level modeling and wrapping tactical code. While the results of these digital simulations are very accurate, this accuracy comes with high computational expense. There would be many more simulation trials desired to perform different types of analysis than would be able to be executed.

Lower fidelity models that represent the MDS can be run much faster but sacrifice some fidelity and realism of the higher fidelity models. Given benchmark data from physical tests or from high fidelity models, this topic seeks both metrics and measures of model performance as compared with the benchmark data and methods to automate the calibration of models to better align performance with benchmark data. Standardized approaches to comparing model performance with benchmark data would increase analyst confidence and ability to use faster running models for some analysis tasks. Tuning models to yield outputs that better match benchmark data would make models useful for analysis for more use cases. The ability to use lower fidelity models with confidence for more MDS analysis use cases would enable more studies to be completed and more rapidly advance the state of the MDS.
Model tuning is an optimization problem where distance measures between model outputs and benchmark data are minimized by adjusting available model parameters. In this tuning process, care must be shown to avoid overfitting and provide tuned models that are robust for use on a variety of MDS scenarios.

PHASE I: Research, design and develop metrics and measures to compare model performance vs. benchmark data. Research and create proof of concept optimization methods to automate the tuning of models to bring performance into line with benchmark data.

PHASE II: Expand the benchmarking methodology and tuning algorithms to create a full prototype capability. Work with project sponsors to perform a benchmarking study using this new technology with MDS data and models.

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 into a missile defense system level testbed for regular analyst use.

REFERENCES:

1. A multi-fidelity surrogate-model-assisted evolutionary algorithm for computational expensive optimization problems; Journal of Computational Science January 2016. https://www.sciencedirect.com/science/article/abs/pii/S1877750315300387
2. Agents for sequential learning using multiple-fidelity data; Palizhati, A., Torrisi, S.B. https://pubmed.ncbi.nlm.nih.gov/35304496

KEYWORDS: benchmarking; missile defense; modeling and simulation; model tuning

MDA241-008 TITLE: Extremely Thin and Flexible Electromagnetic Shielding for High Temperature Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Microelectronics; Advanced 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(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 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 lightweight, extremely thin electromagnetic shielding capable of defending from 20MHz to 20GHz at a level of 48 dB or higher. Shielding must be suitable for hypersonic applications, to include thermal considerations.

DESCRIPTION: Hypersonic interceptors have multiple systems that utilize internal capacitors, batteries and power conditioning. All of these components give off electromagnetic interference (EMI) that can interact in unintended fashions. Hypersonic flight itself also is a large contributor of EMI, which can have unwanted effects on internal systems. Extremely thin and lightweight material that is capable of efficiently blocking this interference while contributing minimally to the mass or internal volume used is crucial for effective hypersonic capability.

PHASE I: Design and develop innovative solutions, materials, and/or concepts to implement electromagnetic interference protection for internal components during all stages of flight. The solution should contrive novel uses of contemporary technologies, utilize new innovative materials or capture key areas for new 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 would 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, fieldable 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:

1. H. Wang et al., "Transparent Ultrathin Doped Silver Film for Broadband Electromagnetic Interference Shielding," 2018 IEEE MTT-S International Microwave Workshop Series on Advanced Materials and Processes for RF and THz Applications (IMWS-AMP), Ann Arbor, MI, USA, 2018, pp. 1-3, doi: 10.1109/IMWS-AMP.2018.8457129. https://ieeexplore.ieee.org/document/8457129
2. Norikazu Chikyu, Takayuki Nakano, Gunther Kletetschka, Yoku Inoue,Excellent electromagnetic interference shielding characteristics of a unidirectionally oriented thin multiwalled carbon nanotube/polyethylene film,Materials & Design,Volume 195,2020,108918,ISSN 0264-1275, https://doi.org/10.1016/j.matdes.2020.108918.
3. https://www.sciencedirect.com/science/article/pii/S0264127520304524

VERSION 4

KEYWORDS: Electromagnetic; shielding; EMI, interference; materials; signals

MDA241-009 TITLE: High Temperature Tensile Testing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Advanced Materials

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OBJECTIVE: The goal of this topic is to develop methods to test the mechanical properties of materials at temperatures up to 3000°C.

DESCRIPTION: Hypersonic leading edge surfaces and propulsion materials push the limits of requirements of high strength at high temperatures. Proper design of components requires mechanical property data for all temperatures that the component may experience. Performing tensile tests at high temperatures may require the use of refractory materials and cooling of tools to hold the sample, but as the temperature for testing increases, the available materials of construction for the test equipment are limited. Accurately measuring the mechanical properties of a sample at a given temperature requires that the sample specimen is as close as possible to isothermal in the region experiencing strain. Heating methods which are not limited by the thermal or electrical conductivity are preferred. Any cooling of the equipment used to hold the sample specimen needs a method of minimizing the heat transfer from the sample. The test method should achieve high quality data including suitable strain measurement, while maintaining uniform heating of the test sample in the gauge section during testing.

PHASE I: Design a system to achieve high quality strain measurement data on samples from room temperature to 3000°C under applied stresses of up to 300 MPa at 3000°C. The proposed system should be capable of measuring Young's modulus, proportional limit, strain rate, and ultimate tensile stress of samples. The method of heating and proposed grip solutions must not cause any damage to the sample by chemical contamination of extraneous species, and must maintain uniform heating in the sample gauge section during testing. If Phase I does not include elevated temperature bench scale tests, thermal/structural FEA models should demonstrate structural margin in each of the test apparatus components when test sample stresses are up to 300 MPa at 3000°C.

PHASE II: Demonstrate that the designed system in Phase I is capable of measuring Young's modulus, the proportional limit, strain rate, and ultimate tensile stress of samples at temperatures up to 3000 °C. The designed system must be capable of measuring stresses up to 300 MPa at 3000 °C. Proposers must obtain refractory material samples and test the samples at temperatures up to 3000 °C; however, maximum stresses can be demonstrated by load capability of the test setup at temperature.

PHASE III DUAL USE APPLICATIONS: Demonstrate scalability of the testing method to maximize the number of tests possible per day. The proposer must partner with a prime contractor or system manufacturers to test refractory materials for development projects.

REFERENCES:

1. Mechanical Properties of Wrought Tungsten. https://apps.dtic.mil/sti/citations/AD0427126
2. Tensile Strength of Carbon-Carbon Composites at High Temperature up to 2773K. Institute of physics https://iccm-central.org/Proceedings/ICCM17proceedings/papers/D3.6%20Kobayashi.pdf

KEYWORDS: Testing; Tensile; Materials; High Temperature; Propulsion; Hypersonics

MDA241-010 TITLE: Strain Tolerant Coatings/Coating Architectures

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Advanced Materials

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OBJECTIVE: Develop high temperature, oxidation resistant, strain tolerant coating solutions viable for hypersonic surfaces that undergo geometrical changes during flight.

DESCRIPTION: Significant investments have been made in the development of high temperature, oxidation resistant coatings capable of surviving extreme conditions of hypersonic flight, both acreage and stagnation point regions. Recent research efforts have also investigated advancing the performance of hypersonic systems by implementing morphing surfaces, such as vehicle outer mold line and control surfaces. The low strain capability of state of the art coating solutions are not viable for highly morphing surfaces. This topic seeks the development of coating chemistries and/or coating architectures that are viable for morphing surfaces. Solutions should be able to adhere to flexing vehicle outer mold line and control surfaces during hypersonic flight. Solutions must provide equivalent high temperature oxidation resistance performance to state of the art solutions.

PHASE I: Develop strain tolerant oxidation resistant coatings which could survive heat fluxes greater than 50 W/cm2 and are also flexible. The work should target strains above 5% in the coating during flight conditions. Proposed coatings would be applicable to metallic substrates, carbon fiber composite substrates, or both.

PHASE II: Determine the strain capability of the coatings developed in Phase I, and test the survivability of the coatings developed in Phase I under simulated morphing hypersonic flight. Demonstrate scalability of coating solutions to relevant geometries. If the proposed coating solution has limited room temperature ductility, testing must demonstrate that the coating solution can survive handling and launch environments.

PHASE III DUAL USE APPLICATIONS: Partner with a prime contractor to apply coatings to hypersonic aerocontrol surfaces that would be tested under high-enthalpy air flow on flexible materials. Proposals must include a demonstration of the ability to scale the coating process to required sizes, and the scrap rate of the coating process must be demonstrated to be less than 10 percent.

REFERENCES:

1. High-temperature flexible, strength and hydrophobic YSZ/SiO2 nanofibrous membranes with excellent thermal insulation - ScienceDirect https://www.sciencedirect.com/science/article/abs/pii/S0955221920307986
2. A highly strain and damage-tolerant thermal barrier coating fabricated by electro-sprayed zirconia hollow spheres. https://doi.org/10.1111/jace.15697

KEYWORDS: Coatings; Hypersonics; Materials; Oxidation

MDA241-011 TITLE: Non-eroding Nozzle Materials for High Temperature Combustion Gases

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Advanced Materials

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OBJECTIVE: Develop ablation resistant, non-eroding, rocket nozzle materials with high temperature strength and compatibility with highly oxidizing propellant combustion gases.

DESCRIPTION: Maximizing missile range requires higher propellant combustion temperatures without nozzle erosion. Controllable solid propellant rockets use a variety of propellants based on their application, and many propellants used for controllable solids produce highly oxidizing combustion gases. While some propellants are seen as reducing, this topic is specifically asking for solutions for highly oxidized propellants. Besides high temperature strength, successful nozzle materials must also be capable of surviving the thermal shock experienced during ignition.

PHASE I: Develop nozzle material solutions with predicted high temperature strength and resistance to high partial pressures of oxidizing species such as oxygen, carbon dioxide, and water. If no testing is performed in Phase I, thermo-structural and chemical reaction modeling should demonstrate ablation and erosion resistance, high temperature strength, and thermal shock resistance for use in rocket motors with combustion temperatures up to 2800°C. Manufacturability of the material solution must be demonstrated.

PHASE II: Demonstrate the survivability of the material solutions developed in Phase I with loads and temperatures representative of those experienced by solid propellant rocket nozzles. High temperature mechanical and thermal material properties of the material solution should be characterized by the end of this effort. Testing must demonstrate thermal shock resistance under temperature rises experienced by rocket nozzles. Identify additional applications for the proposed technology beyond MDA applications.

PHASE III DUAL USE APPLICATIONS: Produce nozzle components that meet the requirements of a propulsion system supplier and demonstrate performance of the nozzle components through static testing. Demonstrate the quality, reproducibility, and production requirements for a developing, prime contractor system.

REFERENCES:

1. Non-eroding nozzle throat material for rocket motors with AP-based propellant https://arc.aiaa.org/doi/abs/10.2514/6.1998-3972
2. Chemical Erosion of Refractory-Metal Nozzle Inserts in Solid-Propellant Rocket Motors https://arc.aiaa.org/doi/abs/10.2514/1.37922
3. Status of army pintle technology for controllable thrust propulsion https://arc.aiaa.org/doi/abs/10.2514/6.2001-3598

KEYWORDS: Hypersonics; Materials; High Temperature; Propulsion; Nozzle

MDA241-012 TITLE: Artificial Intelligence/Machine Learning (AI/ML) for Kinetic and Non-Kinetic (K-NK) Missile Defense Battle Management

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber; Directed Energy (DE); Hypersonics; Integrated Network Systems-of-Systems; Human-Machine Interfaces

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OBJECTIVE: This topic seeks proposals that describe appropriate research to develop AI/ML tools necessary to integrate real time information from multiple sensors and available shooters in varying weather conditions. The tools should provide decision aids for Commanders to authorize and oversee weapons selection and fire control in a user-friendly format to defend a defined scenario. The tools in real-time continuously assess the environment, the sensor data and the weapon systems' effectiveness in order to quickly determine potential threat neutralization and determine the next weapon selection requirements.

DESCRIPTION: Directed Energy (DE) weapons, also known as Non-Kinetic (NK) weapons (e.g., Radio Frequency, Lasers, etc.), will be introduced into the Missile Defense System, which currently relies on Kinetic (K) kill weapons and supporting sensors (e.g., Electro-Optical (EO), Terrestrial, Airborne). The new NK weapons would add to our defensive capacity. However, the introduction of NK weapons would further complicate the decision process for Combatant Commanders on which weapon should be selected. This decision process would be based upon the type and volume of threats faced and is further complicated by weather conditions would could affect the efficacy of NK weapons. Thus, the Commanders of the future would need new situational awareness and fire control tools for rapid decision-making and weapon selection in a highly complex battlefield environment.

PHASE I: Deliver a Concept Design and present the design, trades and design issues to the Government. A Design Reference Mission can be provided by the Government to confine the scenario. This Concept Design should include:
1. A description of the AI/ML tool, the algorithms proposed, and the learning methodology.
2. Descriptions of the Commander's and support staff interface and decision capability for sensor/weapon knowledge, fire control and scenario execution (situational awareness and prosecution).
Ability to conduct work at the classified level is desired, but not required.

PHASE II: Deliver and test prototype tools and accompanying descriptions based upon the Phase I activities.

PHASE III DUAL USE APPLICATIONS: Transition prototype tool.

REFERENCES:

1. Battle Management/Command and Control, and Communications (BM/C3), Environmental Assessment https://apps.dtic.mil/sti/citations/ADA213942

2. Battle Management: DOD and Air Force Continue to Define Joint Command and Control Efforts https://www.gao.gov/products/gao-23-105495
3. Command and Control, Battle Management, and Communications (C2BMC) https://missilethreat.csis.org/defsys/c2bmc

KEYWORDS: Battle Management; Command and Control; Kinetic and Non-Kinetic; Directed Energy

MDA241-013 TITLE: Directed Energy Lethality Assessments of Hypersonic Threats

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Directed Energy (DE); Hypersonics;

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OBJECTIVE: Develop, verify and validate fast running models, simulations, tools, and analyses, including using machine learning or artificial intelligence algorithms, to describe the interaction of directed energy with a threat's vulnerable aimpoints and the materials associated with these aimpoints, or to determine the amount of directed energy required to defeat a variety of hypersonic threat systems.

DESCRIPTION: Maneuvering hypersonic velocity threats are among the most difficult threats for future directed energy weapons to defeat. The government is seeking proposals that describe the development, verification, and validation (V&V) of appropriate, affordable, and accurate models, simulations, tools, or analyses of the lethal effects of directed energy on these threat systems. Government Furnished Data can be provided upon request.

PHASE I: Propose a plan for the development, V&V of models, simulations, tools, or analyses that describe the physics associated with the interaction of directed energy on a hypersonic threat system and the associated lethality of the interaction. This plan should include:
1. A detailed description of the development plan for the model, simulation, tool, or analysis. It shall include a description of any AI/ML tools proposed as well as the learning methodology
2. A detailed description of the V&V plan and procedures of the model, simulation, tool, or analysis, including any ground based testing or flight testing necessary to verify and validate the proposed model,
3. A detailed list of the assumptions and caveats used in the development and V&V of the proposed model.
4. A list of any required GFE or GFI to use the code or perform the analysis.
Ability to conduct work at the classified level is desired, but not required.

PHASE II: Execute the plan described in Phase I. Demonstrate any models, simulations, or tools developed that describe the interaction of directed energy and the hypersonic threat system. Using the developed capability, complete and deliver an assessment of the lethality of directed energy against a hypersonic threat system, including a list of vulnerable aimpoints of the threat system, required levels of directed energy to cause a lethal effect, and the time-to-lethal effect. Government Furnished Data for model development and validation can be provided upon request.
Ability to develop, process, and store data at the classified level is required.

PHASE III DUAL USE APPLICATIONS: Additional threat analyses; further V&V of models & simulations. Also work with the government on requirements development for future directed energy systems capable of defeating hypersonic threats.

REFERENCES:

4. Science & Tech Spotlight: Directed Energy Weapons https://www.gao.gov/products/gao-23-106717
5. High Energy Laser (HEL) Lethality Data Collection Standards - Revision A https://www.deps.org/store/merchandise/TOCs/lethHandbookPreface.html
6. U.S. Hypersonic Weapons and Alternatives https://www.cbo.gov/publication/58924

KEYWORDS: Directed Energy; Lethality; Hypersonic, Models, Simulation, AI/ML

MDA241-014 TITLE: Passive Sensing for Distributed Radars

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Integrated Sensing and Cyber;Integrated Network Systems-of-Systems

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OBJECTIVE: Develop capabilities for passive sensing for distributed radars. Key technical objectives are:
• Passively collect radar reflections
• Measure the time difference of arrival (TDOA) of collected signals
• Determine the range of the object
• Calculate the location, heading, and speed of the object
• Develop techniques to provide accurate location, heading, and speed with degraded or no knowledge of the emitting source
• Provide information to determine how to size passive arrays for different mission areas

DESCRIPTION: Typical sensors consist of a transmitter and a receiver (e.g. phased array radars). Passive sensors instead collect radar reflections using third-party transmitters in the environment (typically non-cooperative). Recent efforts have used this approach to perform passive sensing of objects. In order to further the technology being developed in this effort, this topic seeks the development of passive sensing of distributed radars to accomplish the Key Technical Objectives below. Potential solutions could take the form of either a new passive sensing approach, a new processing algorithm, or a combination of both. Passive sensors count on the existence of reference signals. These are signals typically from non-cooperative (unwitting) sources. With the reception of the reference signal, such passive systems can achieve successful results regarding target detection. Without reception of the transmitted signal or other prior information, it would be very challenging to perform target detection since both the transmitted signal and the channel response is completely unknown to radar receivers. When multiple incoming targets are considered, the scenario becomes even more complicated. The mixture of multiple target reflections is received at every receiver in the distributive radar system, and no extra information can be pre-obtained.

PHASE I: Passively collect radar reflections and measure the time difference of arrival (TDOA) of collected signals. Potential solutions could take the form of either a new passive sensing approach, a new processing algorithm, or a combination of both. The overall system design at this point could be rough with many questions remaining to be answered, such as how the system would determine the range of the object or calculate the location, heading and speed of the object.

PHASE II: System development would continue with the goals of both determining the bistatic range of the object and then calculating the location, heading, and speed of the object. Again, potential solutions could take the form of either a new passive sensing approach, a new processing algorithm, or a combination of both.

PHASE III DUAL USE APPLICATIONS: The team should improve upon the technology and implement a full design. The improvements could be in the form of shrinking the size of the overall system, improving upon the hardware/software solution, and/or implementing lessons learned from Phase I and II.

REFERENCES:

1. Growth in Passive Radars for Air Defence and Maritime Suveillance: https://idstch.com/technology/electronics/passive-radar-systems-for-air-defence-and-maritime-surveillance
2. Multi-target Detection by Distributed Passive Radar Systems without Reference Signals: https://ieeexplore.ieee.org/abstract/document/9417324

KEYWORDS: Passive, radars; distributed; sensing