DEPARTMENT OF DEFENSE
SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM
STTR 24.B Program Broad Agency Announcement (BAA)

April 17, 2024: DoD BAA issued for pre-release
May 15, 2024: DoD begins accepting proposals
June 12, 2024: Deadline for receipt of proposals no later than **12:00 p.m. ET**

Participating DoD Components:

- Department of Army (Army)
- Department of Navy (Navy)
- Department of Air Force (Air Force)
- Defense Threat Reduction Agency (DTRA)
- Missile Defense Agency (MDA)
- Office of the Secretary of Defense – National Geospatial-Intelligence Agency (OSD – NGA)

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.

This BAA also incorporates FAR 52.204-29 and FAR 52.204-30, Federal Acquisition Supply Chain Security Act (FASCSA) Orders. Small business concerns are highly encouraged to review the full text of these clauses and required representations found in section 8.2 of this BAA.

Deadline for Receipt: Complete proposals must be certified and submitted in the Defense SBIR/STTR Innovation Portal (DSIP) no later than **12:00 PM** ET on **June 12, 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 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 DSIP 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.

SBIR/STTR Updates and Notices: To be notified of SBIR/STTR opportunities and to receive email 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**.

TABLE OF CONTENTS

1.0 INTRODUCTION

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. Consistent with the SBA SBIR/STTR Policy Directive, the Department of Defense (DoD) is soliciting proposals as a Broad Agency Announcement (BAA). The DoD SBIR/STTR Programs follow the policies and practices of the most current SBA SBIR/STTR Policy Directive. 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.

Army, Navy, Air Force, DTRA, MDA and OSD-NGA, hereafter referred to as DoD Components, invite proposing small business concerns and research institutions to jointly submit proposals under this BAA for the Small Business Technology Transfer (STTR) 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.

The STTR Program, although modeled substantially after the Small Business Innovation Research (SBIR) Program, is a separate program and is separately financed. Subject to availability of funds, DoD Components will support high quality cooperative research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector. Partnerships between small businesses and Historically Black Colleges and Universities (HBCUs) or Minority Institutions (MIs) are encouraged, although no special preference will be given to STTR proposals from such proposers.

This BAA is for Phase I proposals only. A separate BAA will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All 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 a risk-based due diligence security review and the availability of funds. DoD is not responsible for any monies expended by the proposing small business concern before the issuance of any award.

2.0 PROGRAM DESCRIPTION

2.1 Objectives

The objectives of the DoD STTR 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".

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 DoD 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 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 following: cybersecurity practices; patent analysis; employee analysis and foreign ownership 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.

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 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 current SBA Policy Directive guidelines. 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 current SBA Policy Directive guidelines. 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 small business concern is required to obtain funding from either the private sector, a non-SBIR/STTR 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/STTR Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR Program. Phase III work is typically oriented towards commercialization of SBIR/STTR research or technology.

2.5 Program on Innovation Open Topics

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

(A) increase the transition of commercial technology to the DoD;
(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 DoD needs.

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.

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.

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.

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.

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 CFR §§ 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 and Section 4.4 of this BAA).
b. A minimum of 40% of each STTR project must be conducted by the small business concern and a minimum of 30% of the effort performed by the single research institution, as defined in Section 3. The percentage of work is measured by both direct and indirect costs. Deviations from these STTR requirements are not allowed, as the performance of work requirements are specified in

statute at 15 USC 638(e). 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 small business firm or the research institution at the time of award and during the conduct of the proposed effort. At the time of award of a Phase I or Phase II contract, the small business concern must have at least one employee in a management position whose primary employment is with the small business and who is not also employed by the research institution. 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 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

f. A small business concern must negotiate a written agreement between the small business and the research institution allocating intellectual property rights and rights to carry out follow-on research, development, or commercialization (see Model Agreement for the Allocation of Rights).

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, if applicable.

4.5 Export-Controlled Topic Requirements

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, https://www.dla.mil/Logistics-Operations/Services/JCP/DD23%2045Instructions/.

DD Form 2345 approval will be required if a proposal submitted in response to a topic marked as ITAR/EAR is selected for award.

4.6 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.

4.7 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.

4.8 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 prohibiting 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 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 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.

4.9 Classified Proposals

Classified proposals will not be accepted under the DoD STTR Program. If topics will require classified work during Phase II, the proposing small business concern must have a facility clearance to perform the 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/.

4.10 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 to avoid potential delay of contract award.**

4.11 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 to avoid potential delay of contract award.**

4.12 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.

4.13 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.

4.14 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 email address 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 SBA.

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

4.15 Award Information

All 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, scientists or subject matter experts 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 Awards**. The number of awards will be consistent with the Component's RDT&E budget. No contracts will be awarded until evaluation of all qualified proposals for a specific topic is completed.

b. **Type of Funding Agreement**. Each 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**. 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 an award by the DoD Component that originated the topic no later than 90 days of the closing date for this BAA. Please refer to the Component-specific instructions for details.

e. The SBA SBIR/STTR Policy Directive, Section 7(c)(1)(ii), states agencies should issue the award no more than 180 days after the closing date of the BAA.

4.16 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**:
DSIP (https://www.dodsbirsttr.mil/submissions/login) 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 (https://www.defensesbirsttr.mil/) 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 **April 17, 2024 – May 15, 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 **May 15, 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 **April 17, 2024** and closes to new questions on **June 5, 2024**, **at 12:00 PM ET**. Once the BAA closes to proposal submission, no communication of any kind with the topic author or through Topic Q&A regarding your submitted proposal is allowed.

   Proposing 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.

4.17 Registrations and Certifications

Individuals from proposing small business concerns must be registered in the DSIP 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 the sharing of accounts and passwords is a violation of the Terms of Use for Login.gov and DoD policy.

Please note 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 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.

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 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 STTR 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.

4.18 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.

4.19 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 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).

4.20 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 DoD, Office of Inspector General Hotline ("Defense Hotline") is an important avenue for reporting fraud, waste, abuse, and mismanagement within the DoD. 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.

4.21 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 STTR Program. These services vary from state to state, but may include:

- Information and technical assistance;
- Matching funds to STTR 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.

4.22 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 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 proposing small business concerns register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process.

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. Other supporting documentation (Refer to Component-specific instructions for additional Volume 5 requirements)
A completed proposal submission in DSIP does NOT indicate the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure 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 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 data in their proposals 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 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 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, the small business concern will not be able to proceed with proposal submission. Deviations from the POW minimum requirements for STTR proposals are not allowed.

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 DSIP when the Cover Sheet was created. The header may be included in the one-inch margin.

c. **Content of the Technical Volume (Volume 2)**

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

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

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

(3) **Phase I Statement of Work (including Subcontractors' Efforts)**
   a. Provide an explicit, detailed description of the Phase I approach. If a Phase I option is required or allowed by the Component, describe appropriate research activities which would commence at the end of Phase I base period should the Component elect to exercise the option. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.
   b. This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. 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 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 STTR project 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 STTR 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 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 STTR 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 research institution in the project is required and the institution should be identified and described to the same level of detail as the prime contractor costs. A minimum of 40% of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. STTR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposers must certify their use of such facilities on the Cover Sheet of the proposal.

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

a. Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.
b. Date of proposal submission or date of award.
c. Title of proposal.

d. Name and title of principal investigator for each proposal submitted or award received.
e. Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
f. If award was received, state contract number.
g. Specify the applicable topics for each STTR 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 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.
   - **WARNING:** 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)

A completed proposal submission in DSIP does NOT indicate 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. DD Form 2345, if applicable (see section 4.5)
9. 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.

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 DoD 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. **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 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.

7.0 PHASE II PROPOSAL INFORMATION

7.1 Introduction

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.

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 STTR contracts and other contracts of similar size with the 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 STTR 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 STTR funding if the proposing small business concern can match the additional STTR funds with non-STTR 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.

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 examples below are 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 Federal Acquisition Supply Chain Security Act (FASCSA) Orders

FAR 52.204-29 Federal Acquisition Supply Chain Security Act Orders—Representation and Disclosures and FAR 52.204-30 Federal Acquisition Supply Chain Security Act Orders—Prohibition are included in this solicitation. In accordance with FAR 52.204-29 and FAR 52.204-30, proposers must review FASCSA orders at https://sam.gov/content/supplychainorders for covered articles, or any products or services produced or provided by a source, that are prohibited by an applicable FASCSA order.

During contract performance, the Contractor shall review SAM.gov at least once every three months, or as advised by the Contracting Officer, to check for covered articles or for products or services produced by a source subject as part of any new FASCSA order(s) that could impact their supply chain, and report to the Contracting Officer if any covered article or product or service produced or provided by a source was provided to the Government or used during contract performance.

By submission of a proposal in response to this BAA, the proposing small business concern represents that it has conducted a reasonable inquiry, and that the small business concern does not propose to provide or use in response to this BAA any covered article, or any products or services produced or provided by a source, if the covered article or the source is prohibited by an applicable FASCSA order in effect on the date the BAA was issued.

FULL TEXT:

FAR 52.204-29 Federal Acquisition Supply Chain Security Act Orders—Representation and Disclosures (Dec 2023)

(a) *Definitions.* As used in this provision, *Covered article, FASCSA order, Intelligence community, National security system, Reasonable inquiry, Sensitive compartmented information, Sensitive compartmented information system,* and *Source* have the meaning provided in the clause 52.204-30, Federal Acquisition Supply Chain Security Act Orders—Prohibition.

(b) *Prohibition.* Contractors are prohibited from providing or using as part of the performance of the contract any covered article, or any products or services produced or provided by a source, if the prohibition is set out in an applicable Federal Acquisition Supply Chain Security Act (FASCSA) order, as described in paragraph (b)(1) of FAR 52.204-30, Federal Acquisition Supply Chain Security Act Orders—Prohibition.

(c) *Procedures*.

(1) The Offeror shall search for the phrase "FASCSA order" in the System for Award Management (SAM)(*https://www.sam.gov)* for any covered article, or any products or services produced or provided by a source, if there is an applicable FASCSA order described in paragraph (b)(1) of FAR 52.204-30, Federal Acquisition Supply Chain Security Act Orders—Prohibition.

(2) The Offeror shall review the solicitation for any FASCSA orders that are not in SAM, but are effective and do apply to the solicitation and resultant contract (see FAR 4.2303(c)(2)).

(3) FASCSA orders issued after the date of solicitation do not apply unless added by an amendment to the solicitation.

(d) *Representation.* By submission of this offer, the offeror represents that it has conducted a reasonable inquiry, and that the offeror does not propose to provide or use in response to this solicitation any covered article, or any products or services produced or provided by a source, if the covered article or the source is prohibited by an applicable FASCSA order in effect on the date the solicitation was issued, except as waived by the solicitation, or as disclosed in paragraph (e).

(e) *Disclosures.* The purpose for this disclosure is so the Government may decide whether to issue a waiver. For any covered article, or any products or services produced or provided by a source, if the covered article or the source is subject to an applicable FASCSA order, and the Offeror is unable to represent compliance, then the Offeror shall provide the following information as part of the offer:

(1) Name of the product or service provided to the Government;

(2) Name of the covered article or source subject to a FASCSA order;

(3) If applicable, name of the vendor, including the Commercial and Government Entity code and unique entity identifier (if known), that supplied the covered article or the product or service to the Offeror;

(4) Brand;

(5) Model number (original equipment manufacturer number, manufacturer part number, or wholesaler number);

(6) Item description;

(7) Reason why the applicable covered article or the product or service is being provided or used;

(f) *Executive agency review of disclosures.* The contracting officer will review disclosures provided in paragraph (e) to determine if any waiver may be sought. A contracting officer may choose not to

pursue a waiver for covered articles or sources otherwise subject to a FASCSA order and may instead make an award to an offeror that does not require a waiver

(End of clause)

FAR 52.204-30 Federal Acquisition Supply Chain Security Act Orders—Prohibition

(a) Definitions. As used in this clause— https://www.acquisition.gov/far/52.204-30.

(b) *Prohibition.*

(1) Unless an applicable waiver has been issued by the issuing official, Contractors shall not provide or use as part of the performance of the contract any covered article, or any products or services produced or provided by a source, if the covered article or the source is prohibited by an applicable FASCSA orders as follows:

(i) For solicitations and contracts awarded by a Department of Defense contracting office, DoD FASCSA orders apply.

(ii) For all other solicitations and contracts DHS FASCSA orders apply.

(2) The Contractor shall search for the phrase "FASCSA order" in the System for Award Management (SAM) at *https://www.sam.gov* to locate applicable FASCSA orders identified in paragraph (b)(1).

(3) The Government may identify in the solicitation additional FASCSA orders that are not in SAM, which are effective and apply to the solicitation and resultant contract.

(4) A FASCSA order issued after the date of solicitation applies to this contract only if added by an amendment to the solicitation or modification to the contract (see FAR 4.2304(c)). However, see paragraph (c) of this clause.

(5)

(i) If the contractor wishes to ask for a waiver of the requirements of a new FASCSA order being applied through modification, then the Contractor shall disclose the following:

(A) Name of the product or service provided to the Government;

(B) Name of the covered article or source subject to a FASCSA order;

(C) If applicable, name of the vendor, including the Commercial and Government Entity code and unique entity identifier (if known), that supplied or supplies the covered article or the product or service to the Offeror;

(D) Brand;

(E) Model number (original equipment manufacturer number, manufacturer part number, or wholesaler number);

(F) Item description;

(G) Reason why the applicable covered article or the product or service is being provided or used;

(ii) *Executive agency review of disclosures.* The contracting officer will review disclosures provided in paragraph (b)(5)(i) to determine if any waiver is warranted. A contracting officer may choose not to pursue a waiver for covered articles or sources otherwise covered by a FASCSA order and to instead pursue other appropriate action.

(c) *Notice and reporting requirement.*

(1) During contract performance, the Contractor shall review *SAM.gov* at least once every three months, or as advised by the Contracting Officer, to check for covered articles subject to FASCSA order(s), or for products or services produced by a source subject to FASCSA order(s) not currently identified under paragraph (b) of this clause.

(2) If the Contractor identifies a new FASCSA order(s) that could impact their supply chain, then the Contractor shall conduct a reasonable inquiry to identify whether a covered article or product or service produced or provided by a source subject to the FASCSA order(s) was provided to the Government or used during contract performance.

(3)

(i) The Contractor shall submit a report to the contracting office as identified in paragraph (c)(3)(ii) of this clause, if the Contractor identifies, including through any notification by a subcontractor at any tier, that a covered article or product or service produced or provided by a source was provided to the Government or used during contract performance and is subject to a FASCSA order(s) identified in paragraph (b) of this clause, or a new FASCSA order identified in paragraph (c)(2) of this clause. For indefinite delivery contracts, the Contractor shall report to both the contracting office for the indefinite delivery contract and the contracting office for any affected order.

(ii) If a report is required to be submitted to a contracting office under (c)(3)(i) of this clause, the Contractor shall submit the report as follows:

(A) If a Department of Defense contracting office, the Contractor shall report to the website at *https://dibnet.dod.mil*.

(B) For all other contracting offices, the Contractor shall report to the Contracting Officer.

(4) The Contractor shall report the following information for each covered article or each product or service produced or provided by a source, where the covered article or source is subject to a FASCSA order, pursuant to paragraph (c)(3)(i) of this clause:

(i) Within 3 business days from the date of such identification or notification:

(A) Contract number;

(B) Order number(s), if applicable;

(C) Name of the product or service provided to the Government or used during performance of the contract;

(D) Name of the covered article or source subject to a FASCSA order;

(E) If applicable, name of the vendor, including the Commercial and Government Entity code and unique entity identifier (if known), that supplied the covered article or the product or service to the Contractor;

(F) Brand;

(G) Model number (original equipment manufacturer number, manufacturer part number, or wholesaler number);

(H) Item description; and

(I) Any readily available information about mitigation actions undertaken or recommended.

(ii) Within 10 business days of submitting the information in paragraph (c)(4)(i) of this clause:

(A) Any further available information about mitigation actions undertaken or recommended.

(B) In addition, the Contractor shall describe the efforts it undertook to prevent submission or use of the covered article or the product or service produced or provided by a source subject to an applicable FASCSA order, and any additional efforts that will be incorporated to prevent future submission or use of the covered article or the product or service produced or provided by a source that is subject to an applicable FASCSA order.

(d) *Removal*. For Federal Supply Schedules, Governmentwide acquisition contracts, multi-agency contracts or any other procurement instrument intended for use by multiple agencies, upon notification from the Contracting Officer, during the performance of the contract, the Contractor shall promptly make any necessary changes or modifications to remove any product or service produced or provided by a source that is subject to an applicable FASCSA order.

(e) *Subcontracts*.

(1) The Contractor shall insert the substance of this clause, including this paragraph (e) and excluding paragraph (c)(1) of this clause, in all subcontracts and other contractual instruments, including subcontracts for the acquisition of commercial products and commercial services.

(2) The Government may identify in the solicitation additional FASCSA orders that are not in SAM, which are effective and apply to the contract and any subcontracts and other contractual instruments under the contract. The Contractor or higher-tier subcontractor shall notify their

subcontractors, and suppliers under other contractual instruments, that the FASCSA orders in the solicitation that are not in SAM apply to the contract and all subcontracts.

(End of clause)

8.3 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.

8.4 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.

8.5 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.

8.6 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.

8.7 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.

8.8 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.

8.9 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.

8.10 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 STTR contract is subject to STTR 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 STTR 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 "STTR 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/STTR)
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 STTR Data Rights protected under DFARS 252.227-7018 Class Deviation 2020-O0007.

ATTACHMENT 1

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

Contractor Certification Regarding Provision of 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:

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.

"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)

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: _____

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;

(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).

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-

(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.

(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)

ARMY
24.B Small Business Technology Transfer (STTR)
PROPOSAL SUBMISSION INSTRUCTIONS

The approved 24.B Broad Agency Announcement (BAA) topics for the Army Small Business Technology Transfer (STTR) Program are listed below. Offerors responding to this BAA must follow all general instructions provided in the Department of Defense (DoD) Program BAA. Specific Army STTR requirements that add to or deviate from the DoD Program BAA instructions provided in the Preface are provided below.

The STTR Program Management Office (PMO), located at the Combat Capabilities Development Command (DEVCOM) Army Research Laboratory (ARL) Army Research Office (ARO), manages the Army's STTR Program. The Army STTR Program aims to stimulate a partnership of ideas and technologies between innovative small business concerns (SBCs) and research institutions (RIs) through Federally-funded research or research and development (R/R&D). To address Army needs and opportunities, the PMO relies on the vision and insight of science and engineering workforce across eight (8) participating Army organizations to put forward topics that are consistent with their mission, as well as command and STTR program goals. More information about the Army STTR Program can be found at https://www.armysbir.army.mil.

See DoD Program Announcement Preface for Technical questions and Topic Author communications. Specific questions pertaining to the Army STTR Program should be submitted to:

Army STTR Program Manager usarmy.rtp.devcom-arl.mbx.sttr-pmo@army.mil	DEVCOM-ARL-Army Research Office P.O. Box 12211 Research Triangle Park, NC 27709 (919) 549-4200

In addition to the formal announcement period, the Army STTR Program Office will be hosting virtual Army STTR Industry Days on 24-25 April 2024 to further delineate Army requirements, provide opportunity for interested parties to engage topic authors, and enable small business/research institute partnership-building to expand participation. Please visit: www.armysttr.com for more information.

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.

PHASE I PROPOSAL GUIDELINES

Phase I proposals should address the feasibility of a solution to the topic. The Army anticipates funding two (2) STTR Phase I contracts to small businesses with their research institution partner for each topic. The Army reserves the right to not fund a topic if the proposals received have insufficient merit. Phase I contracts are limited to a maximum of $204,000.00 over a period not to exceed six (6) months. **PLEASE NOTE THAT THE MAXIMUM DOLLAR AMOUNT HAS BEEN INCREASED COMPARED TO PREVIOUS PHASE I's**. Army STTR uses only government employee reviewers in a two-tiered review

process unless otherwise noted within the topic write-up. Awards will be made on the basis of technical evaluations using the criteria described in this DoD BAA Preface and availability of Army STTR funds.

The DoD SBIR/STTR Proposal Submission system (https://www.dodsbirsttr.mil/submissions/login) provides instruction and a tutorial for preparation and submission of your proposal. Refer to DoD BAA Preface for detailed instructions on Phase I proposal format. The Company Commercialization Report (CCR) must be uploaded in accordance with the instructions provided in the DoD Program BAA. Information contained in the CCR during will be considered during proposal evaluations.

The Army requires your entire proposal to be submitted electronically through the DoD-wide SBIR/STTR Proposal Submission Web site (https://www.dodsbirsttr.mil/submissions/login). STTR Proposals consist of six required volumes: (1) Proposal Cover Sheet, (2) Technical Volume, (3) Cost Volume, (4) Company Commercialization Report (CCR), (5) Supporting Documents, and (6) Fraud, Waste, and Abuse Training. Proposals not conforming to the terms of this BAA will not be considered for evaluation nor award.

The Army has established a **10-page limitation** for Technical Volume, Volume 2, submitted in response to its topics. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), the Cost Volume, Volume 3, or the CCR, Volume 4. The Technical Volume, Volume 2, includes but is not limited to: technical approach and objectives, key personnel background and qualifications, facility information, the relationship of the proposed work to any prior, current, or pending support of similar proposals or awards, commercialization strategy, references and letters of support, appendices, and all attachments.

The Army requires that small businesses complete the Cost Volume form on the DoD Submission site versus submitting it within the body of the uploaded Technical Volume. It is the responsibility of submitters to ensure that the Technical Volume, portion of the proposal does not exceed the 10-page limit. Do not include blank pages, duplicate the electronically generated cover pages, or put information normally associated with the Technical Volume such as descriptions of capability or intent in other sections of the proposal, as these will all count toward the 10-page limit.

Army STTR Phase I proposals submitted containing a Technical Volume over 10 pages will be deemed NON-COMPLIANT and will not be evaluated nor considered for award. It is the responsibility of the Small Business to ensure that once the proposal is submitted and uploaded into the system, that the technical volume .pdf document complies with the 10-page limit. If you experience problems uploading a proposal, email DSIP Support at DoDSBIRSupport@reisystems.com.

Companies should plan carefully for research involving animal or human subjects, biological agents, etc. as noted in the DoD BAA Preface. The short duration of a Phase I effort may preclude plans including these elements unless coordinated before a contract is awarded.

If the offeror proposes to employ a foreign national, refer to the DoD BAA Preface for definitions and reporting requirements. Please ensure no Privacy Act information is included in this submittal.

If a small business concern is selected for a STTR award, they must negotiate a written agreement between the small business and their selected research institution that allocates intellectual property rights and rights to carry out follow-on research, development, or commercialization (see DoD BAA Preface for more information).

PHASE II PROPOSAL GUIDELINES

All Phase I awardees may apply for a Phase II award for their topic – i.e., no invitation required. Please note that Phase II selections are based, in large part, on the success of the Phase I effort, so it is vital for SBCs to discuss the Phase I project results with their Army Technical Point of Contact (TPOC). Army STTR does not currently offer a Direct-to-Phase II option. Each year the Army STTR Program Office will post Phase II submission dates, 30-day window, on the Army SBIR/STTR web page at https://www.armysbir.army.mil/phase/. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the Army STTR PMO via subsequent notification of Phase I awardees. The SBC may submit a Phase II proposal for up to three years after the Phase I selection date, but not more than twice. The Army STTR Program *cannot* accept proposals outside the Phase II submission dates established. Proposals received by the DoD at any time other than the submission period will not be evaluated.

Phase II proposals will be evaluated for overall merit based upon the criteria in the DoD BAA Preface of this BAA. STTR Phase II proposals have six required Volumes: (1) Proposal Cover Sheet, (2) Technical Volume, (3) Cost Volume, (4) Company Commercialization Report (CCR), (5) Supporting Documents, and (6) Fraud, Waste, and Abuse Training. The Technical Volume has a **20-page limit** including: table of contents, pages intentionally left blank, technical references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes), and any attachments. However, offerors are instructed to NOT leave blank pages, duplicate the electronically generated cover pages, or put information normally associated with the Technical Volume in others sections of the proposal submission as these will count toward the 20-page limit. ONLY the electronically generated Cover Sheets, Cost Volume, and CCR are **excluded** from the 20-page limit. As instructed in the DoD BAA Preface, the CCR is generated by the submission website based on information provided by you through the "Company Commercialization Report" tool. **Army STTR Phase II proposals submitted containing a Technical Volume over 20 pages will be deemed NON-COMPLIANT and will not be evaluated nor considered for award.**

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

Army Phase II Cost Volumes must contain a budget for the entire 24-month period not to exceed the maximum dollar amount of $1,363,000.00. **PLEASE NOTE THAT THE MAXIMUM DOLLAR AMOUNT HAS BEEN INCREASED COMPARED TO PREVIOUS PHASE II's**. Costs for each year of effort must be submitted using the Cost Volume format (accessible electronically on the DoD submission site). The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the base year prior to extending funding for the option year. Phase II proposals are generally structured as follows: the first 12 months (base effort) should be approximately $681,500.00; the second 12 months of funding should also be approximately $681,500.00. The entire Phase II effort should not exceed $1,363,000.00. The Phase II contract structure is at the discretion of the Army's Contracting Officer, and the PMO reserves the option to reduce an annual budget request of greater than $681,000.00 if program funds are limited.

Any Sequential Phase II proposal (i.e., a second Phase II subsequent to the initial Phase II effort) shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by Army STTR PM in advance.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), offerors are encouraged to request technical and business assistance. The objective of this effort is to increase Army STTR technology

transition and commercialization success thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth. Details related to TABA are described in the DoD STTR Program BAA. All such requests must be made in accordance with these instructions. TABA may be proposed in the Base and/or Option periods, but the total value may not exceed $6,500 in Phase I and $25,000 per year in Phase II (for a total of $50,000 for two years). All details of the TABA agency and what services they will provide must be listed in the technical proposal under "Consultants." **The request for TABA must be included in Volume 2 under the Consultants subsection and include details on what qualifies the TABA firm to provide the services that you are requesting, the firm name, a point of contact for the firm (email address and phone number), and a website for the firm. The requested TABA amount must be noted in Volume 3. List all services that the firm will provide and why they are uniquely qualified to provide these services.** The award of TABA funds is not automatic and must be approved by the Army STTR Program Manager.

NOTIFICATION SCHEDULE OF PROPOSAL STATUS AND TECHNICAL EVALUATION FEEDBACK

Once the selection process is complete, an email will be sent to the "Corporate Official" listed on the Proposal Coversheet with a link to the Army STTR Small Business Portal, notifying firms of their proposal's change of status. In the portal, a letter signed by the Army STTR Program Manager indicating selection or non-selection will be available with instructions on how to request a Technical Evaluation Feedback. Small Businesses will receive a notification email for each proposal submitted. The Army STTR Program Manager and/or the Organization's Program Coordinator will provide ***written*** Technical Evaluation Feedback at the request of the offeror.

PROTEST PROCEDURES

Refer to the DoD Program Announcement for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: usarmy.rtp.devcom-arl.mbx.sttr-pmo@army.mil

DEPARTMENT OF THE ARMY PROPOSAL CHECKLIST

Please review the checklist below to ensure that your proposal meets the Army STTR requirements. You must also meet the general DoD requirements specified in the BAA. **Failure to meet all the requirements may result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

1. The proposal addresses a Phase I effort (up to **$204,000.00** for up to six-month duration).

2. The proposal is addressing only **ONE** Army BAA topic.

3. The technical content of the proposal includes the items identified in the DoD BAA Preface.

4. STTR Phase I Proposals have six volumes: (1) Proposal Cover Sheet, (2) Technical Volume, (3) Cost Volume, (4) Company Commercialization Report (CCR), (5) Supporting Documents, and (6) Fraud, Waste, and Abuse Training.

5. The Cost Volume has been completed and submitted for Phase I effort. The **total cost should match** the amount on the Proposal Cover Sheet.

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

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

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

9. If applicable, Foreign Nationals are identified in the proposal. Include country of origin, type of visa/work permit under which they are performing, and anticipated level of involvement in the project.

ARMY STTR PROGRAM COORDINATORS (PCs) and Army STTR 24.B Topic Index

Participating Organizations	PC	Email
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Army STTR 24.B Topic Index

A24B-T001 TITLE: Hexavalent Chrome Replacement for Small Caliber Barrels

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 a high temperature, corrosion, and wear resistant hexavalent chrome replacement for use on small caliber weapon system barrels.

DESCRIPTION: Small caliber weapon system barrels operate in a high temperature, chemically corrosive, and high mechanical wear environment. This environment leads to rapid deterioration of substrate materials and ultimately, failure of the barrel to meet performance requirements. In extreme cases, the combination of extreme environments can cause catastrophic failure of the weapon system component, resulting in injury to the operator. Future weapon systems are anticipated to further push the extremes with a combination of hotter flame temperature and more chemically corrosive propellants, higher pressures, and harder projectiles. Chrome application processes result in environmentally hazardous byproducts and does not sufficiently perform under the required conditions

There is a need for the development of coatings / plating for barrel bores internal surfaces which can perform / remain adhered under extreme temperatures, and which prevent chemical and mechanical corrosion associated with small arms firing. Proposed coatings / plating shall be compatible chemically, thermally, and mechanically with a variety of materials, both traditional and novel. Proposed coating / plating materials and application processes shall be compatible with small caliber barrel bores as small as 5.56mm in diameter. Further, application processes shall take into account the requirements of the coated / plated components in the small arms system - the application processes shall not adversely affect the substrate material in ways that may affect performance, including dimensional changes or effects on material properties, such as strength or fatigue life.

PHASE I: Phase I is expected to yield the following:

- Baseline or existing coating / plating properties to be used as starting point for this application, including: Coating thickness, Coating hardness, Coefficient(s) of friction, Corrosion resistance, Color ranges, Operating temperatures and thermal stability, Adhesion to substrate, Chemical compatibility, Application limitations, including internal diameter limitations, Line of sight or Non-Line of sight, substrate compatibility, etc.
- Baseline or existing coating / plating application parameters, including: Application temperature, Application time, Other relevant application parameters,
- Baseline or existing coating / plating performance, including: Description of the system and operating environment that the existing coating is applied to,
- Performance metrics and data in that application
- Cost of the baseline or existing coating / plating
- Estimated or predicted properties of the proposed coating / plating, including: Coating thickness, Coating hardness, Coefficient(s) of friction, Corrosion resistance, Color ranges, Operating

temperatures and thermal stability, Adhesion to substrate, Chemical compatibility, Application limitations, including internal diameter limitations, substrate compatibility, etc.
- Predicted application parameters of the proposed coating / plating, including: Application temperature, Application time, Other relevant application parameters
- Results of all analyses performed to show that the proposed development process will result in coating / plating that will meet the Government's needs, including:
- Results of modeling and simulation, Results of all analyses, including chemical, thermal, and structural analyses, Ability of the coating / plating to be applied to the internal bore of the barrel, Overall predicted performance in use as a small caliber bore coating or an internal signature suppressor coating
- Estimated cost of proposed coating / plating

The Offeror is encouraged to provide any other relevant information at the conclusion of Phase I to substantiate that the proposed technology is sufficiently feasible to proceed to Phase II.

PHASE II: The primary deliverables for Phase II should include:
Development of one or more coating(s) / plating(s) formulations and associated application processes that meet the Government's requirements. This deliverable includes all necessary documentation to define the formulation as well as the application process.

A comprehensive report that documents the entirety of the effort. The report shall highlight the development process, results of all analyses performed throughout the development process, results of destructive testing (i.e. coating thickness in sectioned barrels), and contractor's test results in lab (coupon testing) as well as simulated operational environment (live fire testing of coated barrels. The report shall highlight and address any shortcomings in performance, propose potential fixes to these shortcomings, and shall address any anticipated challenges with scaling to full rate production. The report shall also provide estimates of the cost to implement the proposed coating / plating in a production setting.

Quantity of five (5) small caliber barrels with coated / plated bores (weapon system / caliber to be determined - barrels may be provided as GFM).

PHASE III DUAL USE APPLICATIONS: The following post Phase II R&D efforts will be instrumental to transition:
- Additional Science and Technology development of coatings to improve performance in extreme operating regimes
- Application of coating / plating to additional quantities of barrels that represent either challenging performance requirements or challenging application requirements.

Virtually all small caliber weapon systems, commercial and military, would benefit from improved barrel systems. There is a large commercial market for small arms, and much money is spent by individuals upgrading barrels. An Offeror would likely need to partner with an OEM barrel manufacturer and have this technology offered as part of the item itself, since it is unlikely that existing barrels would be able to be coated or plated at a reasonable cost to the consumer.

From the DoD/military side, again the technology would apply to virtually all small arms systems, but primarily to advanced next generation systems or legacy belt fed systems that generate large amounts of heat, chemical erosion, and mechanical wear from the projectile. For newly acquired systems, Program Management offices could include this technology as part of the TDP. For legacy systems, the technology could be added to TDPs as Engineering Change Proposals (ECP) and could be included in weapon system overhauls and rebuilds.

REFERENCES:

1. Xiaolong Li, Yong Zang, Lei Mu, Yong Lian, Qin Qin, 2020, Erosion analysis of machine gun barrel and lifespan prediction under typical shooting conditions, Wear, Volumes 444-445, 203177, ISSN 0043-1648, https://doi.org/10.1016/j.wear.2019.203177;
2. Sopok, Samuel. (2010). Modeling Gun Bore Heat Transfer & Degradation. 10th AIAA/ASME Joint Thermophysics and Heat Transfer Conference. 10.2514/6.2010-5063.;
3. Wear and Erosion in Large Caliber Gun Barrels, Richard G. Hasenbein, https://apps.dtic.mil/sti/pdfs/ADA440980.pdf;
4. Understanding and Predicting Gun Barrel Erosion, Ian A. Johnston, https://apps.dtic.mil/sti/pdfs/ADA440938.pdf

KEYWORDS: hexavalent chrome, barrel, advanced coating, high temperature, bore erosion, small caliber, small arms

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A24B-T002 TITLE: Zernike Polynomials via Phase 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: Technology capable of completely characterizing an optic under test by implementing phase recovery and a collimated, partially coherent light source.

DESCRIPTION: Developing this capability will enable improved resolution in the Army's ubiquitous direct view optical systems. This advance will improve soldier survivability and lethality due to increased situational awareness and greater ability to detect, classify, recognize and identify (DCRI) threats.

The United States Army requires the ability to completely characterize optical systems to validate their design and performance. Commercial systems can measure the Modulation Transfer Function (MTF), effective focal length, field curvature, and distortion. These systems monitor the Fourier transform plane of the lens under test (LUT). They are currently unable to extract coma and spherical aberrations. Hopkins or Seidel coefficients that pertain to ray traces do not form an orthonormal basis; however, the Zernike polynomials are a proper basis that describes wavefront error. Frame captures contain only intensity information, and recovering the Zernike coefficients requires phase recovery. The Hubble Space Telescope was characterized by Brady (2005) and Fienup (1993) using a variation of the Gerchberg-Saxton algorithm (Wittle, 2018). Phase recovery is an inverse problem and requires constraints. Normally one uses two planes: the image plane and the Fourier transform plane. Other methods may be employed, e.g., the use of a series of frame captures about the Fourier Transform plane (Dube, 2018; Zhou, 2021; Gureyev, 2004); Mehrabkhani, 2017; Volkov, 2001). Pinhole illumination is assumed in advance. This would be near the effective focal length of the LUT. Because this is near the waist of the caustic, there is a concern as to how much (Fisher) information is available. Thus, the auxiliary planes will need to be near the region of maximum curvature for the caustic. In the far field, one can use the Fraunhofer approximate for the more general Huygen-Fresnel (H-F) propagator. Whether a Fresnel approximation is valid may depend upon the f-number of the LUT.

The acquisition of off-axis terms will require that the lens be rotated about its second nodal point. This is also true for interferometric approaches (Gates, 1955; ZYGO). The rotation of the LUT also satisfies the conditions outlined in Zhou (2021). As implemented, it is a form of tomography. Neither compressive sensing (Candes, 2011; Li, 2020) nor any other solution that requires the addition of optical elements (Fuerschbach, 2014) such as phase screens or beam splitters into the optical path are of interest for the purpose of this topic. Assume that the aberrated Airy disk is commercially examined via a microscope objective and image sensing array.

PHASE I: Develop the algorithms needed for implementing phase recovery using a series of planes about the location of the Fourier transform plane of the LUT. Demonstrate that the algorithm can converge to solutions that are consistent with those derived from interferometric methods. Determine the criteria for setting the spacing between these planes for best performance.

PHASE II: Using the results from phase I, develop the hardware and software to realize the procedure on a commercial system. Plane locations can be manually entered and the images offloaded for processing.

PHASE III DUAL USE APPLICATIONS: Make the necessary hardware and software adjustments to a commercial platform, automate the acquisition procedure, and automate the extraction of the Zernike polynomials.

REFERENCES:

1. Brady (2005), Gregory R. and James R. Fienup; "Phase retrieval as an optical metrology tool"; In Optifab 2005: Technical Digest (Vol. 10315, pp. 143-145). SPIE. Proceedings of SPIE - The International Society for Optical Engineering. 10.1117/12.605914.;
2. Candes (2011), Emmanuel J., Thomas Strohmer and Vladislav Veroninski; "PhaseLift: Exact and Stable Signal Recovery from Magnitude Measurements via Convex Programming"; arXiv:1109.4499v1 [cs.IT] 21 Sep 2011.;
3. Dube (2018), Brandon D. "On the Use of Classical MTF Measurements to Perform Wavefront Sensing"; Thesis, The Institute of Optics Hajim School of Engineering and Applied Sciences; https://www.retrorefractions.com/pdf/bdd_ug_thesis_10.pdf;
4. Fienup (1993), James R.; "Phase-retrieval algorithms for a complicated optical system". Applied optics, 32 10, 1737-46.;
5. Fuerschbach (2014), Kyle, Kevin P. Thompson, and Jannick P. Rolland; Interferometric measurement of a concave, φ-polynomial, Zernike mirror"; Optics Letters / Vol. 39, No. 1 / January 1, 2014.;
6. Gureyev (2004), T.E.; A Pogany, D.M Paganin, S.W Wilkins, "Linear algorithms for phase retrieval in the Fresnel region"; Optics Communications,Vol. 231; Issues 1–6, Pp. 53-70,; ISSN 0030-4018,; https://doi.org/10.1016/j.optcom.2003.12.020.;
7. Li (2020) Fanxing, Wei Yan, , Fupin Peng, Simo Wang and Jialin Du; "Enhanced Phase Retrieval Method Based on Random Phase Modulation"; Appl. Sci. 2020, 10, 1184; doi:10.3390/app10031184;
8. Mehrabkhani (2017), Soheil & Kuester, Melvin. "Optimization of phase retrieval in the Fresnel domain by the modified Gerchberg-Saxton algorithm"; https://arxiv.org/ftp/arxiv/papers/1711/1711.01176.pdf;
9. Volkov (2001), V., & Zhu, Y.; "Phase Retrieval from Two Defocused Images by the Transport-Ofintensity Equation Formalism with Fast Fourier Transform". Microscopy and Microanalysis, 7(S2), 430-431 Aug. 5-9 Long Beach CA; doi:10.1017/S1431927600028221;
10. Wittle (2018), Lily. Investigating the Gerchberg-Saxton Phase Retrieval Algorithm. SIAM Undergraduate Research Online. 11. 10.1137/17S016610.;
11. Zhou (2021) Guocheng, Shaohui Zhang, Yayu Zhai, Yao Hu, Qun Hao; "Single-Shot Through-Focus Image Acquisition and Phase Retrieval from Chromatic Aberration and Multi-Angle Illumination"; Frontiers in Physics, vol.9; DOI=10.3389/fphy.2021.648827; https://www.frontiersin.org/articles/10.3389/fphy.2021.648827;;
12. ZYGO "Typical Interferometer Setups"; https://www.zygo.com/-/media/project/ametekxa/zygo/ametekzygo/downloadables/brochures/interferometers/typical-interferometer-setups.pdf]

KEYWORDS: Phase Recovery, Zernike Polynomials, Fresnel Propagator, Inverse problem, Constraints, Priors.

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A24B-T003 TITLE: High Reflector Microstructure for 1 Micron Continuous Wave Light and Mid to Long Wave Transmission

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE), Space Technology, Advanced Materials

OBJECTIVE: Build a microstructure designed for dielectric optically-transparent materials to act as a narrowband (1030 to 1070nm) high-reflector for cw laser light, while maintaining high transmission in the MWIR to LWIR.

DESCRIPTION: There is a need to develop highly reflective microstructures for the 1030 to 1070 nm range for continuous wave (cw) laser light to protect and allow uninterrupted operation of mid-wave to long-wave infrared sensors. Such microstructures will efficiently block the specified range of wavelengths while transmitting light in the rest of the infrared spectral region and maintaining good optical imaging quality.

The primary goal of the current STTR is to develop a microstructure, which can be etched onto a variety of dielectric optical materials whose transparency regions span the infrared (specifically ZnS, ZnSe, BaF2, Silicon, Ge, and other such optics), that will be capable of reflecting greater than 99.5% of 1030 to 1070 nm light while not reducing the transmission of the substrate by more than 10% and maintaining good optical imaging quality (structural similarity index measure (SSIM) greater than 0.9) in the infrared spectral region. A microstructure capable of handling optical powers of up to 10 MW/cm2 is preferred, with an acceptance angle of at least +/- 15 degrees over a one-inch clear aperture. Proposed microstructures should clearly include an efficient mechanism for dissipating the absorbed or reflected optical energy at the specified wavelength range. Materials should not be limited to traditional optical materials; instead exploitation of compatible material platforms suitable for operation in the infrared spectral range is encouraged. Ability of the chosen material to dissipate the required optical power and operate under standard military specification should be addressed. The proposed designs should be both polarization and vibration insensitive. Fabrication techniques needed to realize proposed filter designs should be clearly defined in the Phase I effort. Such structures should be scalable for dielectric optics with a diameter up to 5 inches.

Nano-structure resonant surfaces, a type of microstructure, consist of an array of index variations formed by holes or mesas. Typically, the array is etched into a substrate like fused silica and then conformally coated with a thin layer of higher index material like aluminum oxide or tantalum pentoxide. This gives a high low index contrast and periodic variation in a direction transverse to the beam propagation direction. In this way you can set-up a filter function in a single structured surface that performs as well as 50 to 200 thin-film layers typical of an interference filter. Interference Filters accumulate their resonance in the longitudinal direction. This is one of the major advantages of nano-structure resonant (NSR) reflection (notch transmission) filters.

Such cw microstructures are useful for commercial applications that use 1030 to 1070nm lasers for manufacturing, as well as other industrial applications where protection of the operator and the environment is required to avoid damage from high intensity laser radiation. The cw high reflector microstructure filters will provide uninterrupted, enhanced force protection and day/night situational awareness. There exist numerous military applications for this technology which can be further discussed at the CUI and higher levels.

PHASE I: Design, analysis and fabrication of a cw high reflector microstructure for dielectric optical materials capable of reflecting greater than 99.5% of 1030 to 1070 nm light, while not reducing the transmission of the unaltered substrate in the rest of the MWIR, and LWIR (3 μm to 12 μm) spectral

regions by more than 10% and not degrading the optical quality of the transmitted light significantly (SSIM greater than 0.9). A microstructure capable of handling optical power densities up to 10 MW/cm2 is preferable with an acceptance angle of ± 10 degrees over a one-inch clear aperture. These filters should be both polarization and vibration insensitive. The deliverables shall include a detailed design for a high reflector microstructure on four of the substrate materials (zinc selenide, and three of the following: zinc sulfide, barium fluoride, silicon, and germanium). Include simulation results of the transmittance and reflectance spectra spanning the full spectral range (400 nm through 12 µm) along with a prototype coupon, i.e. a small-scale device 1in2 or larger with full functionality, as a proof of concept that demonstrates critical aspects of the manufacturing, and clearly demonstrates the capability to actualize the proposed reflectors.

PHASE II: Fabrication and demonstration of prototype cw high reflector microstructures with a 2 inch clear aperture (but scalable up to a 4 inch clear aperture), with an acceptance angle of ± 15 degrees, on four of the substrate materials (including ZnSe). The filter should be capable of rejecting greater than 99.5% of 1030 to 1070 nm continuous wave light, while not reducing the transmission in the rest of the 3 µm to 12 µm spectral region by more than 10% and not degrading the optical quality of the transmitted light significantly (SSIM greater than 0.9). Additionally, the reflectance should be polarization insensitive. They should also be capable of handling optical power densities up to 10 MW/cm2. Damage testing will be conducted at the U.S. Army Research Laboratory with a 200 µm to 900 µm beam spot size. The expected deliverables are at least four fully-operational prototype cw high reflector microstructures on four different materials covering the spectral range of 3 µm to 12 µm. Deliverables will be tested for cw damage threshold and within sensor systems. Also, potential commercial and military transition partners for a Phase III effort shall be identified.

PHASE III DUAL USE APPLICATIONS: Further research and development during Phase III efforts will be directed towards a final deployable design, incorporating design modifications based on results from tests conducted during Phase II, and improving engineering/form-factors, equipment hardening, and manufacturability designs to meet the U.S. Army CONOPS and end-user requirements. Manufactured cw high reflector microstructures shall be integrated into relevant systems.

Potential commercial applications include protection of thermal cameras for Private security. The possibility to incorporate these structures onto other glasses could also be explored, for the potential protection of any infrared systems.

REFERENCES:

1. Magnusson, R., “Wideband reflectors with zero-contrast gratings,” Optics Letters 39, (15) 4337 (2014) Chen, G., et. al., “Period photonic filters: theory and experiment,” Opt. Eng. 55 (3), 037108 (2016) http://spie.org/Publications/Journal/10.1117/1.OE.55.3.037108?SSO=1;
2. Zhang, S., et. al., “Broadband guided-mode resonant reflectors with quasi-equilateral triangle grating profiles,” Opt. Exp. 25 (23), 28451 (2017) https://www.osapublishing.org/oe/abstract.cfm?uri=oe-25-23-28451;
3. Hobbs, D.S., MacLeod, B.D., and Manni, A.D., "Pulsed laser damage resistance of nanostructured high reflectors for 355nm” Proc. SPIE 10447, 104470W (2017) LASER DAMAGE SYMPOSIUM XLIX

KEYWORDS: high power, continuous wave, microstructure, 1 micron, optics, infrared, high reflector, dielectric, high transmission, MWIR, LWIR, reflective

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A24B-T004 TITLE: Metamaterials Based on Magnetic Shape Anisotropy for K-band Microwave Applications

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

OBJECTIVE: Develop a metamaterial utilizing magnetic shape anisotropy of ferromagnetic nanoparticles for operation of ultracompact antenna in the K frequency band of the microwave spectrum.

DESCRIPTION: Metamaterials demonstrating resonant response to electromagnetic radiation in the microwave Ku (12 GHz to 18 GHz) and K (18 GHz to 26.5 GHz) bands are highly desirable for multiple applications, including ultracompact microwave antennae, radar detection and frequency-selective wireless heating. Availability of ferromagnetic materials with high saturation magnetization and low magnetic damping [1,2], combined with recent advances in nanolithography, enable the development of such metamaterials based on arrays of ferromagnetic nanoparticles, where the resonance frequency of the metamaterial is determined by the magnetic shape anisotropy of the nanoparticles [3]. The shape anisotropy enables fabrication of devices with a selection of operation frequencies via lithography. For example, arrays of ultracompact antennae covering a wide band of the microwave spectrum, where each antenna is tuned to its own resonance frequency via control of the fabricated nanoparticle shape, can be used for ultrafast monitoring of the electromagnetic environment. An important advantage of a magnetic metamaterial is independence of its resonance frequency on the antennae dimensions [4], which enables ultracompact antennae for communications with miniature devices. The metamaterial antenna gain can be further boosted via magneto-electric or magneto-resistive effects in nanoparticle-based heterostructures to reach record levels of sensitivity to microwave signals [5].

The goal of this proposal is development of magnetic metamaterials based on arrays of ferromagnetic nanoparticles that show resonant response to electromagnetic radiation tunable by the nanoparticle shape. The metamaterial must operate at room temperature without a bias magnetic field and must show tunability of its frequency via shape anisotropy in the 2 GHz – 26.5 GHz frequency range (covering S, C, X, Ku and K bands). The metamaterial must exhibit resonant response to the frequency of incident electromagnetic radiation with the quality factor exceeding 100. To enable commercial applications, the metamaterial must be fabricated from a polycrystalline or amorphous ferromagnetic film deposited at room temperature by a high-throughput technique such as sputtering or electrodeposition. Operation of a K-band ultra-compact microwave antenna based on the shape-anisotropy metamaterial must be demonstrated. The overall antenna dimensions must not exceed 5 millimeters.

PHASE I: Develop a magnetic metamaterial defined by arrays of ferromagnetic nanoparticles that shows resonant response to electromagnetic radiation in the microwave Ku band (12 GHz – 18 GHz) at zero magnetic field and scalability of the concept to the K frequency band.

PHASE II: Determine the optimal combination of high saturation magnetization and low magnetic damping to demonstrate resonant response of the metamaterial in the K frequency band (18 GHz to 26.5 GHz) with the resonance quality factor exceeding 100 throughout that frequency band. The metamaterial fabrication process must be compatible with standard high-throughput film deposition. Demonstrate control of the resonance frequency by shape anisotropy and fabricate metamaterial samples operating in the S, C, X and Ku microwave bands. Design, implement and test an ultra-compact (dimension below 5 mm) K-band antenna based on the shape-anisotropy metamaterial. Demonstrate the possibility of higher antenna gain using magneto-electric or magneto-resistive effects. Provide a sample of the metamaterial and the K-band antenna to the Army for further testing.

PHASE III DUAL USE APPLICATIONS: The ultracompact microwave antennae based on shape-anisotropy magnetic metamaterial can be used as receivers in miniature autonomous vehicles. An array of

such ultracompact microwave antennae enables continuous monitoring of the electromagnetic spectrum over a wide microwave band, which can be used for rapid detection of threats with known electromagnetic signatures.

REFERENCES:

1. M. A. W. Schoen, D. Thonig, M. L. Schneider, T. J. Silva, H. T. Nembach, O. Eriksson, O. Karis, J. M. Shaw, Ultra-low magnetic damping of a metallic ferromagnet. Nat. Phys. 12, 839–842 (2016).;
2. N. Ji, X. Liu, J.-P. Wang, Theory of Giant Saturation Magnetization in α-Fe16N: Role of Partial Localization in Ferromagnetism of 3d Transition Metals, New J. Phys. 12, 063032 (2010).;
3. C. Bayer, J. Jorzick, B. Hillebrands, S. O. Demokritov, R. Kouba, R. Bozinoski, A. N. Slavin, K. Y. Guslienko, D. V. Berkov, N. L. Gorn, M. P. Kostylev, Spin-Wave Excitations in Finite Rectangular Elements of Ni80Fe20, Phys. Rev. B 72, 064427 (2005).;
4. Y. Malallah, K. Alhassoon, D. Venkatesh, A. S. Daryoush, C. Chinnasamy, M. Marinescu, and H. Gundel, Gain Improved Stacked Antenna Tuned Using Ferromagnetic Nanoparticles and Ferroelectrics Films, in 2016 46th European Microwave Conference (EuMC) (2016), pp. 1007–1010.;
5. B. Fang, M. Carpentieri, X. Hao, H. Jiang, J. A. Katine, I. N. Krivorotov, B. Ocker, J. Langer, K. L. Wang, B. Zhang, B. Azzerboni, P. Khalili Amiri, G. Finocchio, Z. Zeng, Giant Spin-Torque Diode Sensitivity in the Absence of Bias Magnetic Field, Nature Commun. 7, 11259 (2016).

KEYWORDS: magnetic metamaterial, shape anisotropy, microwave antenna, nanolithography, magnetic resonance

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A24B-T005 TITLE: Aluminum Nitride-Based Monolithic Microwave Integrated Circuits

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

OBJECTIVE: To develop aluminum nitride-based platform for monolithic microwave integrated circuits for extreme radio frequency and high-power operation.

DESCRIPTION: The next generation of devices and systems for electronic microwave applications need to offer high frequencies, high power, compactness, high-performance, and high temperature operation. Several materials platforms such as silicon carbide (SiC), gallium arsenide (GaAs), silicon (Si), and aluminum nitride (AlN) are competing for market share in this emerging high frequency applications. Among them however, AlN stands out as an exceptional material for next-generation monolithic microwave integrated circuits (MMICs), offering a multitude of advantages that are paramount for advanced electronic systems. These include its ultrawide and direct bandgap (6.2 eV), large critical electric field (15 MV/cm) and high thermal conductivity (~340 W/mK) allowing for efficient heat dissipation, critical in maintaining high power operation and reliability of high-frequency circuits. Current research and development focus is being placed on gallium nitride (GaN) and aluminum gallium nitride (AlGaN) high electron mobility transistors (HEMTs) for operations requiring both high-power and high frequency. This has led to demonstration of the state-of-the-art GaN HEMTs with output power of up to 8.84 W/mm at up to 94 GHz. However, the GaN HEMTs were fabricated on SiC substrates. AlN's compatibility with GaN and AlGaN HEMTs facilitates seamless integration, avoiding the lattice mismatch issues encountered in SiC substrates. This would enable the development of compact, high-frequency devices with superior operational capabilities. Additionally, current availability of insulating AlN of high substrate quality and large enough size ensures precise and reliable MMIC fabrication, and unwanted electrical interactions, thus, enhancing signal integrity at high frequencies. However, despite these advantages, research and development of AlN-based MMICs are still in their infancy and more effort is needed to fully harness its capabilities. The utilization of high-purity semi-insulating AlN as a substrate for MMICs requires precise knowledge of materials properties of AlN at millimeter-wave frequencies (such as electrical permittivities) to accurately predict the propagation delay and attenuation of waves along the transmission lines.

The goal of this topic is to leverage recent achievements in AlN and AlGaN and create commercializable AlN-based MMICs which outperforms current state-of-the-art GaN MMICs for higher power/frequency applications. The needed work includes fundamental research and development to establish materials properties and fabrication routes for AlN-based devices. This would require design and fabrication of resonators for microwave or RF circuits, which could be accomplished via closed-loops, circular waveguides, or transmission lines to allow for resonance at specific microwave frequencies. The developed resonators would be used to extract fundamental materials properties such as permittivity and loss tangent. Subsequently, a route towards integration of the developed resonators with typical electronic components need to be pursued, focusing on the proposer’s defined application. The anticipated product is a fully integrated microwave circuit presented as a prototype.

PHASE I: In phase I, the awardee will describe a few important Army-relevant applications for AlN-based MMICs and select the particular application they wish to address. Using this application as a testbed, AlN-based microwave/mmWave resonators should be designed and fabricated. The fabricated resonators should be used to extract the substrate’s frequency-dependent material properties up to W-Band (i.e., 1 to 75 GHz). This information should then be used to design, fabricate, and test transmission lines with return loss < 10 dB and insertion loss < 0.6 dB/mm up to 75 GHz. At the end of Phase I, the feasibility of AlN-based MMICs should be assessed. With the growing demand for high frequency and high power MMICs for military and civilian applications, mmWave MMICs based on AlN projects strong commercialization potential.

PHASE II: During Phase II, the awardee will design, fabricate, and characterize the AlN-based resonators to obtain frequency-dependent material parameters up to 170 GHz. The performer must demonstrate a process for substrate thinning to a thickness of 100 µm or smaller. In addition, through substrate vias (TSV) should be demonstrated with a diameter less than 100 µm. This will result in the design, fabrication and characterization of low-loss waveguides and waveguide transitions with demonstrations in the W- and D-bands. The peak return loss and average insertion loss should be <18 dB and <0.5 dB/mm, respectively, up to 170 GHz. Then, in order to demonstrate the feasibility of AlN-based MMICs, the awardee will integrate the waveguides with an electronic element aligned with the proposed application, such as an amplifier, mixer, oscillator, or switch. At the end of Phase II, the awardee should demonstrate that the developed systems address limitations of current systems for the chosen application. In addition, the awardee should thoroughly investigate the commercial transition potential of AlN-based MMICs. Given their potential to advance high-frequency electronics significantly, the awardee is encouraged to explore this avenue, potentially positioning themselves as a key player in industries such as telecommunications, aerospace, and defense, where advanced electronic solutions are in high demand.

PHASE III DUAL USE APPLICATIONS: During Phase III approach, the work from Phase II should be continued. Here the focus should be on the development of a truly integrated MMIC. The awardee should undertake reliability testing/qualification, produce a process design kit. Moreover, the potential to transfer the technology to military systems (e.g., radar, electronic warfare, communication), as well as civilian applications should be explored. The awardee should work with Army primes and industry partners to commercialize the technology via a trusted foundry for technology availability to the defense and military markets.

REFERENCES:

1. Hickman, A. L., Chaudhuri, R., Bader S. J., Nomoto, K., Li, L., Hwang, J. C. M., Xing, H. G., and Jena, D. “Next generation electronics on the ultrawide-bandgap aluminum nitride platform.” Semicond. Sci. Technol. 36 044001 (2021). https://doi.org/10.1088/1361-6641/abe5fd;
2. Li, L., Reyes, S., Asadi, M.J., Fay, P., Hwang, J.C.M. “Extraordinary permittivity characterization of 4H SiC at millimeter-wave frequencies”. Applied Physics Letters 123, 012105 (2023). https://doi.org/10.1063/5.0148623;
3. Singhal, J., Chaudhuri, R., Hickman, A., Protasenko, V., Xing, H. G., Jena, D. “Toward AlGaN channel HEMPTs on AlN: Polarization-induced 2DEGs in AlN/AlGaN/AlN heterostructures”. Applied Physics Letters Materials 10, 111120 (2022). https://doi.org/10.1063/5.0121195;
4. Schwantuschke, D., Godejohann B. J., Brückner, P., Tessmann, A., and Quay, R. “mm-Wave operation of AlN/GaN-devices and MMICs at V- & W-band”. 22nd International Microwave and Radar Conference (MIKON), Poznan, Poland, pp. 238-241 (2018). doi: 10.23919/MIKON.2018.8405187. https://ieeexplore.ieee.org/document/8405187;
5. Collazo R., Sitar Z., High n-type conductivity and carrier concentration in Si-implanted homoepitaxial AlN, Applied Physics Letters 118, 112104 (2021). https://doi.org/10.1063/5.0042857;
6. Doolittle, W.A., Matthews, C.M., Ahmad, H., Motoki, K., Lee, S., Ghosh, A., Marshall, E. N., Tang, A. L., Manocha, P., Yoder, P. D., “Prospectives for AlN electronics and optoelectronics and the important role of alternative synthesis”. Applied Physics Letters 123, 070501 (2023). https://doi.org/10.1063/5.0156691;
7. Ahmad, H., Lindemuth, J., Engel, Z., Matthews, C. M., Motoki, K., Doolittle, W. A., “Substantial p-type Conductivity of AlN Achieved via Beryllium Doping”, Advanced Materials 33, 2104497 (2021). https://doi.org/10.1002/adma.202104497;
8. Romanczyk, B., Zeng, X., Guidry, M., Li, H., Hatui, N., Wurm, C., Hrishna, A., Ahmadi, E., Keller, S., and Mishra, U. K., “W-Band Power Performance of SiN-Passivated N-Polar GaN

Deep Recess HEMTs". IEEE Electron Device Letters, 41 (3), 349-352 (2020). 10.1109/LED.2020.2967034

KEYWORDS: Aluminum Nitride, MMICs, Ultra-Wide Bandgap, High Frequency, Microwave, mmWAve

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A24B-T006 TITLE: Fast Charge Silicon Anode Lithium-Ion Cells for Small UAS Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Renewable Energy Generation and Storage, Advanced Materials

OBJECTIVE: Fast charge silicon anode lithium-ion cells for small UAS systems.

DESCRIPTION: The ability to fast charge (less than 6 minutes) commercial graphite anode Li-ion cells to specific energies greater than110 Wh/kg is a significant challenge. The inability to fast charge to higher specific energy means that more batteries must be in the logistics chain to supply operations and that onboard/critical edge charging is not an option for many fast-paced operations. A promising technology that is currently being developed for high energy Li-ion cells (300-400 Wh/kg) is based on silicon (Si) anodes that have demonstrated fast charge capability in prototype cells. The challenges with Si anode cells are cycle life, calendar life, and safety. Many Si anode cell developers are focused on achieving the highest energy batteries and not on the ability to fast charge with long cycle or calendar life.

Cell capacity, safety, and cycle life typically suffer when Li-ion cells are charged quickly with the limitations mainly relating to the graphite anodes inability to absorb lithium ions without plating lithium metal. Si anodes alloy with lithium and demonstrate capacities 10X that of graphite at a potential and electrode thickness that make lithium plating much less likely under fast charge. Si anode cycle life is lower than commercial graphite systems due to several factors including the mechanical grinding of the Si alloy under repeated cycling that leads to loss of active material contact as well as the continuous new surface generation and subsequent passivation that occurs as the Si swells and contracts upon charge and discharge. Calendar life is poor in these systems which limits its use in EV applications, but for several specialty applications, the specific energy provides much needed capability.

Energy sharing between energy sources (vehicles, generators, solar chargers) and Soldiers already occurs when BB2590 batteries are charged in the field. The charging process is slow and often it is easier to swap batteries if available. Fast charge batteries are part of the DEVCOM Army Research Laboratory VICTOR (VERSATILE TACTICAL POWER AND PROPULSION) Essential Research Program and in tandem with wireless recharge and silent power generation, will eliminate battery swaps, reduce the cognitive and physical load on Soldiers, and reduce the logistical tail in batteries. One example is the use of fast charge batteries in small unmanned air systems (sUAS) charged from mobile ground stations that enable autonomous recharge, freeing the Soldier from carrying and changing batteries, and reducing their exposure on the battlefield.

This topic seeks the development of Si based fast charge cells with demonstrated specific energy greater than 200 Wh/kg in 6 minutes of charge in order to enable new concepts in energy sharing, increased pace of operations, and compact energy sources for high power devices. This topic looks to have Si anode materials brought further into development and to demonstrate the improvements in full Li-ion cells for use in VICTOR ERP programs.

PHASE I: In the phase I effort, demonstrate single/few layer Si anode full cells that when fast charged at 10C (6 minute) rates, cycle for >1000 continuous cycles at 3C discharge to > 80% capacity. These cells should support the development of multi-Ah cells with a specific energy > 200 Wh/kg. Deliverables would be 10 full cells of >100 mAh capacity capable of 10C charge / 3C discharge and >1000 cycles to > 80% capacity.

PHASE II: Phase II would involve producing and characterizing cells in sufficient quantities to fully characterize them for rate, temperature performance, and continuous cycling stability. Deliverables

include 20 full cells at a rated capacity of > 2Ah capable of 10C/3C charge-discharge cycling at an energy density of >200 Wh/kg at the 10C charge rate.

PHASE III DUAL USE APPLICATIONS: The applications where this technology could be used include storage for high energy storage modules (HESM), jammer applications, 6T battery applications, and for fast charge batteries in UAS systems. Commercial applications include batteries for hybrid electric vehicles and eVTOL. Likely sources of funding if the phase III program is successful include PEO Soldier, PM UAS, and C5ISR.

REFERENCES:

1. Inorganics 2023, 11(5), 182; https://doi.org/10.3390/inorganics11050182;
2. Nature Nanotechnology, volume 3, pg 31–35 (2008);
3. https://amprius.com/technology/;
4. https://arl.devcom.army.mil/what-we-do/victor/

KEYWORDS: Fast charge, Lithium-ion, Silicon anode, High power

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A24B-T007 TITLE: Multicomponent Reduced Order Modeling of Hypersonic Boundary Layers

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: To develop multi-physics component-based reduced order models (ROMs) and associated interfaces to accelerate high-fidelity design tools for predicting detailed time-accurate hypersonic vehicle flow-fields.

DESCRIPTION: The Army is interested in designing next-generation hypersonic flight vehicles with enhanced system speed, reach, and lethality addressing Army's and DoD's Priorities in Long Range Precision Fires and Hypersonics. Revolutionary systems must meet new tactical requirements for performance, reach, and lethality. Computational fluid dynamics (CFD) has played a central role in the design and development of hypersonic vehicles, in part due to prohibitive costs associated with testing facilities. However, existing CFD approaches have prohibitive computational costs when attempting to predict high Reynolds number hypersonic aerothermodynamics and its interactions with fully resolved physical processes. Hypersonic modeling under realistic flight conditions is complicated by the nonlinearity and multiphysics nature present that acts across a wide range of scales [1]. Variations in atmospheric conditions, chemical kinetics, vibrational excitation, ablation products, and gas-surface interactions further complicate high enthalpy flow and plasma [2]. Recent detailed direct molecular simulations have also demonstrated macroscopic impacts of complex transport phenomena often omitted in coarse grained models such as Large Eddy Simulation (LES) and Reynolds Averaged Navier Stokes [3,4]. The computational expense associated with solving complex coupled fluid, thermal, kinetic, and structural problems currently significantly limit the rate at which design space can be accurately explored. Recent success accelerating modeling of complex flows of similar computational complexity through component-based ROMs[5] suggests potential for model acceleration strategies that exploit coupling of local mesoscale ROM domains. Newly developed localized ROM domain partitioning, nonlinear compression, and adaptivity suggest potential to attain greater efficiency and scalability than start-of-the-art models through the mitigation of high Kolmogorov n-width complexity associated with device scale transient turbulent flows. To shorten design cycles, revolutionary capabilities for accelerating high fidelity external and internal aerothermodynamics such as these must also be integrated with associated multi-physics couplings. The Army is therefore soliciting scalable adaptive model order reduction technologies capable of recovering high-fidelity predictive power for the flight environment of a hypersonic vehicle, along with associated gas-flow chemistry, detailed transport, shock induced heating, and their associated material-responses. The goal will be to achieve at least an order of magnitude reduction of computational cost versus existing wall-resolved LES (WR-LES) techniques while recovering full Direct Numerical Simulation (DNS) accuracy levels on transitional flows where wall-modeled (WM-LES) results diverge from WR-LES and DNS solutions. While either non-invasive data-driven model order reduction or fully invasive ROM technologies will be considered, priority will be given to approaches that develop modular compressed bidirectional data interfaces that enable tight coupling among diverse physics tools with improved scalability. The new tools should be able to handle realistic glide body, missile geometries, and scramjet propulsion systems for sustained powered flight in

the Mach 6 to 20 range. Models that reduce sensitivity to near-wall mesh quality are particularly encouraged. Tools must have the ability to be deployed in traditional/emerging high performance computing architectures (CPU GPU) efficiently and demonstrate efficient weak scaling at least competitive with LES models. Compressed interfaces for in-situ visualization and data extraction techniques enabling seamless navigation of the sea of data encountered in real-time analysis is also encouraged.

PHASE I: Develop component-based reduced order model (ROM) technologies that, once trained, demonstrate accurate 3D high-fidelity prediction of transient hypersonic boundary layer flows with transition for novel flow conditions within training set bounds. Attain order of magnitude reduction in memory footprint compared to existing state-of-art WR-LES of commensurate accuracy without explicitly defined wall models. Ability to recover DNS level solution accuracy in geometries incompatible with existing wall models should also be demonstrated with order of magnitude speedup relative to state of the art fully resolved high-order DNS solutions. Performance scaling for high fidelity reacting turbulence commensurate with DNS solutions with finite rate chemical kinetics and detailed transport should also be demonstrated. The company should identify strengths/weaknesses associated with alternative solutions, methods, and new concepts. Demonstrate theoretical credibility of proposed computational methods. Computational vetting and demonstration of concepts to be conducted using canonical blunt-nose single or double cone hypersonic shapes and simple flameholder geometries at minimal Reynolds number required to demonstrate transitional flow behaviors is suitable in this phase. Solutions capable of maintaining order of magnitude speedups with ROM training or adaptation time included without loss of predictive accuracy across parametrically varying geometric configurations are highly encouraged.

PHASE II: During Phase-II, the framework developed in Phase-I will be extended and validated to support hypersonic design of potential applications in air-breathing missiles, boost-glide missiles, and high-maneuver interceptors. Tools should demonstrate ability to model complex aerothermochemistry, transport, thermoacoustics, shock induced heating, and structural material responses with statistical properties shown to converge towards DNS and canonical experimental data with computational cost at least one order of magnitude below WR-LES models for equivalent conditions. Fluid-structure component-based ROM coupling that enables conjugate heat transfer and fluid structure interaction calculations that accurately model sharp features resulting from shock-heating are also encouraged. The tools should inherit the ability to capture in detail non-equilibrium processes including boundary layer transition to turbulence, onset of material ablation, finite-rate non-equilibrium chemistry, and gas-surface interactions responsible for surface deformation from baseline full-order DNS models. Tight-coupling of time-accurate predictions through compressed component-based ROM interfaces for fluid structure interactions for parametric variations of both flow boundary conditions and design properties for external hypersonic vehicle flows should be demonstrated. Complete model, multi-physics ROM interface application programming interfaces (APIs), and executable code for deployment on state-of-the-art high performance computing systems with demonstrable performance on existing or emerging computing architectures is expected.

Teams must demonstrate model validation by comparison with experiments, reference DNS databases in the open literature, or data from the Army or DoD laboratories. Capturing turbulent transition at dramatically reduced computational complexity for arbitrary geometries and flow conditions is emphasized. The complete software package shall be available to ARL during all phases of the project to conduct independent assessment and vetting of the developed tools. Development efforts will be coordinated with the government and potential prime-contractor partners to ensure product relevance and compatibility with missile defense projects and government modeling and simulation systems. While compatibility with specific production codes is not required, selection will favor projects with viable transition strategies for either enhancing or supplanting production codes in existing high-cost

Multiphysics analysis pipelines. The developed complete computational tool sets along with user guide(s) at the end of Phase-II shall be delivered to ARL for government use on HPC platforms to conduct mission projects.

PHASE III DUAL USE APPLICATIONS: This work will enable collaboration with high-fidelity simulation model developer(s) and/or user(s) on integration of product(s) into accelerated missile defense application pipelines. Long-term optimization of toolsets and APIs to accommodate new advances in the technology of tracking and prediction of glide body or cruise missile flight will continue. Technology will transition to an appropriate government or defense contractor for integration and testing. Integration and validation into design cycles for a real-world missile defense application will continue.

REFERENCES:

1. Candler, G.V., “Rate effects in hypersonic flows”, Annual Review of Fluid Mechanics, vol. 51, pp. 379-402, 2019.;
2. Bisek, N. J., I.D. Boyd, J. Poggie, "Numerical Study of Plasma-Assisted Aerodynamic Control for Hypersonic Vehicles", AIAA J. Spacecraft and Rockets, vol. 46 (3), 2009;
3. Grover, M.S., A. M. Verhoff, P. Valentini, N. J. Bisek, “First principles simulation of reacting hypersonic flow over a blunt wedge”, Phys Fluids 35, 086106, 2023;
4. Morreale, B.J., J. Shine, R. D. Bowersox, N. Bitter, R. Wagnild, “Hypersonic Multi-Fidelity Turbulence Modeling on a Mach 5 Blunt Ogive with Cool Walls”, AIAA 2023-0455, 2023;
5. Huang, C., K. Duraisamy, C. Merkle, “Component-Based Reduced Order Modeling of Large-Scale Complex Systems”, Front. Phys., 2022;
6. US3D: Aerodynamic and Aerothermodynamic Simulations Software (20110126, Dr. Graham Candler)

KEYWORDS: Reduced order modeling, hypersonics, aerothermochemistry, computational fluid dynamics

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A24B-T008 TITLE: Modeling Tools for Army Vehicle (tanks and rotorcraft) Mobility Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy, 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: To incorporate new mathematical constructs and high-fidelity design tools to predict Fluid-Structure interactions of Army vehicle (tanks and rotorcraft)

DESCRIPTION: The United States Army is actively seeking to advance its capabilities in aerodynamic analysis and design for a wide range of vehicles spanning from rotary-wing aircraft to medium/long-range hypersonic projectiles. A critical need to understand and optimize flight characteristics across various mobility applications is behind this initiative. The United States Army has a need to develop high-fidelity, computationally efficient solvers for the aerodynamic analysis and design of vehicles ranging from rotary-wing aircrafts to medium/long-range hypersonic projectiles. The Army has unique gaps in understanding the flight characteristics (e.g., mobility applications, including gas-turbine engine flow and heat transfer analysis for vehicles that include these propulsion systems) and Extreme-event mitigation including air-blast FSI modeling and simulation for Army vehicles and structures. Isogeometric Analysis (IGA) has brought superior accuracy to spatial and temporal discretization in fluid and structural mechanics simulations. Complex-geometry NURBS mesh (Non-Uniform Rational B-Spline Surfaces) generation tools developed in recent years are making IGA simulations more applicable to real-world problems in fluids, structures, and fluid–structure interaction (FSI) and thus more practical and widespread. Bringing even higher fidelity and higher efficiency to IGA FSI simulations will require mid-processing tools. The mid-processing tools should include those listed below. i) More effective unstructured IGA discretization and mesh refinement tools, such as T-splines, subdivision, and locally refined B-splines. Correct prediction of hypersonic boundary layer transition locations, turbulent heat fluxes and vortical structures of high-speed wakes are of paramount importance in enabling the prediction of a next generation hypersonic vehicle’s performance.

In conclusion, enhancing the fidelity and efficiency of IGA FSI simulations represents a critical competency that provides the United States Army with advanced aerodynamic analysis and design capabilities.

PHASE I: The Phase 1 effort shall carefully assess the i) More effective unstructured IGA discretization and mesh refinement tools, such as T-splines, subdivision, and locally refined B-splines.
ii) Advanced IGA mesh moving tools, such as the method based on fiber-reinforced hyper elasticity, that significantly increase the scope and accuracy of the IGA FSI computations with body-fitted methods.
iii) Tools that will make it simpler in fluid mechanics and FSI simulations carried out with the Variational Multiscale (VMS) method to use more sophisticated and better-performing stabilization parameters, such as those targeting IGA discretization. These parameters play a key role in the stability and accuracy of VMS computations.
iv) Visualization tools that will give the users a better understanding of the performance of the IGA computational methods they are using and help them steer the simulations to even higher fidelity.

One of the Phase 1 outcomes will be outline of Phase 2 schedule for implementation of Advanced IGA mesh moving tools. Another outcome will be a report summarizing the assessments, a plan to move forward, an estimate of the increased fidelity possible through i-iv, or a recommendation for a prioritization of which tools would be most likely to significantly enhance design tools.

PHASE II: In Phase II the mid-processing tools itemized below will be developed.

i) Advanced IGA mesh moving tools, such as the method based on fiber-reinforced hyper elasticity, that significantly increase the scope and accuracy of the IGA FSI computations with body-fitted methods.
ii) Tools that will make it simpler in FSI simulations carried out with the Variational Multiscale (VMS) method to use more sophisticated and better-performing stabilization parameters, such as those targeting IGA discretization. These parameters play a key role in the stability and accuracy of the VMS computations.
iii) Visualization tools that will give the users a better understanding of the performance of the IGA computational methods they are using and help them steer the simulations to even higher fidelity.

PHASE III DUAL USE APPLICATIONS: Collaborate with model, software developers, and users on integration of products into a Long-Range Precision Fires application. Optimize toolset to accommodate new advances in the technology delivering high-speed weapons in anti-access/area-denial environments. Transition the technology to an appropriate government agency or prime defense contractor for integration and testing. Integrate and validate the functional aerothermodynamic tools into a real-world development or acquisition program.

REFERENCES:

1. T.J.R. Hughes, J.A. Cottrell, and Y. Bazilevs,“Isogeometric analysis: CAD, finite elements, NURBS, exact geometry, and mesh refinement”, Computer Methods in Applied Mechanics and Engineering, 194 (2005) 4135-4195.;
2. Y. Otoguro, K. Takizawa, and T.E. Tezduyar, “Space–time VMS computational flow analysis with isogeometric discretization and a general-purpose NURBS mesh generation method”, Computers & Fluids, 158 (2017) 189-200.;
3. T.E. Tezduyar, K. Takizawa, and Y. Bazilevs, “Isogeometric analysis in computation of complex-geometry flow problems with moving boundaries and interfaces”, Mathematical Models and Methods in Applied Sciences, to appear (2023).;
4. E. Wobbes, Y. Bazilevs, T. Kuraishi, Y. Otoguro, K. Takizawa, and T.E. Tezduyar, “Advanced IGA mesh generation and application to structural vibrations”, to appear as a chapter in Frontiers in Computational Fluid-Structure Interaction and Flow Simulation: Research from Lead Investigators under Forty – 2023, Modeling and Simulation in Science, Engineering and Technology, Springer (2023).;
5. T. Kuraishi, Z. Xu, K. Takizawa, T.E. Tezduyar, and S. Yamasaki, “High-resolution multi-domain space-time isogeometric analysis of car and tire aerodynamics with road contact and tire deformation and rotation”, Computational Mechanics, 70 (2022) 1257-1279.;
6. Y. Bazilevs, V.M. Calo, J.A. Cottrell, J. Evans, T.J.R. Hughes, S. Lipton, M.A. Scott, and T.W. Sederberg, “Isogeometric analysis using T-splines,” Computer Methods in Applied Mechanics and Engineering, 199 (2010) 229-263.;
7. F. Cirak, M.J. Scott, E.K. Antonsson, M. Ortiz, and P. Schröder, “Integrated modeling, finite-element analysis, and engineering design for thin-shell structures using subdivision”, Computer Aided Design, 34 (2002) 137-148.;
8. K.A. Johannessen, T. Kvamsdal, and T. Dokken, “Isogeometric analysis using LR B-splines”, Computer Methods in Applied Mechanics and Engineering, 269 (2014) 471-514.;

9. K. Takizawa, T.E. Tezduyar, and R. Avsar, “A low-distortion mesh moving method based on fiber-reinforced hyperelasticity and optimized zero-stress state”, Computational Mechanics, 65 (2020) 1567-1591.;
10. Y. Otoguro, K. Takizawa, and T.E. Tezduyar, “Element length calculation in B-spline meshes for complex geometries”, Computational Mechanics, 65 (2020) 1085-1103.

KEYWORDS: Fluid-Structure interactions, hyperelasticity, modeling, design, tools, air vehicles

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A24B-T009 TITLE: High Throughput, High Temperature Mechanical Test Platform

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

OBJECTIVE: Design, develop, and demonstrate a high-throughput mechanical test platform capable of replicating extreme thermal-mechanical-chemical environments.

DESCRIPTION: The DoD requires robust, high temperature materials for a variety of extreme thermomechanical applications, including hypersonics, advanced propulsion, and next generation materials processing. These structures may experience transient thermomechanical loads while also in the presence of harsh chemical environments that may accelerate material degradation. However, most current mechanical test practices are unable to replicate relevant environments to inform material behaviors under extreme conditions. For example, currently there are two ASTM standards available for determining the flexure strength (ASTM C1211) and uniaxial tensile strength (ASTM C1366) of ceramics at elevated temperatures. In general, "elevated temperature" may be considered as temperatures up to 1600 °C, well below the temperatures that ceramics may experience under extreme conditions, e.g. in hypersonic and advanced propulsion applications. Neither of these tests are designed for high throughput and the test fixtures may not have the thermomechanical properties to survive more extreme conditions.

Thus, new methodologies for quickly testing structural materials under relevant environments are required to accelerate materials development for extreme operating conditions. A variety of sub-scale, high-throughput experimental techniques have emerged as potential routes for quickly screening candidate materials, although more research is needed to assess whether these approaches are representative of full-scale testing.

If successful, this effort would enable a novel characterization tool that would be capable of simulating the extreme operating environment to rapidly assess next generation materials expected to experience harsh thermal, mechanical, and chemical loads.

PHASE I: Identify a methodology and initiate fixture fabrication along with associated hardware/software to perform high-throughput, high temperature mechanical testing of materials. The specific methodology is not prescribed but must be capable of performing mechanical testing in relevant thermal environments. Specific capabilities that are desired include: the ability to rapidly vary and control the temperature of the sample while simultaneously performing mechanical characterization. The approach should incorporate automation where possible to enable rapid assessment (e.g., in sample preparation, sample loading, testing, and/or data analysis). To maximize testing and data throughput, the concept must demonstrate at least a 10-fold improvement in the rate of experimentation over current manual high temperature mechanical testing techniques. The method should be tailored for research and development of next-generation structural materials for extreme environments, e.g. ultrahigh temperature ceramics, carbon-carbon composites, and/or refractory metals. The concept must also outline an approach for assessing the accuracy of the method with respect to current testing standards (e.g. ASTM C1211 and C1366). Develop a Phase II plan.

PHASE II: Design and develop a high-throughput, high temperature mechanical test platform with the ability to rapidly vary and control environmental conditions as prescribed by the user. Validate the thermomechanical characterization method with conventional testing approaches. In addition, performer should outline a plan for integrating atmospheric control and/or surface characterization methods to determine sample degradation due to the thermal-mechanical-chemical environment, e.g. through modular fixtures that enable imaging and/or emission spectroscopy techniques. It is recommended that the performer work with bulk material vendors/Original Equipment Manufacturers (OEMs) and/or high temperature material testing agencies to facilitate transition for Phase III. Successful completion of

Phase II shall include a demonstration to DEVCOM Army Research Laboratory scientists and engineers engaged in high temperature testing of materials for extreme thermomechanical environments.

PHASE III DUAL USE APPLICATIONS: The completion of this effort would provide an automated tool that receives, prepares, assesses, and analyzes the high temperature performance of materials in extreme thermal-mechanical-chemical environments in a way that accurately reflects the full-scale behaviors of the structures. Phase III will transition high throughput, high temperature materials testing techniques to commercial suppliers through bulk material vendors, OEMs, or other partnering agreement(s). Commercialization of this technology may be through the development of kits or modules for retrofitting existing high temperature testing apparatus, or through the development of full turn-key systems. Spatially and temporally measuring surface chemistry in these environments is of high interest given the importance for understanding materials degradation as well as multi-physics behaviors, e.g. gas-materials interactions during high speed flows. Surface characterization methods may include imaging approaches, emission spectroscopy techniques, etc. If successful, this technology would provide DoD scientists and engineers a platform for rapidly assessing next generation high temperature structural materials.

REFERENCES:

1. ASTM C1211 “Standard Test Method for Flexural Strength of Advanced Ceramics at Elevated Temperatures,” ASTM International;
2. ASTM C1366 “Standard Test Method for Tensile Strength of Monolithic Advanced Ceramics at Elevated Temperatures,” ASTM International

KEYWORDS: High temperature mechanical test, high temperature material, subscale testing, data-driven design, hypersonics, automation, machine learning, autonomous experimentation, high-throughput experimentation

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A24B-T010 TITLE: Leveraging Advanced Computation to better employ Additive Manufacturing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software, Advanced Materials, Human-Machine Interfaces

OBJECTIVE: This topic seeks to advance the science of Additive Manufacturing by developing advanced in-process monitoring and parameter optimization to the 3D printing capability of local users throughout the Army.

DESCRIPTION: The Army could greatly enhance its utilization of Additive Manufacturing (AM) by better leveraging advanced computational tools and instrumentation. A more robust implementation of AM could make invaluable contributions to fielded capabilities and Soldier Lethality, as well as future systems such as Next Generation Combat Vehicle (NGCV), Future Vertical Lift (FVL), and Long Range Precision Fires (LRPF). One of the greatest handicaps faced by AM thus far has not been the printer hardware itself, but rather the ability to trust that prints have been optimally executed [5]. Subsequently, the quality of printed parts and their respective material properties is typically interrogated by destructive testing and/or the contemporaneous printing of test coupons. This post-hoc analysis is an inefficient and impractical exercise for many printer operators, especially those in remote locations. Monitoring prints in real-time, however, could alleviate the need for this after-the-fact verification and constitute a significant advancement in the Science of Additive Manufacturing. Using sensors and printer outputs to collect data, and then statistically correlating that data with resultant material properties, can yield instantaneous confirmation that the print is of baseline quality. Such a method could be significantly enhanced with advanced computational methods such as artificial intelligence and machine learning. Furthermore, the correlations between input and output can be employed not only to verify the printer output, but also to enhance the printer inputs [4]. A feedback loop using these same computational tools can be leveraged to optimize the parameters and settings of the printer to factor in material selection, part requirements, and environmental conditions. This approach could even identify and control non-intuitive contributing factors to print quality. Thus, it would be desirable for the Army to develop and field a printer kit featuring both the real-time monitoring and verification of the printing process, in addition to the fine-tuning of setup parameters. The desire for these AM-augmenting functions is not here newly articulated, having rather been under investigation for some time by various institutions. However, such investigations have typically been in a sanitary, high-resource environment using particular printer platforms [1], [2], [3]. The novelty of the proposed kit, then, is in the implementation of these features in a way that is accessible to non-experts and modular for interface with a variety of printer systems.

The proliferation of both AM hardware and widely-accessible advanced computational tools make the time ripe to develop this next advancement in the Science of Additive Manufacturing. Thus, this topic seeks to develop a modular kit, consisting of sensor, software, and computational tools, to augment the AM process. This product would afford users the ability to verify the quality of each printed part, but also ensure that the material properties of the part are optimized. A higher-quality and higher-confidence AM capability would immensely assist forward assets and Soldier Lethality, as well as affording FVL, NGCV, and LRPF far greater design space. A successful execution and implementation of this topic would thus assist both the direct users and operators of AM as well as the Army in general.

PHASE I: Identify the COTS hardware, software, and computational products relevant to this application, and begin combining them into a benchtop prototype. Initially orient the prototype toward optimizing a polymer FDM system. All prototypes must cohere with Army IT security protocols. This prototype should be demonstrated to generate recommended parameters for print an Army-relevant polymer, as well as pass/fail determination in real-time. The prototype will be evaluated by comparing test parts/coupons printed using optimized parameters against those printed by stock/automatic machine parameters.

Additionally, a methodology for modularizing the prototype (necessary for commercial viability) should be outlined.

PHASE II: Transition the benchtop prototype from Phase 1 into a modular kit capable of interfacing with different 3D printers and different materials. Develop a robust user-interface that makes the data accessible to AM technicians and machine operators. Begin testing the kit on different FDM systems and high temperature materials. Demonstrate the prototype's expanded modular capability by successfully using it on three different machines and 3 different materials. Outline a way in which this prototype could be modified/replicated to function with Laser Powder Bed Fusion process.

PHASE III DUAL USE APPLICATIONS: This technology has tremendous use-case applications within not only the Army, or DoD as a whole. It could revolutionize many aspects of AM in general. Potential transition points and commercial markets include fabrication/manufacturing entities, biomedical institutions, research institutions, and auto manufacturers. Such an "AM enhancement kit" could be sold as a standalone product, or marketed to 3D Printer manufacturers as an upgrade for their operating protocols.

REFERENCES:

1. https://www.ornl.gov/news/inspection-method-increases-confidence-laser-powder-bed-fusion-3d-printing;
2. https://www.ornl.gov/news/ai-software-enables-real-time-3d-printing-quality-assessment;
3. https://www.sciencedirect.com/science/article/abs/pii/S221486042300430X?dgcid=author;
4. https://commons.erau.edu/cgi/viewcontent.cgi?article=1655&context=edt;
5. https://www.sciencedirect.com/science/article/abs/pii/S2214860420311210

KEYWORDS: Additive Manufacturing, optimization, 3D printing, in-situ monitoring, material properties

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A24B-T011 TITLE: Efficient Red Micro-LEDs with Pixel Size < 5 Microns for Next-Generation Displays and Visible Light Communication Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): FutureG, Integrated Sensing and Cyber, Microelectronics, Integrated Network Systems-of-Systems, Advanced Materials, Human-Machine Interfaces

OBJECTIVE: Develop and demonstrate new micro-LED architectures which will lead to red micro-LEDs with high external quantum efficiency (>2%) when the pixel size is less than 5 microns.

DESCRIPTION: Due to their fast response, lightweight, low power consumption, and high efficiency, micro-LEDs have received considerable attention in the development of next-generation displays and visible light communication systems for strategic and tactical battlefield applications for dismounted soldiers, as well as command and control systems. Virtual Reality (VR) and Augmented Reality (AR) systems must have a high number of PPI (at least 4,000) since they emphasize the importance of small areas and high resolutions for battlefield visualization. In order to achieve the required miniaturization and high-resolution design, each micro-LED must be less than 5 microns in size.

In spite of the reduction in LED chip size to below 10 microns, GaN-based blue and green micro-LEDs retain high performance in terms of external quantum efficiency (EQE). Most red micro- LEDs, however, suffer from significant size-dependent efficiency droop as a result of serious surface recombination at the edges of the device. Existing red micro-LEDs shows EQE as low as 0.1% when their size is less than 5 microns which represents a significant challenge for next-generation high-resolution AR/VR systems.

Many approaches, such as those based on InGaN-quantum wells, quantum dots enhanced structures, etc. have been proposed in the literature to address this problem with some success. However, many of these approaches are for chips with larger dimensions than what is required in this solicitation. In spite of this, they indicate that there are potential paths towards realizing high efficient red micro-LEDs. As part of addressing this technology gap, innovations in material development and novel fabrication technologies as well as significant improvements in existing materials and processes will be necessary to minimize, if not eliminate, sidewall damage and degradation of electrical injection. Several strain engineering methodologies have also been reported in the literature, especially those relating to the fabrication of multiple quantum well structures. In order to achieve EQE greater than 2% for red micro-LEDs with a size between 2 and 5 microns, the Army is seeking solutions. A new LED architecture should be compatible with RGB full color integration and be capable of accommodating large arrays. It should be noted that we are not looking for traditional technical approaches such as sidewall passivation using ALD or micro-LED pyramids.

PHASE I: Develop a proof-of-concept solution for red micro-LEDs with pixel sizes of 2-5 microns and EQEs exceeding 2%. A detailed micro-LED architecture design and theoretical/numerical estimations of the EQE based on the pixel size must be included in the solution. Ensure that all aspects of device fabrication are considered, including a preliminary assessment of long-term environmental stability and justify the approach's feasibility and practicality. Phase I is designed to assess the technical merit, feasibility, and commercial potential of a proposed effort, and to evaluate the performance prior to providing further support in Phase II. The deliverables should include a comprehensive final report, a presentation of the concept design, models, modeling data and results, model validation data, an optional demonstration of the proof of technology, and plans for the continuation of Phase II work.

PHASE II: Using the results of Phase I, develop and demonstrate a prototype red micro-LED device that meets all the requirements stated above. The prototypes should be fabricated by using standard cleanroom processes and be capable of integrating with the existing standard LED drivers for displays. In addition,

they should demonstrate the modularity of the system and prove the feasibility of large arrays during operational demonstrations. Conduct accelerated aging tests to determine the lifetime reliability and performance characteristics of the devices in both storage and operation. Deliverables must also include a detailed final report comprising a comprehensive assemblage of design documents, fabrication methods, experimental protocols, and prototype testing data and results. In addition, a full-scale prototype system with associated documentation must also be delivered to the government point of contact for independent testing and evaluation at a government laboratory.

PHASE III DUAL USE APPLICATIONS: Based on the prototypes developed in Phase II, continuing development must lead to productization of miniaturized red micro-LEDs for optical systems. Conduct testing on variety of military platforms and develop a process for a large-scale production to support potential transition partners including Army, and other DoD agencies. Despite the fact that this technology is aimed at military and strategic applications, many other optical circuit applications, including in telecom industry hardware, can also be benefited by miniaturized red micro-LEDs. The sources that can operate over a very wide range of environmental conditions are likely to bring value to many existing commercial applications. Also, technology meeting the needs of this topic could be leveraged to bring AR/VR systems toward a price point that could make them more attractive to the commercial markets.

REFERENCES:

1. "Laser Lift-off Mechanism and Optical-electric Characteristics of Red Micro-LED Devices," Opt. Express, 31, pp. 7887-7899 (2023).;
2. "An Ultrahigh Efficiency Excitonic Micro-LED," Nano Lett. 23, PP. 1680–1687 (2023).;
3. "InGaN-based Red Light-emitting Diodes: From Traditional to Micro-LEDs," Jpn. J. Appl. Phys. 61 SA0809 (2022).;
4. "2000 PPI Silicon-based AlGaInP Red Micro-LED Arrays Fabricated via Wafer Bonding and Epilayer Lift-off," Optics Express, 29, pp. 20217-20228 (2021).;
5. "Fabrication and Study on Red Light Micro-LED Displays," IEEE J. Electron Devices Soc., 6, pp. 1064-1069 (2018).;
6. "Enhanced Efficiency InGaN/GaN Multiple Quantum Well Structures via Strain Engineering and Ultrathin Subwells Formed by V-Pit Sidewalls," ACS Appl. Opt. Mater. 2, pp. 220-229 (2024).;
7. "The Size-Dependent Photonic Characteristics of Colloidal-Quantum-Dot-Enhanced Micro-LEDs," Micromachines, 14, (2023).;
8. "Improvement of 0ptical Properties of InGaN-based Red Multiple Quantum Wells," Optics Express, 31, pp. 18567-18575 (2023).

KEYWORDS: Micro-LEDs, Full-color display, Display devices, RGB displays, Light emitting diodes, Optoelectronic devices, Virtual reality, Augmented reality, External quantum efficiency

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A24B-T012 TITLE: Engineered Bolometer Leg Materials Towards Physics-Limited Thermal Infrared Imaging Arrays

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): 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: Demonstrate an engineered material system able to be deposited and patterned with semiconductor foundry techniques with very low thermal conductivity and reasonable electrical conductivity for use as a bolometer leg.

DESCRIPTION: Bolometer technology is used in nearly all uncooled longwave imaging sensors worldwide; these sensors are widely used for both commercial and military applications on ground, personnel-carried, and air platforms. This technology supports targeting, autonomy, situational awareness, security, and many other application spaces with its inclusion into numerous Army Programs of Record (PoR) and are increasingly used as inputs to AI/ML-powered algorithms. This is because bolometer-based sensors are uniquely positioned to provide low-cost imaging in the longwave infrared (thermal) band.

Domestic U.S. industry has historically held strong advantages in both performance and number of sensor units manufactured. However, high levels of investment by foreign companies and countries has eroded this advantage. This topic seeks to extend the advantage of U.S. industry.
A bolometer-based imaging sensor is comprised of a focal plane where each pixel is a bolometer structure, a read-out integrated circuit, supporting electronics, optics, and a mechanical housing. The basic bolometer structure itself, a microelectromechanical structure (MEMS), is comprised of a transducing body and two legs. The legs serve to mechanically support the body and thermally isolate it while passing an electric current to read out the transducing body's signal.
The leg, and the materials that comprise it, are key to a highly sensitive and manufacturable (high yielding) pixel. Higher thermal isolation results in a more sensitive pixel. However, the typical way to increase thermal isolation is to make the leg longer and thinner, often wrapping around the pixel many times. This, in turn, decreases the pixel manufacturability and sensor robustness in operational use. This is especially important as bolometer pixels get smaller in support of higher resolution devices.

Therefore, this topic seeks a new material or engineered material system which is inherently more thermally isolating while maintaining electrical conductivity and mechanical robustness. This would enable a shorter, wider leg and push bolometers closer to their physical performance limit and away from the practical structural limits imposed today. This necessarily requires a material system which breaks the usual Wiedemann–Franz relationship between electrical and thermal conductivity.

To be applicable to high-rate bolometer fabrication, the material must be capable of being deposited and lithographically patterned by standard CMOS foundry equipment used in bolometer fabrication and be compatible with other portions of the fabrication and packaging processes. A low-noise ohmic contact must be formed with the substrate and bolometer body material (commonly vanadium oxide, but

sometimes α-silicon, titanium oxide, or other materials). Overall total leg thermal mass must be low to avoid degrading sensor performance.
Note that proposals will not be considered for material systems for other bolometer components (e.g., the body/transducing material), alternate sensing technologies, other components of the camera module, or anything else that is not a bolometer leg capable of mechanical support, thermal isolation, and electrical conductivity.

PHASE I: Describe one or more material systems and propose a method of fabricating the material compatible with the constraints of a semiconductor fabrication facility. Through a combination of modeling, theory, and/or experimental evidence, demonstrate that the system meets all requirements to act as a bolometer leg and is superior to materials used in current production devices. The material system will be evaluated based on it having low thermal conductivity (< 250 pW/K, ideally approaching 0), low overall thermal mass (<0.3 pJ/K), moderate electrical conductivity (ideally resistance < 250 kΩ, but up to 2 MΩ for certain readouts), ability to form low-noise ohmic contacts, low deposition thermal budget (<200°C), and overall thermal and mechanical robustness (withstand 300°C, mechanical shock and vibration). This shall be delivered in a final technical volume.

PHASE II: Further develop, fabricate, and characterize the material system. Show that the material system is capable of meeting the requirements of bolometer legs. No particular physical form is required for this demonstration, but it is desired that the final material system demonstration be as high fidelity as possible in replicating its end use as a bolometer leg (though a complete bolometer is not necessary). Formulate a fabrication process flow fully compatible with bolometer fabrication flows used by U.S. industry to promote transition of the material system. Collaboration with industry is desired to show buy-in of the material system and compatibility with production flows. Demonstrate or otherwise show that this fabrication method is low-cost, high yield, and high uniformity.

PHASE III DUAL USE APPLICATIONS: Work with a U.S.-based bolometer fabricator to transition the material system to a high-rate production environment. Support the bolometer fabricator in developing an imaging demonstration prototype LWIR bolometer sensor system, perhaps based on an existing camera/sensor product, to prove the viability and benefits of the material system for increasing performance and/or manufacturing yield. Such a material system is useful to all domestic bolometer manufacturers and could be used to improve any existing or future bolometer product (domestic or commercial use) as a 100% drop-in replacement. The enhanced sensors could then be qualified for use in any COTS or Program of Record acquisition program for operational use. Since sensors utilizing this material system would be a 100% drop-in replacement, it could be used in existing or future programs utilizing uncooled thermal technology.

REFERENCES:

1. Hopkins, P.E. (2013). Thermal Transport across Solid Interfaces with Nanoscale Imperfections: Effects of Roughness, Disorder, Dislocations, and Bonding on Thermal Boundary Conductance. ISRN Mech Eng. 2013. http://dx.doi.org/10.1155/2013/682586;
2. Xiong, S., Sääskilahti, K., Kosevich, Y. A., Han, H., Donadio, D., & Volz, S. (2016). Blocking Phonon Transport by Structural Resonances in Alloy-Based Nanophononic Metamaterials Leads to Ultralow Thermal Conductivity. Phys Rev Lett, 117(2), 025503-9. http://dx.doi.org/10.1103/PhysRevLett.117.025503;
3. Maldovan, M. (2013). Sound and heat revolutions in phononics. Nature, 503(7475), 209-217. https://doi.org/10.1038/nature12608;
4. Davis, B. L. & Hussein, M. I. (2014). Nanophononic Metamaterial: Thermal Conductivity Reduction by Local Resonance. Phys Rev Lett, 112(5), 055505-10. https://doi.org/10.1103/PhysRevLett.112.055505;

5. Wilson, A. A., Sharar, D. J., Smith, G. L. & Knick, C. R. (2021) Phonon disruptors for increased thermal resistance without sacrificing electrical signal quality in thermal sensors (U.S. Patent No. US20220381623A1). U.S. Patent and Trademark Office. https://patents.google.com/patent/US20220381623A1/en;
6. Wilson, A. A., Waldron, D. L., Knick, C. R. & Sharar, D. J. (2022) Phonon disruptors for increased thermal resistance without sacrificing electrical signal quality in thermal sensors using alloy and intermetallic materials (U.S. Patent No. US20220373395A1). U.S. Patent and Trademark Office. https://patents.google.com/patent/US20220373395A1/en

KEYWORDS: Bolometer, microbolometer, longwave, LWIR, sensor, thermal, conductivity, MEMS

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A24B-T013 TITLE: Underlay Communications with Wide SINR Range

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): 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: Utilize Canonical Correlation Analysis (CCA) to achieve high levels of interference suppression for tactical communications which supports underlay wireless communications for military networks.

DESCRIPTION: The Army communications networks need to operate in a congested and contested electromagnetic spectrum (EMS) environment. The tactical radio receiver in such environments may face significant co-channel interference (significantly higher than the desired received signal level). The interference may result from other EMS users, such as radio stations or radars, or other interferers such as Electronic Warfare (EW) systems. One traditional approach to sustain resilient communications in such environments is spread-spectrum communications or high-coded communications that takes advantage of the capacity vs. Low Probability of Detection (LPD) and Anti Jam (AJ) performance trades space. This approach requires significant channel bandwidth and treats the interference as noise which cannot be excised from the receiver. However, recognizing that interference is not thermal noise, this topic is looking for solutions (e.g., CCA, Singular Value Decomposition, etc) that would enable operation of communications links in the presence of considerable co-channel interference.

In cognitive radio literature, the ability to operate a link in the presence of a primary user at sufficiently low power to avoid interference with the primary user is called underlay communications. In the military context, underlay communications have many benefits, including improved spectrum efficiency, improved covertness and improved resistance to interference. The key innovation needed is the ability to operate an underlay network at capacity that is significantly higher than would be expected if the interference was treated as noise. The technology solution should be a physical layer design that supports tactically relevant bandwidths and should be a single-antenna transmitter with single or multiple antenna receiver. The maximum number of receive antennas is four. Also, it is important that the performance of the link not suffer any sharp degradation if the primary signal varies in power or behaves intermittently. The underlay system cannot assume any prior knowledge of the primary signal.

PHASE I: The feasibility study should outline the theory of operation, describe relevant signal processing algorithms, any limiting factors and simulation results. The study should also address how the proposed physical layer may be integrated with higher-layer protocols (e.g., layer 3, etc.).
The algorithm allows the underlay communications signal the ability to maintain an SER/BER performance with interference degradation no more than a factor of six compared to no interference at the same SNR.

PHASE II: Phase II should deliver a functioning underlay link physical layer prototype implemented on a widely used software defined radio (SDR) platform. The prototype should be physically provided to perform independent lab-based assessment of link performance using a set of primary signals selected.

During Phase II, it is not required for the demodulation and decoding to occur in real time. For proof of concept, post-processing of the received digital signal samples is a viable approach.

An important element in Phase II is the interaction between testing and iterative software refinement by the performer. Therefore, the first iteration of the prototype should be available at least three months before the conclusion of Phase II

The algorithm allows the underlay communications signal the ability to maintain an SER/BER performance with interference degradation no more than a factor of five compared to no interference at the same SNR.

PHASE III DUAL USE APPLICATIONS: Phase III should deliver a real-time implementation of the algorithm using hardware acceleration if necessary. The algorithm allows the underlay communications signal the ability to maintain an SER/BER performance with interference degradation no more than a factor of five compared to no interference at the same SNR.

REFERENCES:

1. M. S. Ibrahim and N. D. Sidiropoulos, "Blind Carbon Copy on Dirty Paper: Seamless Spectrum Underlay via Canonical Correlation Analysis," 2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2021, pp. 8123-8127, doi: 10.1109/ICASSP39728.2021.9414621.;
2. M. S. Ibrahim, P. Karakasis, and N. D. Sidiropoulos, “A Simple and Practical Underlay Scheme for Short-range Secondary Communication”, in IEEE Transactions on Wireless Communications, vol. 21, no. 11, pp. 9990-10004, Nov. 2022, doi: 10.1109/TWC.2022.3181618.;
3. M. S. Ibrahim, and N. D. Sidiropoulos, “Cell-Edge Interferometry: Reliable Detection of Unknown Cell-Edge Users via Canonical Correlation Analysis,” at the 20th IEEE SPAWC, Cannes, France, July 2020;
4. M. S. Ibrahim, and N. D. Sidiropoulos, “Reliable Detection of Unknown Cell-Edge Users via Canonical Correlation Analysis", IEEE Transactions on Wireless Comm., vol. 19, Mar. 2020.;
5. M. Sørensen, C. I. Kanatsoulis and N. D. Sidiropoulos, "Generalized Canonical Correlation Analysis: A Subspace Intersection Approach," in IEEE Transactions on Signal Processing, vol. 69, pp. 2452-2467, 2021, doi: 10.1109/TSP.2021.3061218.;
6. M. S. Ibrahim, and N. D. Sidiropoulos, “Underlay Scheme for Short-range Secondary Communication”, US Patent pending.;
7. M. S. Ibrahim, A. Hussain and N. D. Sidiropoulos, "A Novel Linear Precoder Design for Reliable UL/DL Detection in TDD Cellular Networks," in IEEE Transactions on Communications, vol. 70, no. 12, pp. 8167-8180, Dec. 2022, doi: 10.1109/TCOMM.2022.3217129.;
8. M. S. Ibrahim, P. A. Karakasis and N. D. Sidiropoulos, "A link between Multiuser MMSE and Canonical Correlation Analysis," in IEEE Wireless Communications Letters, doi: 10.1109/LWC.2023.3319292.

KEYWORDS: Underlay networks, spectrum efficiency, congested spectrum, contested spectrum, Symbol Error Rate (SER), Bit Error Rate (BER), Signal to Noise (SNR).

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A24B-T014 TITLE: Phase Change Materials for Enhanced Warfighter Survivability

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

OBJECTIVE: The Army seeks innovative solutions utilizing phase change materials tailored for thermal regulation within a Closed-Circuit Self-Contained Breathing Apparatus to reduce thermal burden, enhance operational longevity, and improve warfighter efficiency.

DESCRIPTION: This STTR topic addresses the need for an advanced material solution capable of thermally regulating the microclimate of a Closed-Circuit Self-Contained Breathing Apparatus (CC-SCBA) by acting as a heat exchanger within the system. The envisioned technology would utilize phase change materials (PCMs) that are lightweight, reusable, and regenerative, with a transition temperature tailored to the unique operational demands of tactical respiratory protection devices.

Current CC-SCBA systems place a significant thermal load on the operator, leading to increased fatigue and reduced mission duration and effectiveness. Additionally, the inherent heat generation compromises the CO2 scrubbing efficiency, curtailing system endurance. The integration of an optimized PCM matrix could surmount these limitations by regulating the temperature of inspired air, thereby enhancing warfighter lethality and survivability.

The material must demonstrate efficacy in a composite or blend format, ensuring compatibility with existing CC-SCBA configurations and surpassing the performance of conventional ice-based systems. The developed technology should demonstrate structural stability and efficient thermal exchange within the constrained form factor of CC-SCBA units. Overall, success is defined by a phase change material that extends the operating lifetime of a CC-SCBA in terms of the thermal limitations set forth by the current NIOSH standard for CC-SCBAs (42 CFR 84.103). The ideal solution is a phase change material that can maintain an inspired air temperature below 35 °C under operational flow conditions for a duration of 4 or more hours.

The development process will include the optimization of encapsulation methods to prevent leakage and enhance material integration within the CC-SCBA framework. Additionally, these materials should exhibit long-term chemical stability and resistance to thermal degradation over repeated use cycles, ensuring reliability and safety in field operations. It should also be noted that the PCM will be required to operate in nearly 100% humidity in most normal conditions.

PHASE I: The initial phase will focus on the synthesis and laboratory-scale characterization of PCM candidates. These materials must demonstrate a suitable phase transition at operational temperatures and possess the thermal mass necessary to sustainably absorb the heat generated during CC-SCBA operation. This phase will culminate in the delivery of a material sample along with a comprehensive analysis of its thermal performance under simulated operational airflow conditions.

PHASE II: Building upon the findings of Phase I, this phase will involve the integration of the PCM into a prototype CC-SCBA system. The material's performance will be validated in a controlled environment that replicates field conditions. Key performance indicators will include the PCM's ability to maintain a target inspired air temperature below 35°C, the duration of effective thermal regulation, and the material's regenerative capabilities after thermal cycling.

PHASE III DUAL USE APPLICATIONS: Collaboration with industry leaders in the CC-SCBA market will be essential to transition the PCM from a laboratory setting to a field-ready solution. This phase involves the design and production of a modular PCM component that can be seamlessly incorporated into existing CC-SCBA systems. The module must meet military specifications for durability, operational

effectiveness, and ease of integration. Successful demonstration in this phase will lead to the exploration of dual-use applications, where similar thermal management challenges exist, such as in industrial respirators or high-performance athletic wear.

REFERENCES:

1. Salunkhe, P. B.; Shembekar, P. S, A review on effect of phase change material encapsulation on the thermal performance of a system. Renewable and Sustainable Energy Reviews. 2012, 16(8), p 5603-5616. https://doi.org/10.1016/j.rser.2012.05.037.;
2. Wang, X.; Li, W.; Luo.; Wang, K.; Shah, S, A critical review on phase change materials (PCM) for sustainable and energy efficient building: Design, characteristic, performance and application. Energy and Buildings. 2022, 260, p 111923. https://doi.org/10.1016/j.enbuild.2022.111923;
3. Mehling, H.; Brutting, M.; Haussmann, T, PCM products and their fields of application - An overview of the state in 2020/2021. Journal of Energy Storage. 2022, 51, p 104354. https://doi.org/10.1016/j.est.2022.104354;
4. Man tests; performance requirements, 42 CFR §84.103 (2004) https://www.ecfr.gov/current/title-42/chapter-I/subchapter-G/part-84/subpart-H/section-84.103

KEYWORDS: protection, SCBA, closed circuit, phase change materials, thermal regulation, respirator

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A24B-T015 TITLE: Distributed Multithreat Microsensor

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber, Microelectronics, Integrated Network Systems-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: Demonstrate a mission-configurable miniature, deployable sensing capability.

DESCRIPTION: Maneuver elements require early warning and situational understanding of the battlespace to include adversary actions and the threat of area denial tactics through the employment of hazardous persistent chemical agents. Soldiers are at risk of encountering dangerous circumstances as a consequence of having limited remote sensing capabilities for these situations. The joint forces require a small, lightweight technology that integrates with their equipment in a small form factor while affording prompt detection and reporting of the presence of multiple possible hazards or adversary troops and equipment in order to effect risk-based maneuver decisions and avoid hazards.

Emerging technology in miniature sensor science has increasingly demonstrated functionality and performance in the detection of hazardous chemicals and adversary movements and actions. Functionalized materials including metal oxide frameworks, carbon nanotubes, graphene, and conductive polymers have been reported with increasing sensitivity, selectivity, and reliability as environmental sensing modalities. Colorimetric technologies supply an inexpensive option for prompt and effective threat agent detection, and lend themselves to automation through the incorporation of color imagery or diode transduction.

PHASE I: Define a conceptual array of multimission sensing technologies for motion detection, equipment and personnel movements, and materials that deliver a unique response pattern for the presumptive detection of chemical warfare agents (CWAs) including G-, V-, H-, L-, A- series threat agents and pharmaceutical hazards like fentanyl and other drug-derived hazardous agents. Concepts for the sensing of such hazards and hazardous environments may include but is not limited to: magnetic, acoustic, passive infrared, and electromagnetic or electro-optical sensors, arrays of functionalized nanomaterials including metal and metal oxide particles and frameworks, single- and multi-walled carbon nanotubes, graphene, and colorimetric chemistries. The system concept should be modular to accommodate the means by which operators can configure the sensor array to meet a given mission priority (i.e., chem threat sensing or troop movements and actions as appropriate). Concepts should exhibit promising performance potential as evidenced by comparable reported performance testing or literature reporting on the recommended sensors and transduction mechanisms and the multivariate analysis approach that would yield reliable detection results.

PHASE II: Design, build, and test prototype sensor array that incorporates the proposed miniature sensors and functionalized materials onto an integrated compact device to demonstrate the proof of concept for the warning response in the presence of the aforementioned battlespace threat situations. Demonstrate proof of concept for the sensitivity of the array (identification/classification not required) to surface-deposited persistent chemicals and objectively demonstrate warning response. Further optimize the array

performance and demonstrate its performance against each targeted hazardous situation. Devices should be amenable to form factors in the <200g range for the complete system including any battery mass, and operate for 8 hours or longer on a single charge. The starting Technology Readiness Level (TRL) on completion of the SBIR Phase II two-year Period of Performance should be TRL5 or greater, mandating the testing of the prototype under operational conditions and transduction mechanisms validated against live agents.

PHASE III DUAL USE APPLICATIONS: Integrate the prototype sensor array along with its electronic and physical packaging and software, and establish a manufacturing process for production of small production runs of scores of miniature deployable sensors. Establish a quality assurance procedure to validate the reliability, consistency, and reproducibility of the manufactured items. Phase III performance will likely involve the development of non-recurring engineering (NRE) for the production of consistent and reliable multifunctional sensor products. Support a test agency's operational test event and any user feedback events as opportunities present. Demonstrate the "as manufactured" the sensitivity of the array (identification/classification not required) to battlefield threat situations including adversary movements of personnel or equipment, chemical hazards including G-, V-, H-, L-, A- series threat agents and pharmaceutical chemicals, objectively demonstrate warning response. The starting Technology Readiness Level (TRL) on completion of the SBIR Phase III execution Period of Performance should be TRL6 or greater. Develop additional commercial products based on the final integrated system and pursue appropriate demonstration and testing opportunities.

REFERENCES:

1. Potyrailo, R.A., Go, S., Sexton, D. et al. Extraordinary performance of semiconducting metal oxide gas sensors using dielectric excitation. Nat Electron 3, 280–289 (2020). https://doi.org/10.1038/s41928-020-0402-3;
2. Lukasz Kowalski, Joan Pons-Nin, Eric Navarrete, Eduard Llobet and Manuel Domínguez-Pumar (2018) “Using second order sigma-delta control to improve the performance of metal-oxide gas sensors” Sensors (Basel) 18(2): 654.;
3. Thanattha Chobsilp, Worawut Muangrat, Chaisak Issro, Weerawut Chaiwat, Apiluck Eiad-ua, Komkrit Suttiponparnit, Winadda Wongwiriyapan, and Tawatchai Charinpanitkul (2017) “Sensitivity Enhancement of Benzene Sensor Using Ethyl Cellulose-Coated Surface-Functionalized Carbon Nanotubes” Journal of Sensors, vol. 2018, Article ID 6956973;
4. T. M. Swager, “Sensor Technologies Empowered by Materials and Molecular Innovations”, Angewandte Chemie International Edition, 2018.;
5. Jennifer R. Soliz, Andrew D. Klevitch, Coleman R. Harris, Joseph A. Rossin, Amy Ng, Rhonda M. Stroud, Adam J. Hauser, and Gregory W. Peterson, “Structural Impact on Dielectric Properties of Zirconia”, J. Phys. Chem. C 2016, 120, 47, 26834–26840, November 2, 2016 https://doi.org/10.1021/acs.jpcc.6b08478;
6. Xiaohui Lu, Kenneth S. Suslick, Zheng Li, “Nanoparticle Optical Sensor Arrays: Gas Sensing and Biomedical Diagnosis”, Analysis & Sensing, 20 September 2022 https://doi.org/10.1002/anse.202200050;
7. Mitchell B. Lerner, Felipe Matsunaga, Gang Hee Han, Sung Ju Hong, Jin Xi, Alexander Crook, Jose Manuel Perez-Aguilar, Yung Woo Park, Jeffery G. Saven, Renyu Liu, and A. T. Charlie Johnson “Scalable Production of Highly Sensitive Nanosensors Based on Graphene Functionalized with a Designed G Protein-Coupled Receptor” Nano Lett., 2014, 14 (5), pp 2709–2714.

KEYWORDS: microelectronics, sensor arrays, mesh networked sensors, nanotechnology, transducers, electronic nose, pharmaceutical-based agents, chemical hazards

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A24B-T016 TITLE: Standoff Detection of Hidden Objects and Personnel In and Around Foliage

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software, Integrated Sensing and Cyber, Integrated Network Systems-of-Systems, Human-Machine Interfaces

OBJECTIVE: Autonomous standoff detection of hidden objects and personnel in or around foliage at 50 feet to 250 feet.

DESCRIPTION: This Topic seeks technology capabilities to autonomously detect hidden objects and personnel in and around foliage and roadsides at standoff distances from 50 to 250 feet and provide a warning. Current commercial screening technologies include millimeter wave, terahertz sensors, magnetometers, x-rays, and in some cases neutron scattering. These technologies are effective at detecting target objects but are designed for near field detection (inches to feet). There is interest in detecting and tracking target objects at standoff distances of 50 to 250 feet for "agile node" such as expeditionary airfields, survivable command and control, agile support. The purpose of autonomy is to facilitate maneuver, enhance force protection, reduce cognitive and training burden on the operators. Autonomous detection and alarm reduce cognitive burden on operators by preventing screen fatigue and highlighting suspicious objects in a scene. Autonomous software can reduce training demands by supporting and assisting the operator during system start up and operation and suggest courses of action in response to a given alarm. Autonomy enables the operator to be located at a distance greater than 300 to 450 feet (the operator does not have to stay next to the sensor to see information and alarm) enhancing Force Protection. This Topic call does not include leave behind components such as point and vibration sensors.

PHASE I: Demonstrate detection of varying sizes and shapes of metal, plastics that are approximately the size of soup cans, gallon paint cans, small manhole covers, and personnel from distances of 50 feet, 100 feet, 150 feet, 200 feet, and 250 feet from a starting point on the ground representing sensor position to the target. If the sensor is positioned 30 feet in the air or on a post, as an example only, drop a line to the ground for the “starting point”. The objects and personnel should be placed in and around different types of foliage in spring, summer, fall brush, roadside brush, trees. Collect sufficient target data to develop and demonstrate feasibility for target object detection, classification, tracking using machine learning, artificial intelligence, signal processing innovations. Develop and deliver a sensor design that can be used to build a Phase II experimental prototype sensor that can be operated in a field experiment by a Government scientist, engineer, and Soldier. False alarms should be considered. Develop an approach that can be used to characterize system performance for detection and false alarms. An example would be to, but not limited to (NLT), develop a randomized or semi-randomized experimental design and test matrix that can be conducted within the budget boundaries of Phase I that can be used to provide data sufficient for preliminary limited receiver operator characteristics (ROC) curve(s) to demonstrate feasibility of sensor design concept. The purpose is to start thinking about false alarm states and mitigation. The Phase I deliverable should include both the sensor design and experimental data that supports the design and mitigates the Phase II risk. Offerings of market surveys and later down selection will be considered non-responsive.

PHASE II: Build and demonstrate a smart prototype sensor based on the design and algorithms developed in Phase I that can be operated by Government Scientists, Engineers, and Soldiers for the purpose of participating in an Army Expeditionary Warrior Experiment (AEWE) or equivalent user experiment. Collected target data in sufficient quantity to develop and demonstrate machine learning and artificial intelligence to scan, detect, classify, locate, and track target objects and personnel such that receiver operator characteristic curves (ROC) or similar statistical analysis can be developed to characterize system performance. The Phase II smart sensor should issue a visual alarm on a screen that an operator can see. The screen may be either a monitor screen attached to the sensor or a remote screen; one

example would be, but not limited to, a cell phone. The prototype should demonstrate covert autonomous standoff detection from an agile node at 50 feet to 250 feet of a variety of metal shapes and personnel in and around foliage. Examples of an agile node might be expeditionary airfields, survivable command and control, or covert agile support. The prototype should demonstrate preliminary feasibility for operation on the move from a moving vehicle traveling 1 to 20 miles per hour. Using multiple sensors to scan surrounding area is acceptable. Innovations in machine learning and artificial intelligence may be used to scan, detect, classify, locate, and track target objects and personnel. The Phase II deliverable should be a prototype demonstration in contractor's facilities and a Warfighter experiment such as an Army Expeditionary Warrior Experiment (AEWE) or equivalent. The Phase II prototype sensor should be delivered "in place" to the Government. "In place" means that the prototype delivery will be in the Contractor's facility, but accessible for future work by the Government.

PHASE III DUAL USE APPLICATIONS: Further research and development during Phase III efforts will be directed toward refining the final deployable equipment and procedures. Design modifications based on results from tests conducted during Phase III will be incorporated into the system. Manufacturability specific to Counter Improvised Explosives Devices (C-IED) Program Concept of Operations (CONOPS) and end-user requirements will be examined.

REFERENCES:

1. David A. Andrews, Stuart William Harmer, Nicholas J. Bowring, Nacer D. Rezgui, and Matthew J. Southgate. "Active millimeter wave sensor for standoff concealed threat detection." IEEE Sensors journal 13, no. 12 (2013): 4948-4954.;
2. Zhongmin Wang, Tianying Chang, and Hong-Liang Cui. "Review of active millimeter wave imaging techniques for personnel security screening." IEEE Access 7 (2019): 148336-148350.;
3. Boris Kapilevich, and Moshe Einat. "Detecting hidden objects on human body using active millimeter wave sensor." IEEE Sensors journal 10, no. 11 (2010): 1746-1752.;
4. Federico García-Rial, Daniel Montesano, Ignacio Gómez, Carlos Callejero, Francis Bazus, and Jesús Grajal. "Combining commercially available active and passive sensors into a millimeter-wave imager for concealed weapon detection." IEEE Transactions on Microwave Theory and Techniques 67, no. 3 (2018): 1167-1183;
5. Bram van Berlo, Amany Elkelany, Tanir Ozcelebi, and Nirvana Meratnia. "Millimeter wave sensing: A review of application pipelines and building blocks." IEEE Sensors Journal 21, no. 9 (2021): 10332-10368;
6. Roger Appleby, Duncan A. Robertson, and David Wikner. "Millimeter wave imaging: a historical review." In Passive and Active Millimeter-Wave Imaging XX, vol. 10189, p. 1018902. SPIE, 2017;
7. Ting Liu, Yao Zhao, Yunchao Wei, Yufeng Zhao, and Shikui Wei. "Concealed object detection for activate millimeter wave image." IEEE Transactions on Industrial Electronics 66, no. 12 (2019): 9909-9917.;
8. Jeffrey A. Nanzer, Microwave and millimeter-wave remote sensing for security applications. Artech House, 2012; Boris Y. Kapilevich, Stuart W. Harmer, and Nicholas J. Bowring. Non-imaging microwave and millimetre-wave sensors for concealed object detection. CRC Press, 2014;
9. A. Huizing, M. Heiligers, B. Dekker, J. de Wit, L. Cifola and R. Harmanny, "Deep Learning for Classification of Mini-UAVs Using Micro-Doppler Spectrograms in Cognitive Radar," in IEEE Aerospace and Electronic Systems Magazine, vol. 34, no. 11, pp. 46-56, 1 Nov. 2019, doi: 10.1109/MAES.2019.2933972.;
10. Abhishek Gupta, Alagan Anpalagan, Ling Guan, Ahmed Shaharyar Khwaja, "Deep learning for object detection and scene perception in self-driving cars: Survey, challenges, and open issues", Array, Volume

KEYWORDS: standoff detection 20-250 feet, open unstructured environment, moving targets, millimeter wave, autonomous identification and tracking hidden threats and personnel

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A24B-T017 TITLE: Artic Small-Unmanned Aerial System Automatic Ground Control Point Processing for Terrain Modeling

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

OBJECTIVE: Develop and validate an automatic Ground Control Point (Auto-GCP) methodology for orthomosaic and provide advancements in object identification & mapping (KAZE algorithms2) for multiscale feature detection.

DESCRIPTION: Small UAS platforms have redefined squad level ISR collection processes providing an overmatch capability, aiding in soldier lethality and maneuver for both dismounted and mounted off-road mobility platforms. In addition to the challenges of operating small UAS in Artic environmental conditions, the post processing of imagery for orthomosaic and DSMs (photogrammetric surface modelling derived from Structure from Motion) is complex due to the poor availability of identifiable ground features and contrast from a highly reflective surface. Traditional photogrammetry methods rely on GCPs and distinct terrain features to align and process imagery. However, in Artic environments that are characterized by flat, snow-covered terrain, lacking these critical features, rendering traditional methods less accurate and often incalculable. Recent computer vision and remote sensing advancements in object identification and mapping (KAZE algorithms2) for multiscale feature detection in nonlinear scale space will enhance photogrammetric accuracies as well as provide a basis to derive feature matching algorithms for localization in the absence on GNSS.

The goal of this topic is to further define photogrammetric processes unique to Polar Environments from small UAS imagery collections3,4. Those processes will result in automated, near real time product generation that will aid in ground maneuverability, UAS maneuver (obstacle avoidance) and visual terrain referencing for operations in denied GNSS environments.

PHASE I: Integrate and advance the photogrammetry process of automatically defining and matching ground control points (pre bundle adjustment) for accurate terrain modelling and imagery creation. Existing Auto-GCP algorithms will be integrated into the photogrammetric process in post processing of collected imagery to assess model performance on commercial hardware. The identified ground control points will be assessed for accuracies for inclusion in Visual Terrain Referencing in future resection algorithms for localization in GNSS denied environments. A detailed site survey will be produced with known ground control point horizontal and vertical accuracies that compares identified control points and benchmarked control points.

Determine atmospheric conditions in an Artic Environment that will support the desired final products at an absolute accuracy of minimum resolution of 10 centimeters with absolute geolocation accuracy of <5.0 m CE90/LE90 and vertical accuracy of <10 meters. An initial summary of results should include existing and derived results of weather affects on sUAS operations in artic environments. An approach will be established from surrogate or derived SUAS imagery or Full Motion Video for the efficacy of advanced high resolution terrain models and photogrammetric processes that are suitable for tactical level integration in military applications.

PHASE II: Develop a near real time computational process either on-board or via a direct down link to a End User Device that generates an orthomosaic of a pre-defined area and photogrammetrically derived DSM at a minimum resolution of 5 centimeters with absolute geolocation accuracy of <2.0 m CE90/LE90 (matching Artic DEM products) and vertical accuracy of <5 meters1. These 3D models will incorporate existing structure from motion and computer vision techniques employed by commercial and Army systems to derive ultra-high resolution 3D models. In addition to these products the near real time

processing will also need to identify features in the environment that would be hazardous to UAS operations and flight mission planning.

The Auto-GCP algorithms will be fully integrated into the photogrammetric process and run in real-time during the collection phase. Existing algorithms will be incorporated into the photogrammetric processing that include recent advancements in feature detection and alignment and multiple scales (KAZE features9) available from existing automated geo-regristration techniques10.

PHASE III DUAL USE APPLICATIONS: This research will not only pave the way for accurate high-resolution mapping at the squad level in featureless terrain but will also provide methodologies for observing the rapidly changing Artic Environment. This application would also aid in climate change studies and environmental monitoring and assist in ground (mounted / dismounted) and low altitude SUAS maneuvers and flight operations where GNSS is limited or non-existent.

Commercial SUAS offerings in Arctic environments are limited due to the inability to operate above 60◦ latitude requiring a high-resolution Digital Elevation Model to launch and recover for terrain following. Commercial applications of this product will benefit from utilizing new data sets (Artic DEM Project) as well as advanced elevation models for flight planning and operations.

The primary development and integration effort for this phase will establish a near real-time localization algorithm and process for sUAS localization in the absence of GNSS post-initialization. A vision-based navigation or visual terrain referencing software system, encompassing the Phase II Auto-GCP software, will be established to use organically collected imagery and photogrammetrically derived DSM's for feature or horizon matching to determine the aircrafts position. The resulting localization will require an absolute position that is sufficient to carry out flight operations for a minimum of 50% of the entire flight time.
A real time object identification and avoidance model will be developed to aid in low altitude collections and reconnaissance missions derived from on-board optical camera systems. This effort will also aid in vision and terrain-based navigation with ground units for determining SUAS position and ground force localization during denied/degraded GNSS events.

The culmination of phase III will integrate the Android Team Awareness Kit (ATAK) 11 platform to render the resulting orthomosaics and DSM locally on device within 30 minutes of post flight operations. Final products will be delivered in a data format that already supported within the ATAK software suite and be properly aligned in a supported geographic data model (WGS 84 – Web Mercator).

REFERENCES:

1. Center, P. G. (2023, August 17). ArcticDEM mosaic version 4.1 release. ArcGIS StoryMaps. https://storymaps.arcgis.com/stories/6c058b5e770c4a1abdcc5d655e23f0ae;
2. Bhardwaj, A., Sam, L., Akanksha, & Martín-Torres, F. J. (2016). UAVs as remote sensing platform in glaciology: Present applications and future prospects. Remote Sensing of Environment, 175, 196-204.;
3. Nolan, M., Larsen, C., & Sturm, M. (2015). Mapping snow depth from manned aircraft on landscape scales at centimeter resolution using structure-from-motion photogrammetry. The Cryosphere, 9(6), 2089-2102.;
4. Tonkin, T. N., & Midgley, N. G. (2016). Ground-based photogrammetry and digital elevation model accuracy in an Arctic setting. Geomorphology, 269, 16-27.;
5. FACT.MR. Drone Surveying Market Size is Expected to Achieve a Valuation of US$ 8061.5 Million By 2033, States Fact.MR. GlobeNewswire News Room. Published May 8, 2023. Accessed November 12, 2023. https://www.globenewswire.com/news-

release/2023/05/08/2663156/0/en/Drone-Surveying-Market-Size-is-Expected-to-Achieve-a-Valuation-of-US-8061-5-Million-By-2033-States-Fact-;
6. Fact.MR – Drone Surveying Market Analysis, By Survey Type (Land Survey, Property Survey, Rail Survey, Infrastructure Survey), By End Use Industry (Energy, Construction, Transportation & Warehouse, Agriculture, Mining, Others), and Region - Global Market Insights 2023 to 2033. https://www.factmr.com/report/drone-surveying-;
7. Drones Market Insights. https://www.mordorintelligence.com/industry-reports/drones-market#:~:text=The%20Drones%20Market%20size%20is,2028.;
8. Commercial Satellite Imaging Market Size, Share, Trends - 2031. Allied Market Research. https://www.alliedmarketresearch.com/commercial-satellite-imaging-market#:~:text=The%20global%20commercial%20satellite%20imaging,industry%20on%20a%20global%20level.;
9. Alcantarilla, P.F., Bartoli, A., and Davison, A.J., "KAZE features." European conference on computer vision. Springer, Berlin, Heidelberg, 2012.;
10. Zhuo, X.; Koch, T.; Kurz, F.; Fraundorfer, F.; Reinartz, P. Automatic UAV Image Geo-Registration by Matching UAV Images to Georeferenced Image Data. Remote Sens. 2017, 9, 376. https://doi.org/10.3390/rs9040376;
11. TAK.gov. (n.d.). https://tak.gov/products

KEYWORDS: Auto-GCP, Small-Unmanned Aircraft Systems (SUAS), geolocation, Polar/Arctic environments

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A24B-T018 TITLE: Biosynthetic PFAS Alternatives to Provide Omniphobicity

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

OBJECTIVE: Develop and scale production of biosynthetic materials for environmentally friendly, omniphobic technologies for Department of Defense clothing and equipment without use of fluorine or perfluorinated compounds (PFAS).

DESCRIPTION: The Department of Defense (DoD) uses finishes with perfluorinated compounds (PFAS) to provide essential properties for Warfighter protection and survival, including water, chemical, oil, and stain repellency for clothing and equipment items. PFAS, which are associated with cancer, reproductive health issues, and developmental delays, are being banned from use and manufacture worldwide. There are over 9,000 different PFAS compounds, used since 1940 in clothing, food packing, personal care products, water/stain resistant products, and non-stick cookware (1,2). Since PFAS have worked so well in providing water, liquid, oil, and omniphobicity, they have been the default chemicals used in the textile industry to provide the durable treatments needed to meet DoD clothing and equipment requirements.

The DoD is seeking new, biosynthetic and environmentally friendly non-PFAS technologies for clothing and equipment to impart omniphobicity. No PFAS-free alternative has been developed thus far which can provide the needed level of oil repellency, and while water repellency can be obtained, non-PFAS finishes struggle to meet military durability requirements over the expected life cycle of an item. Truly novel non-PFAS formulations/technologies are needed that can provide durable omniphobicity equivalent to those obtained using PFAS.

Biosynthetic materials are key to sustainable domestic production and offer new opportunities to discover and synthesize novel compounds (3,4). The goal of this topic is to solicit new biosynthetic material technologies that can replace PFAS compounds in DoD clothing and equipment, providing the needed level of oil repellency and durability. The developed non-PFAS bioinspired solution should target at least one of the following areas: textile-based systems clothing and equipment items (uniforms, shelters, sleeping bags, hydration systems), food packaging and/or protective clothing items (barrier materials) and be developed into a formfactor that can be integrated into an end item. The biosynthetic solution may be provided as an alternative coating or finish for an existing DoD item, or as an entirely new material or substrate with inherent repellency to replace and/or be integrated into existing materials within the DoD system. Integration into DoD end items must consider other requirements for the final product, such as retaining water repellency, flame resistant properties, or others.

Specific care must be taken to avoid “regrettable substitutions” such as siloxanes, which are under similar scrutiny as PFAS compounds from health and safety standpoints. Due to health, safety, and regulatory concerns, solutions should not contain any carbon-fluorine bonds, including partially fluorinated fluoropolymers, even those not defined as “PFAS” by the EPA. Thoroughly review state-of-the-art for non-PFAS substitutions and be familiar with environmental concerns for manufacture (such as the use of isocyanates or solvents) as well as feasibility of producing omniphobicity with the proposed system using environmentally friendly materials and processes (5).
(Suggested Reference: https://www.ri.se/en/popfree/pfas-substitution-guide-for-textile-supply-chains)

PHASE I: Feasibility Assessment: Demonstrate proof of concept for a biosynthetic solution with no fluorine-carbon bonds that can provide omniphobicity.
The objective is a small-scale demonstration of omniphobicity on a substrate to illustrate proof of concept.

Identify a biosynthetic system that can be synthesized and/or produced to provide omniphobicity. Achieving oil repellency is a greater challenge than water repellency using non-PFAS systems, but both qualities are critical for DoD clothing and equipment. Produce the bioinspired system at quantities over 10 grams (or milliliters), with an objective of 100 grams (or milliliters) and a purity over 80%.

For textile substrates, feasibility can be demonstrated on a swatch or coupon by achieving some level of oil repellency in accordance with the American Association of Textile Chemists and Colorists (AATCC) Test Method 118. Water repellency can be demonstrated through spray rating tests (AATCC Test Method 22), and at this stage should prove water repellency can be achieved in addition to oil repellency using the proposed omniphobic system. If a demonstration on a swatch or coupon cannot be performed during Phase I, a robust model demonstrating how the synthetic biology technology will impart omniphobicity must be provided, with a realistic path towards application on a DoD end item.

An assessment of scaling capability for the omniphobic technology will be made, with special consideration for industry standard practices and limitations, and any benefits of using biotechnology for environmentally friendly manufacture. At the completion of Phase I, a sample of the non-PFAS technology proposed must be made available for independent evaluation by the Government Technical Point of Contacts. If a small-scale demonstration was performed, a sample of these materials should be provided for independent evaluation as well.

Prior to moving into Phase II, the specific targeted application and/or properties expected of the solution should be identified.

PHASE II: Prototype Development: At the end of Phase II there should be a viable solution to provide durable omniphobicity to a DoD end item. The technology should be scalable to commercial levels.

Year 1: Optimization and application of the biosynthetic technology on the targeted substrate and/or application into a DoD end item.

The biosynthetic technology should be scaled to an appropriate level that it can be applied to a DoD end item. Partnership with a manufacturer is encouraged. The scaling method should consider environmentally friendly practices, including use of biotechnology and solvent-free systems. Application or integration of the biosynthetic solution into the DoD clothing or equipment should be determined based on the formfactor of the solution and requirements of the end item. Regardless of formfactor and integration/application method, end items should maintain the desired physical properties as determined by the end use application. For example, weight, thickness, air permeability, durability to abrasion and laundering, etc. for textiles used for personal clothing and equipment items, resistance to cold cracking for shelters application, durability to delamination in food packaging, no leaching etc. The omniphobic solution should not impart more than a 10% weight gain to the end item.
Testing will be performed based on the end use application and properties identified. Oil repellency on textile substrates should be determined in accordance with AATCC TM 118. A 5A oil rating should be achieved, with an objective of higher oil ratings up to 8A (per AATCC TM118). These oil rating values reflect lowered surface energy of the substrate that protects against fuels and battlefield contaminants such as F-24. Spray rating test AATCC TM 22 should be used to determine water repellency on textile substrates. As oil repellency presents the larger challenge, a demonstration that the omniphobic technology can provide water repellency in addition to meeting oil repellency metrics is sufficient.

At the end of year 1, at least 4 sample swatches a minimum of 6 x 6 inch, or one completed prototype incorporating the optimized omniphobic technology should be delivered to the Government Technical Point of Contacts for independent evaluation, along with a report detailing the technology development in

detail, all test data and evaluations conducted to verify that the target performance criteria is met, and a feasibility assessment for scaling up the omniphobic technology.

Year 2: Ability to scale repellent technology.
Lab scale production to 1000 grams (or liters) for industry scale up should be achieved, prioritizing environmentally friendly practices. Work with a manufacturer to scale up the biosynthetic technology to commercial levels and determine a realistic pathway to integrate with the DoD end item. Special consideration should be made to maintaining the DoD end item functionalities – for example, water repellency, flame resistance, dyability. By the end of Year 2, pilot production level quantities of the biosynthetic solution will be achieved in a formfactor and purity level acceptable for manufacture (as determined by standard practices for the targeted DoD end item manufacture). Partnership with a manufacturer is encouraged.

Treated end items at a pilot or prototype scale level must be supplied to the Government Technical Point of Contacts for independent evaluation: 1 yard of a treated fabric substrate, laminate, membrane, or similar material; or 1 prototype of the treated end item (ex. shirts, gloves, sleeping bags, hydration systems). A cost analysis for producing the end items at full scale production is required at the end of Year 2, as well as a durability assessment for the lifecycle of the finished end item predicting durability to laundering, abrasion etc.

PHASE III DUAL USE APPLICATIONS: Commercialization: Proposals should establish a lifecycle framework that can mature as the technology or process advances through the acquisition process. Life cycle management is an important consideration when assessing the potential PFAS release into the environment from manufacturing through use (including abrasion during wear and laundering) and disposal. At end-of-use, any residual chemistry needs to be handled in the relevant material recovery method, regardless of whether it is recycling, incineration, or landfilling. Contamination can occur in:

- Ground/Water - carpet and clothing are most likely sources of PFAS in landfill leachate.
- Air - During manufacturing air emissions from volatile substances must be addressed. PFAS that is polymerized and integrated into the textile, when thermally decomposed such as in burn pits, could also be released into the environment. Burning waste in pits can create more hazards compared to controlled high-temperature burning - like in a commercial incinerator.
- Water – The processing/manufacturing of textiles containing PFAS can lead to wastewater contamination (water emulsions during application to fabrics, effluent water). Many textile manufacturers (Milliken, DuPont, 3M, and Mount Vernon Mills) have been sued for contaminating US public drinking water.

Synthetic biology systems using biomanufacturer for production may offer greener alternatives and reduce environmental contamination.

There are 100 plus DOD items which have been identified as using PFAS to meet omniphobicity requirements in end item applications including many cold weather clothing items. In addition to supporting the Army's Arctic Strategy and the Army's Climate Strategy, the technology developed will be applicable to a variety of items currently in the supply chain. Depending on the technology developed it could benefit clothing and equipment items the Army Overwhite program, ECWCS (Extended Cold Weather Clothing System) and CTAPS (Cold Temperature and Arctic Protection System,), clothing items and/or shelters used to provide chemical and biological protection and other items used for a specific MOS such as fuel handler coveralls etc. where omniphobicity is crucial to provide required protection or food packaging items
The developed technology would provide dual-use applications in the civilian sector in the high end outdoor retail clothing industry, but perhaps more importantly in protective personal equipment for first

responders and healthcare workers in addition to the possibility of replacing PFAS currently used in medical devices all of which have been impacted by PFAS regulations and restrictions.

REFERENCES:

1. Environmental Protection Agency. (December 21, 2021). Our Current Understanding of the Human Health and Environmental Risks of PFAS. EPA.gov. https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas;
2. Gluge, J., et al. (2020). "An overview of the uses of per- and polyfluoroalkyl substances (PFAS)." Environ Sci Process Impacts 22(12): 2345-2373.;
3. Pablo Cárdenas, Starting from scratch: a workflow for building truly novel proteins, Synthetic Biology, Volume 6, Issue 1, 2021, ysab005, https://doi.org/10.1093/synbio/ysab005;
4. Tang, Tzu-Chieh & An, Bolin & Huang, Yuanyuan & Vasikaran, Sangita & Wang, Yanyi & Jiang, Xiaoyu & Lu, Timothy & Zhong, Chao. (2020). Materials design by synthetic biology. Nature Reviews Materials. 6. 10.1038/s41578-020-00265-w;
5. RISE Research Institute of Sweden. (2022). “PFAS Substitution Guide for Supply Chains.” 2022.98. https://www.ri.se/en/popfree/pfas-substitution-guide-for-textile-supply-chains;
6. Gibbons, H.S. and Feeney, B.B. (2023) “Grow Your Own Supply Chain.” Army AL&ST. Fall 2023: 13-17. https://asc.army.mil/armyalt/Fall2023/html/index.html

KEYWORDS: PFAS; Synthetic Biology; Bioinspired; Clothing and Equipment; Omniphobicity; Non fluorinated

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A24B-T019 TITLE: Additive Manufacturing for Protective Eyewear

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

OBJECTIVE: Develop materials and an approach to manufacturing ballistic protection eyewear lenses with integrated prescription correction that is also suitable for point-of-need additive manufacturing.

DESCRIPTION: Combat eye protection is a ubiquitous need for all deployed Soldiers. The eyewear provides the wearer protection against ballistic-fragmentation and environmental concerns, like blowing sand, while remaining transparent to retain situational awareness. Protective eyewear lenses are currently made via injection molding and are not easily customized to provide vision correction. Any needed prescription vision correction is currently achieved with the Universal Prescription Lens Carrier (UPLC).[1] The UPLC sits behind the primary protective lens and contains a separate set of corrective lenses specific to the User's vision correction needs mounted into the UPLC frame. This creates integration issues for equipment worn on the face and eyes and limited field-of-view through the prescription lenses in addition to adding substantial logistical burden. The Army product manager for Soldier Protective Equipment (PdM SPE) has an ongoing initiative to identify technologies that would allow the elimination of a separate vision corrective lens (I.e. an integrated vision correction / ballistic protection lens). These lenses are expected to have a life cycle of less than six months since ballistic eye protection lenses are often rapidly degraded in combat environments due to scratching and abrasion.[2] Therefore, it is also desirable to have rapid turnaround on individually customized corrective lenses and to limit the logistics burden by providing manufacturing capability that is close to the point-of-need as well as being customizable to an individual wearer. An additive manufacturing (AM) method is most likely to meet these requirements. As AM technology has progressed, printing resolution and material development have improved to the point where optically clear samples are now achievable.[3] The cost of this technology has also decreased to being a commercially viable approach to manufacturing custom lenses. Companies in this space are continuously developing new materials for their 3D printers to impart performance that has only previously been attainable with conventional manufacturing methods. Significantly, the expanded use of augmented reality (AR) in both military and civilian sectors has spurred advances in optically clear and durable eyewear manufactured with AM.

The goal of this topic is to develop materials and processes to rapidly manufacture a customized ("one off") optical lens that meets all requirements of MIL-PRF-32432A for ballistic protection lenses as well as providing excellent optical quality, dimensional tolerances, and stability in all environments sufficient to provide vision correction.

PHASE I: Develop the materials and additive manufacturing processes needed to fabricate flat plaques that are optically transparent (>89% luminous transmittance, with less than 3% haze and minimal optical distortion) yet provide ballistic protection as outlined in MIL-PRF-32432A.[4] It should also be demonstrated that the cured plaques remain optically transparent and maintain impact resistance across a range of humidity (35-95% ± 5%), temperature (-60 °F - +160 °F), exposure to solar radiation and common military chemicals to include: 6.0 % by weight sodium hypochlorite, insect repellent-controlled release diethyl toluamide (30% concentration DEET), fire resistant hydraulic fluid (MIL-PRF-46170), hydraulic fluid, petroleum base (MIL-PRF-6083), gasoline (87% octane), motor oil (SAW 10W-30) and F24 fuel (NATO Standard AFLP 3747), as well as resistant to scratching/abrasion, and be resistant to fogging, as required by MIL-PRF-32432A for currently fielded protective eyewear. Some possible candidate materials to achieve this balance include acrylics, urethanes and polycarbonates. Companies making and selling 3D printers and resins may not fully specify the formulation of their products due to proprietary restrictions so in-house resin development may be necessary.

PHASE II: Optimize materials and processes that allow for AM of optical quality structures that meet minimum MIL-PRF-32432A requirements for luminous transmittance, optical clarity and ballistic performance as outlined in MIL-PRF-32432A for military eyewear. The materials should be compatible with standard commercial-off-the-shelf AM systems (dynamic light projection, stereolithography, etc.) without needing customization. Printing of eyewear lens prototypes should be achievable in less than three hours with sub-100 μm printing resolution and allow for printing of a "one-off" lens that demonstrates custom vision correction. Demonstrate the optical transparency and ballistic protection of the resulting cured eyewear prototypes and the fidelity of the printed, cured part to the original design. Parts should be printed to demonstrate the utility of this approach by printing a range of lenses with incorporated vision correction covering a range of –10.00 to +8.00 diopters with up to -3.25 diopters of cylinder. Example lenses shall at a minimum include prescriptions at +8, -10, +5, -5, +1.5,-1.5 diopters as well as a non-prescription optically corrected variant for comparison. Prescriptions shall be reasonably accurate (within 0.25 diopter) as measured on a lensometer. Lens designs shall maximize field of view through the lens, and offer peripheral protection. It is highly encouraged that offerors partner with a protective eyewear supplier early on in the effort. [5]

PHASE III DUAL USE APPLICATIONS: The development and maturation of this technology will allow for integrated sensory protection and vision correction for the wearer. This advancement will enhance situational awareness of the wearer by enabling customization for optimal vision correction not currently available in fielded products. It also reduces the logistical burden and timeframe needed for replacement lens to reach point-of-need, and supports the DoD's National Defense S&T strategy to create and field capabilities at speed and scale through innovation of industrial processes.[6] With this technology, there is significant benefit to the civilian sector for not only protective eyewear, but eyewear in general. The customization achievable with this approach would ensure wearers of every head size, shape and prescription could obtain the best vision correction possible. [7] Specifically the safety, sports and augmented reality areas would benefit from this technology development.

REFERENCES:

1. Auvil, J. R., Evolution of military combat eye protection. U.S. Army Medical Department Journal 2016 April-September, 2016, p 135+.;
2. Program Executive Office Soldier FAQ. https://www.peosoldier.army.mil/Resources/Frequently-Asked-Questions/ (accessed 10/19/2023);
3. MIL-PRF-32432A, Performance Specification Military Combat Eye Protection (MCEP) System, January 2013;
4. Program Executive Office Soldier Authorized Protective Eyewear List (APEL). https://www.peosoldier.army.mil/Equipment/Approved-Eyewear-QPL/;
5. 2023 National Defense Science and Technology Strategy, United States Department of Defense, May 2023;
6. Lee, L.; Burnett, A. M.; Panos, J. G.; Paudel, P.; Keys, D.; Ansari, H. M.; Yu, M., 3-D printed spectacles: potential, challenges and the future. Clinical and Experimental Optometry 2020, 103 (5), 590-596

KEYWORDS: Additive manufacturing; Ballistic protection; Eyewear; Optically transparent; Vision correction; Multifunctional; Integrated protective eyewear; Combat eye protection; Authorized protective eyewear list (APEL)

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A24B-T020 TITLE: Drone Swarm Detection Using Artificial Intelligence Based on Ultrafast Neural Networks

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

OBJECTIVE: Drone swarm detection using Artificial Intelligence. Develop a neural network architecture, and learning processing algorithms for drone identification based on ultra-fast neural networks with low power consumption.

DESCRIPTION: The goal of this Army Small Business Technology Transfer (STTR) topic is the identification of airborne drones from their radio frequency transmissions or radar signatures using ultra-fast neural networks [1]. The drone identification and classification are done by rapidly analyzing RF signals from one or several receiving antennas. As several target drones are often present in the antenna's range, the received signal may represent a result of interference of several sources. For such a multiple target identification in a drone swarm, it is crucial to be able to process information in parallel and directly at the carrier microwave frequency.

Recent research into applications of artificial intelligence (AI) based on neuromorphic networks (in particular, using magnetic artificial neurons [1-5]) was executed to solve a variety of computational and signal processing problems. The purpose of neuromorphic computing is to replicate the human brain functionality in nanoscale using man-made neurons and synapses. The advantage of this approach is highly parallelized computing with large amounts of memory in close proximity to the computing elements, which results in a substantially increased speed and reduced power consumption of computing.

The methodologies described in [1-5] are particularly suited for defense-related computing due to a number of unique features, such as nano-scale sizes, simple implementation of memory elements and strongly nonlinear dynamics. Of a particular interest for military applications is the low power consumption of the network elements, and possibility of operation in GHz [2, 3] and even THz [4, 5] frequency ranges. These high-frequency properties allow one to utilize neural networks for parallel processing of drone microwave signals at the carrier frequency without digitization or super-heterodyning.

Another important consideration in the drone identification problem is the power requirements of the device. Recently, it has been demonstrated [6], that neural networks based on artificial antiferromagnetic neurons are capable of performing simple identification tasks in sub-nanosecond time with extremely low power consumption of less than 1 pJ per synaptic operation. These results look very promising for the development of mobile ultra-fast and low-power devices for neuromorphic identification of drones.

The goal of this call is to develop a neural network capable of simultaneous ultra-fast (time scale of nanoseconds) identification and targeting of large groups (swarms) of drones threatening ground vehicles. Another goal is to design an optimal architecture of an ultra-fast neural networks with integrated memory, and to develop and test learning and data-processing network algorithms suitable for ultra-fast detection of multiple drones in a drone swarm.

PHASE I: Using computer simulations, demonstrate the possibility of using artificial intelligence in the form of an ultra-fast neural network for processing multiple microwave drone signals without super-

heterodyning or/and digitization. Demonstrate possibility of classification of drone microwave signals using ultra-fast neural networks in a case when the input signals from drones are monochromatic (unmodulated).

PHASE II: Determine optimum materials for the development of ultra-fast, lower power consumption neural networks. Develop principles of building large neural networks that will utilize ultra-fast processing capabilities of the chosen network elements (artificial neurons). Develop and test learning algorithms for drone identification in the presence of a single and multiple (2-5) drone signatures and modulated drone signals. Using computer simulations, demonstrate successful drone classification using a developed ultra-fast neural network. Determine processing time, power consumption, weight and size of an anti-drone device based on neural networks.

PHASE III DUAL USE APPLICATIONS: Demonstrate successful drone identification using an experimental prototype of a developed neural network. Demonstrate possibility of simultaneous identification of multiple drone targets. Potential applications include: light weight, ultracompact antenna for use in reconnaissance and observation drones (commercial and military); real-time monitoring of frequency agile microwave K band signals with potential applications to Active and Passive protection systems. Commercial application: Autonomous driving platforms and radar-based collison avoidance systems.

REFERENCES:

1. J. Grollier, D. Querlioz, K.Y. Camsari, et al., “Neuromorphic spintronics.” Nat. Electron. 3, 360–370 (2020). https://doi.org/10.1038/s41928-019-0360-9;
2. A. Ross, N. Leroux, A. De Riz, et al., “Multilayer spintronic neural networks with radiofrequency connections.” Nat. Nanotechnol. (2023). https://doi.org/10.1038/s41565-023-01452-w;
3. J. Torrejon, M. Riou, 3. F. Araujo, et al., “Neuromorphic computing with nanoscale spintronic oscillators.” Nature 547, 428–431 (2017). https://doi.org/10.1038/nature23011;
4. R. Khymyn, I. Lisenkov, J. Voorheis, et al., “Ultra-fast artificial neuron: generation of picosecond-duration spikes in a current-driven antiferromagnetic auto-oscillator.” Sci. Rep. 8, 15727 (2018). https://doi.org/10.1038/s41598-018-33697-0;
5. H. Bradley, S. Louis, C. Trevillian, et al., “Artificial neurons based on antiferromagnetic auto-oscillators as a platform for neuromorphic computing.” AIP Advances 13, 015206 (2023). https://aip.scitation.org/doi/10.1063/5.0128530
6. H. Bradley, S. Louis, V. Tiberkevich, et al., “Pattern recognition using spiking antiferromagnetic neurons.” (Aug 2023). https://www.researchgate.net/publication/373246558

KEYWORDS: artificial intelligence, ultra-fast, artificial neuron, drone identification, learning algorithm

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DEPARTMENT OF THE NAVY (DoN)
24.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to STTR topics only:**
  - **N24B-T025 through N24B-T030**

- 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.
  - Review the Attachments of the DoD Program BAA and ensure the correct versions of the following MANDATORY items are uploaded to the Supporting Documents, Volume 5:
    - Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
    - Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
  - 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.**

- 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 Program Manager of the DoN STTR Program is Mr. Steve Sullivan. 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
N24B-T025 to N24B-T030	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.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 10 pages, regardless of page content
    - Single column format, single-spaced typed lines
    - Standard 8 ½" x 11" paper
    - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - No font size smaller than 10-point
    - Include, within the 10-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified. Phase I Options are exercised upon selection for Phase II.
    - 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 40% of the work is performed by the proposing small business concern, and a minimum of 30% of the work is performed by the single research institution. 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 effort 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 single research institution percentage is calculated by taking the sum of all costs attributable to the

single research institution (identified as Total Subcontractor Costs (TSC) 1 in DSIP Cost Volume) 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.
- Research Institution (numerator for Research Institution calculation):
  - Total Subcontractor Costs (TSC) 1
- 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

- 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
  - Details of Request for Discretionary Technical and Business Assistance (TABA), if proposed, is to be included under the Additional Cost Information section if using the DoN Supporting Documents template.
  - 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.

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 criterion 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 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; 40% of the work is performed by the proposing small business concern, and a minimum of 30% of the work is performed by the single research institution. The percentage of work requirement must be met in the Base costs as well as in the Option costs.
  - **Cost Sharing: Cost sharing is not accepted on DoN Phase I proposals.**

- **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 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 $2,000,000 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 NOT:
- Be subject to any indirect costs, profit, or fee by the STTR proposing small business concern
- Propose a TABA provider that is the STTR proposing small business concern
- Propose a TABA provider that is an affiliate of the STTR proposing small business concern

- Propose a TABA provider that is an investor of the STTR 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 NOT exceed:
- Phase I: A total of $6,500
- Phase II: A total of $25,000 per award, not to exceed $50,000 per Phase II project

If a 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 DoN 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.

Partnering Research Institutions. The Naval Academy, the Naval Postgraduate School, and other military academies are Government organizations but qualify as partnering research institutions. However, DoN laboratories DO NOT qualify as research partners. DoN laboratories may be proposed only IN ADDITION TO the partnering research institution.

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 concerns 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 cost analysis, 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. Additionally, to adjust for inflation DoN has raised Phase I and Phase II award amounts. The maximum Phase I proposal/award amount including all options (less TABA) is $240,000. The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. The maximum Phase II proposal/award amount including all options (including TABA) is $2,000,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of

less than $2,000,000 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 the 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 STTR 24.B Topic Index

N24B-T025 TITLE: Secured Cyber-Physical System for Distributed Additive Manufacturing of Metallic Aerospace Structural Parts

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

OBJECTIVE: Develop a cyber-secured, digital twin-based system for distributed Additive Manufacturing (AM) to ensure trusted/authenticated, intellectual property (IP)-protected, high-quality and reliable/repeatable metallic structural parts.

DESCRIPTION: AM is a melting and rapidly solidifying building process—layer by layer—from a Computer-Aided Design (CAD) 3 dimensional (3D) digital model. Besides its demonstrated values for low-rate production and making complex shapes, AM possesses great potential to be a transformational technology, generating parts just-in-time at the point of need with minimum logistic footprint. This organic capability could significantly improve readiness and aircraft availability for the Navy fleet. For mass production, AM also enables de-centralized/distributed manufacturing (vs. centralized), thereby minimizing backlogs, increasing output capacity/surge-on-demand, and thus making the supply chain more robust and agile. Despite all of the potential promises and benefits, AM still has not yet been widely accepted and implemented across industries due to three main obstacles that must be addressed and show more advancements: (a) data integrity, data rights/ownership and IP protection, (b) cybersecurity, and (c) (Local/Remote) Quality Control and Assurance.

As part of the Naval Product Lifecycle Management (N-PLM) system, Digital Thread (DTh) collects and integrates product-related data dynamically from multiple sources, and then bilaterally exchanges information across enterprises from concept development to disposal. Data associated with typical AM workflow includes CAD design models; detailed part specifications, materials and process specifications; Stereolithography/Additive Manufacturing File (STL/AMF) and G-Code files; machine-specific hardware and software/firmware; processing parameters such as part orientation and placement, energy power level, toolpath and scanning patterns; and so forth. Within the distributed/de-centralized manufacturing eco-system, the need for providing timely access, transmitting and sharing of valuable/proprietary information, and facilitating collaboration is essential among various groups both within the company, as well as outside, such as third-party suppliers. This activity requires proper protection, control, and management of shared trusted data transfer for accountability (tracking and traceability), and product quality assurance along with IP protection. Blockchain is a distributed ledger technology (DLT) that could provide seamless and efficient adaptation of a digital infrastructure such as secured keys for authentication to access the chain and trusted network for data exchange. It also provides immutability of records, which could safeguard sensitive manufacturing information against unauthorized manipulation and IP theft.

AM is considered to be a cyber-physical system (CPS) combining physical hardware with software systems, usually via online network. Researchers have demonstrated that AM process workflow to be susceptible and vulnerable to cyber-attacks on both cyber and physical systems ranging from altering the build file to side channel attack of the printing machine. Malicious attacks could not only degrade the part performance and reliability, but also could damage the machines and cause injury to the operators. The needs for an autonomous system to monitor, detect, and prevent cyber-physical attacks in (near) real-time is paramount for AM.

The AM process possesses a myriad of variabilities that could affect site-specific microstructures, material properties, surface roughness, dimension accuracy, and part performance due to feedstock, part geometries, build orientation, printing process parameters, heat treatments and post-print processing, and so forth. Digital Twin (DT) is a virtual dynamic clone of the AM process including in-situ monitoring,

physics-based model, and closed-loop feedback control. Coupling DT with Artificial Intelligence/Machine Learning (AI/ML) and Big Data analytics, a DLT-enabled network could provide an effective and secured framework for (near) real-time quality control (QC) to assure process stability for repeatability and reliability of the printed parts. In addition to providing in-process visibility, a QC system could also be designed to detect the effects of cyber-attacks, such as part tampering.

The Navy seeks innovative technology solutions that are compatible/adaptable and integrated seamlessly (via Application Programming Interface (API)) with the existing N-PLM systems such as Siemens Teamcenter and PTC Windchill to protect AM system from cyber-physical attacks, prevent IP theft, and allow dynamic and low latency data access and transfer while assuring quality, repeatability/reliability, and manufacturing traceability of the printed parts.

PHASE I: Develop the system architecture and concept of operations for cyber-secured, DT-based distributive AM. Demonstrate the technical feasibility of the proposed concept/construct through working examples. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Expand the architectural design and complete application business model to incorporate business logic for all transactional data in the product life cycle. Demonstrate in cyber and physical environments the following:
1. AM version control and IP protection when distributing to external 3D print suppliers/customers, and implement seamless, secured management of Digital Thread (DTh) to ensure optimal AM part quality via:
    (a) preserving the digital thread for tracking and tracing part life cycle,
    (b) exercising printer controls to limit printing authorized amounts,
    (c) exchanging machine parameters during the cycle runs along with any alarm data from the suppliers to the designated activity for quality buyoff and invoice processing,
    (d) preventing mistakes associated with using wrong or outdated programs in forming a part,
    (e) ensuring authorized personnel to have access to the DLT protecting IP and version control, and
    (f) monitoring, detecting, and preventing cyber-attacks.
2. DT to provide a digital end-to-end simulated picture of AM steps (versus expected actual performance), including scan and design, build and monitor, test and validate, and deliver and manage steps.

PHASE III DUAL USE APPLICATIONS: Finalize the system development and application to plan and manage end-to-end AM management activity. Ensure usability for the end user. Perform final testing on a few representative aircraft parts to demonstrate the model's ability to support Navy Fleet Readiness Centers (FRCs).

Commercial industries have a similar need for their AM product lines and issues concerning product life cycle data and IP protection. Hence this digital system might find wide use across a broad variety of industry sectors.

REFERENCES:

1. Yampolskiy, M.; King, W. E.; Gatlin, J.; Belikovetsky, S.; Brown, A.; Skjellum, A. and Elovici, Y. "Security of additive manufacturing: Attack taxonomy and survey." Additive Manufacturing, 21, 2018, pp. 431-457. https://doi.org/10.1016/j.addma.2018.03.015
2. Ahmad, R. W.; Hasan, H.; Yaqoob, I.; Salah, K., Jayaraman, R. and Omar, M. "Blockchain for aerospace and defense: Opportunities and open research challenges." Computers & Industrial Engineering, 151, 106982, 2021. https://doi.org/10.1016/j.cie.2020.106982

3. Gupta, N.; Tiwari, A.; Bukkapatnam, S. T. and Karri, R. “Additive manufacturing cyber-physical system: Supply chain cybersecurity and risks.” IEEE Access, 8, 2020, pp. 47322-47333. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9026901
4. Mandolla, C.; Petruzzelli, A. M.; Percoco, G. and Urbinati, A. “Building a digital twin for additive manufacturing through the exploitation of blockchain: A case analysis of the aircraft industry.” Computers in Industry, 109, 2019, pp. 134-152. https://doi.org/10.1016/j.compind.2019.04.011
5. Diewald, E. P. “Additive OS: An Open-Source Platform for Additive Manufacturing Data Management & IP Protection.” 2021 International Solid Freeform Fabrication Symposium, University of Texas at Austin. https://hdl.handle.net/2152/90634
6. Yaqoob, I.; Salah, K.; Uddin, M.; Jayaraman, R.; Omar, M. and Imran, M. “Blockchain for digital twins: Recent advances and future research challenges.” IEEE Network, 34(5), 2020, pp. 290-298. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9076112
7. Al Mamun, A.; Liu, C.; Kan, C. and Tian, W. “Securing cyber-physical additive manufacturing systems by in-situ process authentication using streamline video analysis.” Journal of Manufacturing Systems, 62, 2022, pp. 429-440. https://doi.org/10.1016/j.jmsy.2021.12.007
8. Suhail, S.; Jurdak, R.; Matulevicius, R. and Hong, C. S. “Towards Situational Aware Cyber-Physical Systems: Securing Cyber-Physical Systems Through Blockchain-Based Digital Twins and Threat Intelligence.” arXiv preprint arXiv:2105.08886. https://arxiv.org/pdf/2105.08886.pdf
9. Suvarna, M.; Yap, K. S.; Yang, W.; Li, J.; Ng, Y. T. and Wang, X. “Cyber–Physical Production Systems for Data-Driven, Decentralized, and Secure Manufacturing—A Perspective. Engineering,” Engineering, Volume 7, Issue 9, September 2021, pp. 1212-1223. https://doi.org/10.1016/j.eng.2021.04.021
10. Sandborn, M.; Olea, C.; White, J.; Williams, C.; Tarazaga, P. A.; Sturm, L.; Albakri, M. and Tenney, C. “Towards secure cyber-physical information association for parts.” Journal of Manufacturing Systems, 59,2021, pp. 27-41. https://doi.org/10.1016/j.jmsy.2021.01.003
11. Joint Defense Manufacturing Council. “Department of Defense additive manufacturing strategy.” Department of Defense, January 2021. https://www.cto.mil/wp-content/uploads/2021/01/dod-additive-manufacturing-strategy.pdf
12. Cotteleer, M. J.; Goldenberg, S. S.; Wing, I.’ Alliyu, O.; Kania, S.; Mujumdar, V. and Sniderman, B. “Cybersecurity requirements for AM systems: New enforcement in DoD environments, and resources for implementation.” Proceedings of the 2021 Workshop on Additive Manufacturing (3D Printing) Security, November 2021, pp. 49-60. https://dl.acm.org/doi/abs/10.1145/3462223.3485624
13. Romero, D.; Wuest, T.; Harik, R. and Thoben, K. D. “Towards a cyber-physical PLM environment: The role of digital product models, intelligent products, digital twins, product avatars and digital shadows.” IFAC-PapersOnLine, 53(2), 2020, pp. 10911-10916. https://doi.org/10.1016/j.ifacol.2020.12.2829
14. Bonnard, R.; Hascoët, J. Y.; Mognol, P.; Zancul, E. and Alvares, A. J. “Hierarchical object-oriented model (HOOM) for additive manufacturing digital thread.” Journal of Manufacturing Systems, 50, 2019, pp. 36-52. https://doi.org/10.1016/j.jmsy.2018.11.003
15. Pang, T. Y.; Pelaez Restrepo, J. D.; Cheng, C. T.; Yasin, A.; Lim, H. and Miletic, M. “Developing a digital twin and digital thread framework for an ‘Industry 4.0’Shipyard.” Applied Sciences 2021, 11(3), 1097. https://doi.org/10.3390/app11031097
16. Mies, D.; Marsden, W. and Warde, S. “Overview of additive manufacturing informatics: “a digital thread”.” Integrating Materials and Manufacturing Innovation, 5(1), 2016, pp. 114-142. https://link.springer.com/article/10.1186/s40192-016-0050-7
17. Kim, D. B.; Witherell, P.; Lu, Y. and Feng, S. “Toward a digital thread and data package for metals-additive manufacturing.” Smart and sustainable manufacturing systems 2017, 1(1), 75. https://www.astm.org/ssms20160003.html

18. Adamenko, D.; Kunnen, S. and Nagarajah, A. “Digital twin and product lifecycle management: What is the difference?” Springer International Publishing. Product Lifecycle Management Enabling Smart X: 17th IFIP WG 5.1 International Conference, PLM 2020, Rapperswil, Switzerland, July 5–8, 2020, Revised Selected Papers 17, pp. 150-162). https://link.springer.com/chapter/10.1007/978-3-030-62807-9_13
19. Bolbot, V.; Theotokatos, G.; Bujorianu, L. M.; Boulougouris, E. and Vassalos, D. “Vulnerabilities and safety assurance methods in Cyber-Physical Systems: A comprehensive review.” Reliability Engineering & System Safety, 182, 2019, pp. 179-193. https://doi.org/10.1016/j.ress.2018.09.004

KEYWORDS: Additive Manufacturing; Digital Thread; Digital Twin; Cyber-Physical System; In-situ Monitoring; Blockchain

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N24B-T026 TITLE: High-Speed, Cross-Domain Data Transfer

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): FutureG;Integrated Network Systems-of-Systems; Trusted AI and Autonomy

OBJECTIVE: Identify, develop, and demonstrate technologies that enable high-speed, wireless data transfer across the air-sea interface via unmanned platform teaming.

DESCRIPTION: The problem: Advanced sensor payloads are being developed for unmanned underwater vehicles to detect and identify subsea threats. The challenge is to wirelessly transfer the sensor data from these payloads, in a timely manner, across the air-sea interface for analysis.

The current state-of-the-art: Generally, modern underwater communication links use acoustic methods whose biggest shortcoming is low-data bandwidth (< 1 Mbps) [Refs 1, 2]. Currently, high-speed wireless data transfer from underwater platforms requires the platform to surface and establish a radio link or be physically recovered by a crewed platform, interrupting the mission, and revealing the platform's location. Additionally, the time it takes to acquire and process the data may render the information obsolete, reducing its effectiveness for decision making.

Techniques to assist the passage of data through the sea surface, like buoys, are typically passively drifting or moored to a single location, reducing their effectiveness in supporting dynamic missions that cover large areas. With the advancement of autonomous systems, teaming between air, surface, and subsea unmanned platforms combined with new communication techniques, such as those that leverage multiple parts of the frequency spectrum [Refs 3–5] (i.e., acoustic, or optical frequencies underwater, and RF frequencies above water), have the potential to enable cross-domain command and control, and high-speed data transfer. High-speed, underwater, optical communication links have been demonstrated in the lab [Refs 6, 7], but their applicability to a relevant environment is not proven. This STTR topic aims to develop and demonstrate a methodology that leverages multi-spectrum technology (i.e., acoustic, radio, and optical)—paired with unmanned teaming—to enable high-speed communications across the air-sea interface in a wide range of water types. Data rates across the air-sea interface of greater or equal to 10 Mb/s are required, and the size, weight, and power (SWaP) of the components should be compatible with unmanned platforms.

PHASE I: Develop a methodology that incorporates unmanned platform teaming (i.e., air, surface, and underwater) with diverse communication technologies (i.e., acoustic, radio, and optical) to achieve high-data rates across the air-sea boundary. The methodology should include initial modeling of the communication links, and of relevant unmanned platform teaming behaviors to serve as a proof-of-concept for the proposed solution. Metrics such as communication range, throughput, persistence, and reliability should be investigated. Specific sensor technology and unmanned platforms should be identified, and the intended operating environment conditions specified. References to relevant work are encouraged and awardees may include an initial demonstration of communication technologies—and/or unmanned teaming—in simulated or relevant environments to further reinforce the legitimacy of the proposed solution. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Demonstrate the methodology developed in Phase I in a relevant environment. Sensors identified in Phase I should be produced or procured, and integrated into the unmanned platforms, also identified in Phase I. The methodology should be tested in a simulated environment before being deployed in a relevant environment. Unmanned teaming behavior should be developed to support the methodology identified in Phase I. Data from lab and field testing should be used to validate the models within the proposed solution.

PHASE III DUAL USE APPLICATIONS: Develop commercialization of the device, manufacturing methods, and finalize device form factor and capabilities. Evaluate market potential for military and civilian applications and assess required infrastructure for continued technology readiness level (TRL) and manufacturing readiness level (MRL) development.

Persistent situational awareness of the underwater domain is applicable for several private sector applications. Oil and gas can leverage this technology to survey challenging drill sites and inspect underwater infrastructure. Harbor operations, such as hull inspection, security, and infrastructure inspections would benefit as well. Unmanned teaming has the potential to reduce the need for, and risk to, crewed operations. Pairing this with advanced laser sensors will enable higher quality inspections for better decision making.

REFERENCES:

1. "Achieving 1-Mbps/300-m underwater transmission and wireless remotely operated vehicle (ROV) using underwater acoustic communication – Progress towards the extreme coverage extension that 6G-IOWN is aiming for - " NTT Corporation, 1 November 2022. https://group.ntt/en/newsrelease/2022/11/01/221101a.html
2. Zia, M. Y. I.; Poncela, J. and Otero, P. "State-of-the-art underwater acoustic communication modems: Classifications, analyses and design challenges. Wireless Personal Communications, Volume 116, 2021, pp. 1325-1360. https://doi.org/10.1007/s11277-020-07431-x
3. Farr, N.; Bowen, A.; Ware, J.; Pontbriand, C. and Tivey, M. "An integrated, underwater optical/acoustic communications system." OCEANS'10 IEEE SYDNEY, Sydney, NSW, Australia, 2010, pp. 1-6. https://doi.org/10.1109/OCEANSSYD.2010.5603510
4. Tonolini, F. and Adib, F. "Networking across boundaries: Enabling wireless communication through the water-air interface." MIT, 2018. https://www.mit.edu/~fadel/papers/TARF-paper.pdf
5. Grund, M. and Ball, K. "A mobile communications gateway for auv telemetry." OCEANS '13 MTS-IEEE - San Diego, 23-26 September 2013, pp. 1-5. https://doi.org/10.23919/OCEANS.2013.6741208 https://ieeexplore.ieee.org/document/6741208
6. Wang, J.; Lu, C.; Li, S. and Xu, Z. "100 m/500 Mbps underwater optical wireless communication using an NRZ-OOK modulated 520 nm laser diode." Optics Express, 27(9), 12019, pp. 2171-12181. https://doi.org/10.1364/OE.27.012171
7. Wu, T. C.; Chi, Y. C.; Wang, H. Y.; Tsai, C. T. and Lin, G. R. "Blue laser diode enables underwater communication at 12.4 Gbps." Scientific reports, 7(1), 2017, pp. 40480. https://doi.org/10.1038/srep40480

KEYWORDS: communications; autonomy; unmanned; optics; sensors; maritime

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N24B-T027 TITLE: Real-Time In-Flight Aircraft State Estimation

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

OBJECTIVE: Develop a method that utilizes existing aircraft sensors to estimate an aircraft's weight, center of gravity location, airspeed, wind speed, and/or other flight critical aircraft state.

DESCRIPTION: Aircraft are often heavily dependent on key state information, which require redundant sensors to meet flight safety standards or mission requirements. In the case of a failure with a dual system, it is often difficult to determine which sensor is the faulty one. In addition, aircraft weight is often required to be entered by the aircrew, which limits its usability in the vehicle management system (VMS) due to potential inaccuracy.

The Navy requires the ability to utilize additional existing sensors to estimate aircraft states in real time while in-flight, which could lower the number of redundant sensors, lower the likelihood of mission abort, and/or increase pilot situational awareness. The proposer should validate the estimation methodology using simulation or flight test data; and determine the level of accuracy of the estimations. Some of the parameters that would be targeted to estimate are (but are not limited to) on-ground/in-air transitions, airspeed/ground speed, center of gravity location, aircraft gross weight, aircraft with or without an external load, and engine status/performance/approaching a failure.

PHASE I: Determine the technical feasibility of using sensor fusion to create a real-time, in-flight estimation of key aircraft states for an aircraft. Determine the methodology and which existing aircraft sensors are best suited for providing the estimations. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Validate the estimation methodology using simulation or flight test data. Determine the level of accuracy of the estimations.

Some of the parameters that would be targeted to estimate are (but are not limited to) on-ground/in-air transitions, airspeed/ground speed, center of gravity location, aircraft gross weight, aircraft with or without an external load, engine status/performance/approaching a failure.

PHASE III DUAL USE APPLICATIONS: Final testing would be incorporating the state estimation into a flight control algorithm as a sensor monitor and introducing sensor failures to test if the state estimation methodology is able to correctly identify the failed sensor and provide the proper aircraft state to the flight control algorithm. If successful, the estimation methodology would be implemented into new aircraft sensor voting algorithms and reduce the number of needed sources of data.

The ability to utilize existing sensors and reduce the number of additional required sensors to provide accurate, reliable aircraft state information would benefit commercial and military platforms as they share common redundancy requirements. The benefit would be a reduction in system complexity, cost, and weight.

With the projected rapid expansion of the electric vertical take-off and landing (eVTOL) and urban air mobility (UAM) market, the current levels of probability of loss of aircraft (PLOA), even for airliners, may not be sufficient when considering the predicted orders-of-magnitude increase in flight hours and the operation near highly populated, urban areas. We will need to find new technologies (like this) to increase safety without the burden of extra layers of redundancy. These small, weight-sensitive aircraft will not be able to handle the weight and space burden associated with operation in highly populated areas.

REFERENCES:

1. Bi, N.; Haas, D. and McCool, K. “Investigation of in-flight gross weight and cg estimation.” 60th Annual Forum Proceedings-American Helicopter Society, 7-10 June 2004, Baltimore, Maryland, pp. 2244-2254. https://vtol.org/store/product/investigation-of-inflight-gross-weight-and-cg-estimation-for-the-v22-aircraft-4091.cfm
2. Jarrell, J. A. “Employ sensor fusion techniques for determining aircraft attitude and position information.” Thesis, Dissertation, West Virginia University, 2016. https://search.worldcat.org/title/1158304207
3. Henderson, I. “Physics informed neural networks (PINNs): An intuitive guide.” Towards Data Science, October 24, 2022. https://towardsdatascience.com/physics-informed-neural-networks-pinns-an-intuitive-guide-fff138069563
4. Yasar, K. “Neural network.” TechTarget. https://www.techtarget.com/searchenterpriseai/definition/neural-network

KEYWORDS: Artificial Intelligence/Machine Learning; Sensor Fusion; Flight Critical; State Estimation; Redundancy; Vehicle Management Systems; Model-Based Systems Engineering

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N24B-T028 TITLE: Real-Time Detection of Operator Workload as Input to Scalable Autonomy During Dynamic Mission Operations

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Human-Machine Interfaces; Trusted AI and Autonomy

OBJECTIVE: Develop a method for real-time assessment of operator workload during dynamic flight operations to use as input for scalable autonomy in human-autonomy teams.

DESCRIPTION: Changes in the competitive capabilities of our adversaries has brought us to a new playing field in which we need to quickly develop and successfully leverage and integrate new technologies in support of our warfighters and the mission to maintain naval superiority. New developments in Machine Learning and Artificial Intelligence (ML/AI) provide opportunities for the integration and development of new autonomous and automated systems, ranging from advanced automated sensors, decision aids and mission systems to fully autonomous platforms that will work alongside the warfighter as a teammate rather than a tool. Successful integration of autonomy in warfighting systems will depend not only on their reliability and predictability, but their ability to work effectively with the human operator.

Effective human-autonomy teaming in naval operations will only be achieved if the human operator and autonomy system or agent are reactive to—and collaborative with—each other. A reduction in workload due to automation does not always result in superior operator and system performance; if task load is manageable, then offloading of tasks can result in underload and a loss of situational awareness [Ref 3]. Furthermore, automation does not always result in reduced workload. The paradox of automation is that monitoring the autonomous system, in addition to other mission responsibilities, can inadvertently increase workload. This increase in workload is thought to be due to the taxing nature of passive monitoring [Ref 4], which ultimately can result in complacency.

One proposed strategy to enhance human-autonomy teaming effectiveness is to build autonomous systems that adapt to the needs of the human operator in real time via dynamic workload thresholds based upon performance, psychophysiological activity, and/or other relevant metrics. The goal of such a strategy is to maintain situational awareness while moderating workload by increasing or decreasing levels of autonomy (i.e., number and types of tasks that are offloaded, type of decision aids provided, level of transparency, level and types of automated/autonomy functions, etc., [Ref 2]) based upon indicators of operator workload states [Refs 4 and 5]. Ideally, high operator workload would be addressed by increasing levels of automation or autonomous features, offloading/modifying tasks, and enhancing operator performance. Likewise, lower operator workload states would require minimal autonomy in order to ensure that the human remains in the loop to maintain engagement and situational awareness. The current state of autonomous functions of a system is either: (a) to be active at all times, (b) be manually turned on/off by the user, or (c) be manually selected by the user from various predetermined levels of autonomy. Thus, innovation is still needed to develop adaptive automation in real time, so that autonomy can be scaled to match the current operator need in order to ensure mission success. For this, we first need to:
Identify valid, consistent, and resilient metrics/tools to estimate various dimensions of operator workload (i.e., cognitive, temporal, physical, etc.) in real time, and develop a model to combine these into a single workload estimation measurement.
• Multiple metrics/methods/tools are expected to be combined for a more rounded and accurate estimation of workload and could include physiological and/or psychophysiological measures and metrics, as well as operator performance metrics, amongst others.
• The resulting tools and methods need to be unobtrusive to operator performance and comfort.

• The tools and methods need to be able to be resilient and function in naval aviation operational environments, to include in-aircraft use.
• Develop a model for operationally defining workload thresholds (i.e., overloaded or underloaded), which will require changes in system automation level or autonomous behaviors.
• Propose tasks and task allocation strategies between operator and autonomy/automation that would result in increased and/or decreased levels of autonomy/automation as needed, and would be based on the real-time workload indicators.

A solution that addresses the above-mentioned needs would provide a first step in supporting future human-autonomy teams that are inherent in the ever-growing manned-unmanned missions.
Note: NAVAIR will provide Phase I performers with the appropriate guidance required for human research protocols so that they have the information to use while preparing their Phase II Initial Proposal. Institutional Review Board (IRB) determination as well as processing, submission, and review of all paperwork required for human subject use can be a lengthy process. As such, no human research will be allowed until Phase II and work will not be authorized until approval has been obtained, typically as an option to be exercised during Phase II.

PHASE I: Identify the metrics, methods, and tools that will be used for the real-time assessment of operator workload. These should be validated in a simulation environment that dynamically induces varying levels of operator workload (e.g., overload or underload). The Phase I effort will include prototype plans to be developed under Phase II. Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE II: Develop, demonstrate, and validate an unobtrusive and affordable stand-alone kit for the dynamic assessment of operator workload, and its use and effectiveness as input for scalable automation/autonomy. An ideal kit would measure operator workload in an unobtrusive manner, so as not to interfere with operator task load, and would be viable for use in various naval aviation environments to include in-aircraft use. It will also include the development of an algorithm to operationally define overload and underload, as well as optimal workload. In addition, strategies should be proposed for manipulating the levels of automation in response to workload. Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE III DUAL USE APPLICATIONS: Final testing would involve validation of the technology in a naval aviation relevant use case that involves dynamic automation level modifications based on the workload assessment and demonstration that the intervention results in the intended changes in operator workload and enhanced system performance.

The real-time assessment of workload as input to scaling automation levels or autonomy behavior, could be used in any application that involves the interaction of a human operator with an automated system for extended periods and in dynamic environments. Some of these could be autonomous-car or transit vehicle operation, search and rescue mission systems, reconnaissance and surveillance mission systems, and monitoring systems and applications (e.g., scientific, medical, and nuclear).

REFERENCES:

1. Hooey, B. L.; Kaber, D. B.; Adams, J. A.; Fong, T. W. and Gore, B. F. “The underpinnings of workload in unmanned vehicle systems.” IEEE Transactions on Human-Machine Systems, 48(5), 2017, pp. 452-467. https://doi.org/10.1109/THMS.2017.2759758
2. Parasuraman, R.; Sheridan, T. B. and Wickens, C. D. “A model for types and levels of human interaction with automation.” IEEE Transactions on systems, man, and cybernetics-Part A: Systems and Humans, 30(3), 2000, pp. 286-297. https://doi.org/10.1109/3468.844354

3. Young, M. S. and Stanton, N. A. “Attention and automation: New perspectives on mental underload and performance.” Theoretical issues in ergonomics science, 3(2), 2002, pp. 178-194. https://doi.org/10.1080/14639220210123789
4. Parasuraman, R.; Bahri, T.; Deaton, J. E.; Morrison, J. G. and Barnes, M. “Theory and design of adaptive automation in aviation systems.” Naval Air Warfare Center, Warminster, PA, Tech. Rep. NAWCADWAR-92, 17 July 1992, pp. 033-60. https://apps.dtic.mil/sti/pdfs/ADA254595.pdf
5. Kaber, D. B.; Riley, J. M.; Tan, K. W. and Endsley, M. R. “On the design of adaptive automation for complex systems.” International Journal of Cognitive Ergonomics, 5(1), 2001, pp. 37-57. https://doi.org/10.1207/S15327566IJCE0501_3

KEYWORDS: Human-autonomy teaming; adaptive automation; operator workload; real-time monitoring; neuroergonomics; psychophysiology

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N24B-T029 TITLE: ARCTIC FOX Sentinel

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

OBJECTIVE: Develop and demonstrate a new class of Arctic, implanted or embedded passive focused sensor package (air, ground, surface, sub-surface, or a combination thereof) for a variety of surveillance and reconnaissance applications that will be air-deployed, and have the capability for detection of manned and unmanned platforms across difficult terrain such as swamps, desert, tundra, and snow or water bodies to satisfy the most demanding mobility requirements of airborne and expeditionary forces. The end goal is a fully autonomous, air deployable, self-aligning sensor package solution where a multiunit employment team in a communication-degraded and/or GPS-denied environment can complete a mission with minimal human supervision under extreme environmental conditions.

DESCRIPTION: There is interest in utilizing emerging classes of highly sensitive, miniature, and energy-efficient sensors to perform a variety of surveillance and reconnaissance applications in support of the Department of the Navy A Strategic Blueprint for the Arctic. This STTR topic seeks to develop and demonstrate a new class of implanted or embedded passive focused sensor package (air, ground, surface, subsurface, or a combination thereof) in the Arctic environment. These systems will be air deployed and have the capability to detect manned and unmanned platforms across difficult terrain such as swamps, desert, tundra, and snow or water bodies to satisfy the most demanding mobility requirements of airborne and expeditionary forces. The end goal is a fully autonomous, air deployable, sensor package solution where a multiunit employment team in a communication-degraded and GPS-denied environment can complete a mission with minimal human supervision under extreme environmental conditions.

Technical Challenges and System Attributes:
(a) air or ship deployable, direct personnel positioned and recoverable,
(b) envisioned sensors (minimum):
- hydrophone(s) for water, in-ice and under-ice long-range detection,
- magnetometer(s)/Gravimeter for long-range submarine and anomaly detection,
- electric field sensor(s) for perimeter and intruder surveillance,
- seismometer,
- electro-optical/infrared (EO/IR) turret for airborne, perimeter and intruder surveillance,
- electronic warfare signals intelligence (EW SIGINT) (Receiver/Emitter),

(c) operate in temperatures ranging from: -49 °F (-45 °C) to 120 °F (49 °C),
(d) withstand 100 G impact on ice (air deployed),
(e) operate in a communication-degraded and/or GPS-denied environment,
(f) provide access for sensors below ice sheet: 1.5 m (Threshold)/15 m (Objective),
(g) deploy in difficult terrain such as swamps, desert, tundra, and snow or water bodies,
(h) endurance (switchable between modes):
-full operation: 168 hr (Threshold)/336 hr (Objective),
-sleep mode: 168 hr (Threshold)/336 hr (Objective,)
(i) real-time data output: longitude, latitude, altitude/height, velocity, sensor orientation (roll, pitch, yaw /heading), health status, calibrated raw data INS/GNSS (for post-processing),
(j) interfaces: RS422 (UART and HDLC/SDLC) Interfaces, CANaero/ARINC825/CAN, ARINC429, Ethernet (TCP/IP and UDP), SYNC-I/Os, and
(k) output and diagnostic measurement system included (full mission duration storage).
Phase I proposal should include envisioned conceptual overview, implementation/deployment vision, sensor selection, power distribution, data architecture, communication alerts, and notational software application.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 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.

PHASE I: Describe sensor configuration, power generation, deployment methodology and operational features. Define sensor requirements (magnetometer/gravimeter, hydrophone sensors, electric field sensors, EW Receiver/Emitter, seismometer) in terms of power, volume, weight, noise and motion limitations, water access methodology, and so forth. Identify specific sensors or sensor suites (1–6) to be included, and develop the strategy and design of integration and scale of the sensor platform and onboard processing/architecture. Describe communications, logistics, and maintenance strategy. Define the autonomous/data fusion signal processing requirements and communications to allow cooperative sensor array technology collaboration/formation. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop the sensor platform scaled to accommodate 1–6 sensor suites, and validate the sensor integration in terms of physical implementation, electronics, and communications. Perform land/sea trials of individual and system level components in terms of performance, operational agility, and sensor integration. Develop the autonomous/data fusion signal processing requirements and communications defined in Phase I. Perform land/sea trial tests validating sensor data for detection of manned and unmanned platforms. Evaluate sensor performance using both single and multiunit deployment. Demonstrate ability to deploy on difficult terrain such as swamps, desert, tundra, and snow or water bodies.

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

PHASE III DUAL USE APPLICATIONS: Complete final testing and perform necessary integration and transition for use in monitoring operations, remote surveillance and reconnaissance applications with appropriate platforms and agencies, and future combat systems under development. Commercially, this product could be used to enable remote environmental and security monitoring.

REFERENCES:

1. U.S. National Ice Center. “A blue Arctic: A strategic blueprint for the Arctic.” Department of the Navy, 2021. https://media.defense.gov/2021/Jan/05/2002560338/-1/-1/0/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF
2. McConville, J. C. “Regaining Arctic dominance: The U.S. Army in the Arctic.” Department of the Army, January 19, 2021. https://www.army.mil/e2/downloads/rv7/about/2021_army_arctic_strategy.pdf
3. Barrett, B. “Arctic strategy.” The Department of the Air Force, July 21, 2020. https://www.af.mil/Portals/1/documents/2020SAF/July/ArcticStrategy.pdf
4. Tinto, K. J.; Padman, L.; Siddoway, C. S.; Springer, S. R.; Fricker, H. A.; Das, I.; Caratori Tontini, F.; Porter, D. F.; Frearson, N. P.; Howard, S. L.; Siegfried, M. R.; Mosbeux, C.; Becker,

M. K;, Bertinato, C.; Boghosian, A.; Brady, N.; Burton, B. L.; Chu, W.; Cordero, S. I. … and Bell, R. E. “Ross Ice Shelf response to climate driven by the tectonic imprint on seafloor bathymetry.” Nature Geoscience, 12(6), May 27, 2019, pp. 441–449. https://www.nature.com/articles/s41561-019-0370-2

5. Wen, T.; Felton, W. J.; Luby, J. C.; Fox, W. L. J. and Kientz, K. L. “Environmental measurements in the Beaufort Sea, spring 1988 (Report # APL-UW TR 8822).” University of Washington,Mrch 1989. https://apps.dtic.mil/sti/pdfs/ADA209675.pdf
6. “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
7. Turgut, Altan and Schindall, Jeffrey. “Ice-Tethered Acoustic Buoys for Real-Time Acoustic Monitoring, Navigation, and Communication Through the Beaufort Lens (AD1194132).” February 24, 2023. https://apps.dtic.mil/sti/pdfs/AD1194132.pdf

KEYWORDS: Arctic; Remote Sensing; Sensors; AI/ML; Data Fusion; Guard

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N24B-T030 TITLE: Wide Field-of-View, Compact Compound Meta-lenses for Visible-to-Near-Infrared Spectral Range and with 100X Size and Weight Reduction

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials; Microelectronics; Quantum Science

OBJECTIVE: Develop a novel, extremely compact, and lightweight compound lens composed of multiple metasurfaces that permits an ultrawide field of view (FOV) for various imaging and surveillance applications in the visible and near-infrared spectral ranges.

DESCRIPTION: Wide-angle compound lenses, that can provide expanded FOV and keep scenes near and far in focus (large depth of focus), are important for military applications, such as surveillance and vision-based navigation. However, wide-angle lenses are notoriously difficult to create because they have relatively short focal lengths and relatively large lens components, compared to other types of compound lenses. To form images of scenes over a large solid angle while minimizing monochromatic aberrations, existing solutions typically utilize a large stack of aspherical refractive lenses. Even with sophisticated designs, wide-angle of view cameras with FOVs between 60°–110° often require mechanically moving components in order to provide a more comprehensive angular coverage.

It is the focus of this STTR topic to seek a much more promising disruptive technological solution to mitigate the legacy technology shortfalls of size, weight, and robustness issues of wide-angle of view cameras by exploring a wide-angle of coverage compound lens based on metasurface technology. Metasurfaces have recently emerged as a promising platform to realize advanced imaging functionalities [Ref 1]. A metasurface enables a designer to control light by exploiting strong interactions between light and 2D nanostructured thin films [Ref 2]. A metasurface is usually composed of a 2D array of densely-packed, nanoscale optical scattering elements (“meta-units”). The geometric degrees of freedom in the meta-units allow a designer to control a multitude of optical parameters, including the phase delay, amplitude, and polarization state. Therefore, a metasurface can engineer the optical wavefront in a predetermined fashion for the specific applications via the collective action of a 2D array of meta-units. Compared to a simple interface between two optical media, metasurfaces have superb capabilities to bend light beams by large angles with high efficiency [Ref 3], which makes them ideally suited for creating wide-angle of coverage and extremely compact imaging optics. In addition, dispersion engineering of meta-units allows metasurfaces to provide distinct phase profiles at different wavelengths [Ref 4], making it possible to create compound lenses that operate simultaneously at visible and near-infrared spectral bands for various daytime and nighttime operating conditions. The flat form factor of game changing metasurfaces can substantially decrease the weight of optical systems to as small as ~1 % of that of conventional systems based on traditional bulky refractive lenses. Metasurfaces can be fabricated with mature planar wafer-scale fabrication technologies pioneered by the semiconductor industry. That metasurface fabrications can leverage semiconductor manufacturing technology and its concomitant economy of scale represents a revolutionary improvement in low-cost scalable production, a marked departure from the very time consuming and costly legacy grinding and polishing processes currently used for lens manufacturing.

Despite their unique merits as an imaging platform, metasurfaces must overcome a couple of challenges to provide usable performance as wide-angle of coverage imaging optics. Metasurfaces rely on a spatial distribution of phase delay introduced by 2D arrays of subwavelength meta-units. The latter are typically designed without considering the near-field coupling between neighboring meta-units. In reality, a meta-unit is surrounded within subwavelength distances by distinct meta-units and the near-field interactions between them via optical evanescent waves can substantially perturb the local phase and amplitude responses of the meta-unit. This will lead to a deviation from the desired phase and amplitude profiles and could thus severely reduce the transmission efficiency of light through the metasurfaces and degrade the

quality of the formed images. In addition, typical meta-unit designs assume light incidence at a normal angle to the metasurface plane; however, the angular optical response of meta-units can be far from that of a simple point source: the optical modes excited within a meta-unit vary as a function of incident angle, which will result in angularly dependent local phase and amplitude responses, with the ultimate consequence that a metasurface lens designed for normal incidence will fail to function properly at oblique incident angles. Thus, this STTR topic seeks an advanced design methodology where the near-field interactions and angular response of meta-units are taken into consideration while modeling optical response of metasurfaces [Ref 5] and an efficient algorithm is devised to determine the optimal arrangement of meta-units over the metasurface plane to minimize phase and amplitude errors due to near-field coupling over a wide range of incident angles.

Specifically, the meta-lens system should satisfy the following criteria: (a) for a collimated incident beam at a near-infrared wavelength (lambda = 940 nm) over an angular range of 50° (i.e., 100° FOV) in both the transverse directions, the focal spot produced by the meta-lens system should be diffraction limited (Strehl ratio > 0.8); (b) optical transmission through the meta-lens system should be higher than 75 %; (c) maximizing the focusing efficiency at the design wavelengths ranging from 450 nm to 750 nm in steps of 50 nm; (d) the first meta-lens layer of the system (i.e., optical aperture) should have a diameter of 1 mm, the focal distance (between the last meta-lens layer and the focal plane) should be 1 mm, and the entire meta-lens system should be less than 5 mm in thickness; and (e) the weight of the meta-lens system should be below 100 mg. The focusing efficiency, defined as the ratio of the integrated power over a circular aperture with diameter 18 μm (microns) in the focal plane to the total power over the lens aperture as a function wavelength.

Specifically, the camera system equipped with the meta-lens system should satisfy the following criteria: (a) for a collimated incident beam at three visible wavelengths (lambda=450, 550, and 650 nm) and one near-infrared wavelength (lambda=940 nm) over an angular range of 60° in both the transverse directions, the meta-lens should provide the same focal length and the focal spots should be diffraction limited (Strehl ratio > 0.8); (b) optical transmission through the meta-lens system should be higher than 85 % at the near-infrared wavelength and higher than 75 % at the visible wavelengths; (c) maximizing the focusing efficiency at the design wavelengths ranging from 450 nm to 750 nm in steps of 50 nm; (d) the first meta-lens layer of the system should have a diameter of 5 mm, the focal distance at both the visible and near-infrared wavelengths should be 2 mm, and the entire meta-lens system should be less than 7 mm in thickness; (e) the weight of the meta-lens alone should be below 500 mg; and (e) resolution of the camera should be at least 10 MP. The focusing efficiency, defined as the ratio of the integrated power over a circular aperture with diameter 18 μm (microns) in the focal plane to the total power over the lens aperture as a function wavelength.

In summary, this STTR topic seeks a solution to create wide-angle of coverage meta-lenses based on metasurfaces that offer the highest quality wide FOV lens for surveillance high-definition charged-coupled device (CCD) or Complementary metal–oxide–semiconductor (CMOS) cameras but with two orders of magnitude reduction in size and weight.

PHASE I: Demonstrate the efficacy of the new metasurface design methodology and the feasibility of a compound wide-FOV meta-lens system as described in the Description. Demonstrated quantitative agreement between the optical model and experiment, and completed a trade-space analysis that identified the optimal method for meta-lens system. Characterize component meta-atoms used in meta-lens system design. The Phase I effort should include prototype plans to be developed under Phase II.

PHASE II: Design, build prototypes, and demonstrate a high-definition CCD or CMOS camera system integrated with a compound wide-FOV meta-lens with dispersion engineered meta-units as described in the Description under natural sunlight and other broadband illumination conditions in Advanced Naval

Technology Exercise (ANTX) events. Produce a final report that includes a discussion of potential near-term and long-term development efforts that would improve technology performance and/or ease of fabrication; and also an evaluation of the cost of fabrication and how that might be reduced in the future. The prototypes should be delivered by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Design and demonstrate a producible metalens camera from Phase II and validate its resulting manufacturing readiness to be transitioned to a Program of Record. Support the Navy in transitioning the technology to Navy use.

The development of the optoelectronic image sensor has been a significant step towards the on-chip integration of cameras; however, the camera lenses are yet to be fully integrated with the image sensor. The freedom in controlling the metasurface phase profiles has enabled the implementation of spherical-aberration-free flat lenses that focus normally incident light to diffraction limited spots. Metasurface flat lenses are able to correct chromatic aberration over broad wavelength range, and to some degree reduce spherical aberration, coma, and other monochromatic aberrations, that would most likely revolutionize optical instrumentation. The prospect of largely shrinking the complexity and size of optical instruments (e.g., replacing the entire set of compound lenses in a camera lens with a few or even a single dispersion less and aberration-corrected flat lens) seems feasible in view of recent developments of metasurface lenses. Metasurface flat lenses will impact computational imaging, active wavefront manipulation, ultrafast spatiotemporal control of light, quantum communications, thermal emission management, novel display technologies, and sensing.

REFERENCES:

1. Yu, N. and Capasso, F. “Flat optics with designer metasurfaces.” Nature materials, 13(2), 2014, pp. 139-150. https://doi.org/10.1038/nmat3839
2. Yu, N.; Genevet, P.; Kats, M. A.; Aieta, F.; Tetienne, J. P.; Capasso, F. and Gaburro, Z. “Light propagation with phase discontinuities: generalized laws of reflection and refraction.” Science, 334(6054), 2011, pp. 333-337. https://doi.org/10.1126/science.1210713
3. Sell, D.; Yang, J.;Doshay, S.; Yang, R. and Fan, J. A. “Large-angle, multifunctional metagratings based on freeform multimode geometries.” Nano letters, 17(6), 2017, pp. 3752-3757. https://doi.org/10.1021/acs.nanolett.7b01082
4. Shrestha, S.; Overvig, A. C.; Lu, M.; Stein, A. and Yu, N. “Broadband achromatic dielectric metalenses.” Light: Science & Applications, 7(1), 2018, pp. 1-11. https://doi.org/10.1038/s41377-018-0078-x
5. Zhou, M.; Liu, D.; Belling, S. W.; Cheng, H.; Kats, M. A.; Fan, S.; Povinelli, M. L. and Yu, Z. “Inverse design of metasurfaces based on coupled-mode theory and adjoint optimization.” ACS Photonics, 8(8), 2021, pp. 2265-2273. https://doi.org/10.1021/acsphotonics.1c00100

KEYWORDS: metalenses; spectral; metasurfaces; imaging; surveillance; visible; near-infrared

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DEPARTMENT OF THE AIR FORCE
24.B SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) 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 STTR 24.B 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.

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 AF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "24.B 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. All applicants have ample opportunity to request clarifying information. **The DAF encourages applicants to request clarifying information as early as possible, as delays in such requests constrain the DAF's ability to provide satisfactory resolution to applicant concerns.**
- 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.B 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 STTR 24.B 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.

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.

These instructions supplement the 24.B STTR BAA. In addition to the requirements found in the 24.B STTR BAA, applicants are required to provide the following information in Volume 2:

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. Only one principal investigator/project manager can be designated to a proposal at any given time.
- 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 Statement of Work 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 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 consultant in the project's planning and/or research stages may be appropriate. If so, describe in detail and include information in the Cost Volume. A minimum of 40% of each STTR project must be conducted by the SBC and a minimum of 30% of the effort performed by the single partnering Research Institution. Deviations from these performance of work requirements are not permitted. The STTR 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. Additionally, see DoD SBIR 23.3 BAA for more information regarding the required Allocation of Rights Agreement.

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 STTR 24.B 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 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 STTR 24.B 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.B 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.

MAJORITY OWNERSHIP IN PART BY MULTIPLE VENTURE CAPITAL, HEDGE FUND, AND PRIVATE EQUITY FIRMS

Small business concerns that are owned in majority part by multiple venture capital operating companies (VCOCs), hedge funds, or private equity funds are not eligible to submit applications or receive awards for Department of Air Force Topics.

PERFORMANCE OF WORK RE4QUIREMENTS AND LOCATION OF WORK

For both Phase I and Phase II, a minimum of 40% of each STTR award must be conducted by the awardee and a minimum of 30% of the effort must be performed by the single partnering Research Institution. Note, applicants and awardees may partner with multiple entities that separately meet the definition of a "Research Institution" as indicated in the SBIR BAA. Applicants may use only one partnering Research Institution to meet STTR eligibility requirements. The DAF will not consider requests for deviations to these performance of work requirements.

All R/R&D work must be performed in the United States. Based on a rare and unique circumstance, the DAF may approve a particular portion of the R/R&D work to be performed or obtained in a country outside of the United States. The awarding Funding Agreement officer must approve each specific condition in writing. Applicants seeking this approval must make such a request with their initial proposal submission. The DAF will not consider these requests prior to proposal submission.

DAF USE OF SUPPORT CONTRACTORS

Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors. These support contractors may include, but are not limited to 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 regarding the use of support 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 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. Refrain from contacting the BAA CO for proposal status before that time.

Refer to the DoD STTR 24.B 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 Phase I technical performance is ongoing or at any time after the conclusion of the period of performance. This decision will be based on the awardee'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 AF 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 STTR 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.

Department of Air Force STTR 24.B Topic Index

Topic Number	Topic Name	Maximum Value*	Maximum Duration**	Technical Volume Page Limit***
AF24B-T001	Flat Optic Micro Lenslet Array	$180,000.00	6	20
AF24B-T002	Neural Collapse for Responsible Artificial Intelligence in Directed Energy	$180,000.00	6	20
AF24B-T003	Quantum Algorithms for Military Cargo Transport	$180,000.00	6	20
SF24B-T004	Data-Centric AI in Multi Domain Awareness	$180,000.00	6	20
SF24B-T005	Multiple Hypothesis Management	$180,000.00	6	20
SF24B-T006	Probabilistic 3D Outer Zone Radiation Belt Model	$180,000.00	6	20
SF24B-T007	Finding Guaranteed RL Control for Satellite Systems	$180,000.00	6	20
SF24B-T008	Self-Regulating Heaters for Satellites	$180,000.00	6	20
SF24B-T009	Cultivating PWSA Innovations Through Collaboration	$180,000.00	6	20
AF24B-T010	GHz burst mode ultrashort pulse laser	$180,000.00	6	20

*Proposals that exceed this amount will be disqualified.
**Proposals that exceed this duration will be disqualified.
***Pages/slides in excess of this count will not be considered during evaluations.

AF24B-T001 TITLE: Flat Optic Micro Lenslet Array

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 concept and demonstrate a flat optical system for use as a micro lenslet array, appropriate for use with digital micromirror (DMD) devices.

DESCRIPTION: Lenslet arrays provide optical functionality that is desirable for use with arrayed devices such as digital micromirror (DMD) devices, LED arrays, and laser arrays. Standard glass/plastic lenslet arrays have undesirable limitations including wavefront errors, acceptance angle, focal length, and device pitch. Flat replacements for traditional lenslet arrays are desired with pitch and formats that can match standard DMD formats, operate in the visible spectrum, have significant working distance, have large angular acceptance, are polarization agnostic, have high transmittance, have tunable designs, and are manufacturable at scale. An added advantage (optional) would be the ability to “tile” lenslet arrays to make a larger format device. Extension for use in mid-wave infrared (3.0μm to 5.0μm) is also of interest.

PHASE I: Concepts will be evaluated based on a variety of optical and geometrical characteristics such as: lens fill factor, minimum achievable focus spot for a lenslet, wavefront error/image quality, acceptance angle, working distance, bandwidth, uniformity across polarization states, and transmittance. Consideration is also provided for manufacturability, complexity, ability to “tile” arrays, and tunability to reach other bands as desired. The evaluations may be made using simulations if necessary, though preference is given to actual hardware feasibility demonstration using DMDs or representative hardware

PHASE II: Refinement of the concept, development of design, fabrication, and demonstration of a prototype and prototype experimentation/testing will constitute the majority of the Phase 2 effort. Any remaining concept refinements needed after a Phase 1 completion will be addressed early in the Phase 2 effort, ideally in parallel with the design efforts. Prototype to be developed should not be specific to a single illumination type (i.e. laser, LED, or halogen). The design process should include planning for demonstration and testing/measurements. Construction and demonstration of a prototype is expected to require a substantial portion of the phase 2 program depending on lead times of components requiring procurement as well as number of iterations of fabrication to refine the process. With proper planning for demonstration and testing, the final portion of the phase 2 program should be relatively short and produce high quality data that indicates the design functions as intended.

PHASE III DUAL USE APPLICATIONS: Outputs from Phase 2 are anticipated to be TRL 6 but may require additional effort to refine to a more manufacturable design. Phase 3 will concentrate on the manufacturability as well as the manufacturing process itself to prepare the vendor to commercially offer a fully operational product. A final product is expected to be demonstrated and marketed to AFRL as well as our transition partner in the 782d Test Squadron. Additional Phase 3 planning will occur during the Phase 2 process once a design is established and manufacturing requirements and manufacturability become more apparent.

REFERENCES:

1. Fan, ZB., Qiu, HY., Zhang, HL. et al. A broadband achromatic metalens array for integral imaging in the visible. Light Sci Appl 8, 67 (2019).
2. Pisano, G., Austermann, J., Beall, J. et al. Development of Flat Silicon-Based Mesh Lens Arrays for Millimeter and Sub-millimeter Wave Astronomy. J Low Temp Phys 199, 923–934 (2020).;

KEYWORDS: lenslet; metamaterials; optical array; projection; hardware-in-the-loop; test; optics

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AF24B-T002 TITLE: Neural Collapse for Responsible Artificial Intelligence in Directed Energy

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; 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: Purpose:
To develop theoretical foundations necessary to support and sustain Artificial Intelligence technologies within Directed Energy.

Motivation:
Modern neural network-based machine learning techniques achieve high performance, at the cost of limited explainability and understandability through their black box structure. As described in a recent Defense strategy [1] and directive [2] Defense Artificial Intelligence systems in general require a level of trust incompatible with state-of-the art machine learning systems. A recent executive order [3] further demonstrates the need for trustworthy Artificial Intelligence systems.

Benefit:
AFRL/RD is interested in investigating solutions that address the described black box incompatibility for Directed Energy-specific target acquisition and tracking problems. Specific problems might include acquisition of small, unmanned aircraft, cruise missiles, small ground-based targets, and anti-aircraft missiles. If successful, compatibility will have impact to both AFRL/RD and other Directed Energy organizations, with strong potential for generalization to other Department of Defense weapons and commercial applications such as medical diagnostic systems (e.g. the Food and Drug Administration's oncology diagnostics program [4].) The compatibility will enable trust and proliferation of predictive artificial intelligence-based decision-making systems, enabling the Warfighter to automate tasks and achieve well-understood behaviors.

Main Goal:
To understand neural network technology, beyond traditional black box models towards fully explainable, mathematically understood models, enabling Defense users to implement trusted artificial intelligence systems.
Subgoals:

1. (Basic Research) Study fundamentals of neural networks to enable deeper understanding in terms of neural network performance, performance bounds, and limitations, and achieve neural network explainability.
2. (Applied Research) Understand neural network fundamentals and their applicability to Directed Energy problems. Achieve compatibility with Defense strategies and directives [1] [2].

Deliverables:
Reports in Powerpoint and text-based manuscript formats.

A software package including material necessary to understand and reproduce SBIR results.

DESCRIPTION: Recent research has demonstrated a neural network training phenomenon, Double Descent [5]. Here, sufficiently large predictive classification networks can train beyond the overfitting regime and achieve lower local minimum test loss, approaching the global minimum. Later, it was shown that double descent-achieving networks can collapse, or converge, to a structure with well-defined mathematical properties [6]. This is called Neural Collapse, and its study has recently been an active research field regarding its implications on performance, optimality, robustness, and other traits.

AFRL/RD has interest in the Neural Collapse phenomenon because conclusions derived from its study may generalize across all neural networks achieving Neural Collapse. More specifically, recent research has investigated Neural Collapse for traits such as optimality [7], training success [8], transfer learning [9], and robustness [10]. While the state-of-the-art is not fully peer reviewed, success in these lines of research could lead to explainability and trust in a technology that has traditionally been considered a black box, achieving the objective of the STTR.

To meet the objective, potential tasks in several research directions are described below. These tasks are open ended, and comprehensive results are not expected before Phase III. Further related tasks in support of the goals may be proposed due to the fast-paced nature of the research area.

Applied Research (Export Controlled):

1. Demonstrate that networks trained on Directed Energy datasets such as CLIPS, in applications such target acquisition of small, unmanned aircraft, can achieve Double Descent and Neural Collapse.
2. Validation of recent research (References 7-10) with regards to correctness and applicability of Neural Collapse to the Directed Energy dataset.
3. Quantify generalizability of Neural Collapse across different Directed Energy application datasets and sensors. Understand Neural Collapse robustness to specific sensor, noise, and scenario types.

Information Theory/Optimality Basic Research (Not Export Controlled):

1. Using techniques such as Task Specific Information [11] to calculate quantitative optimal detector/classifier task performance, show that a Neural Collapsed network quantitatively approaches this performance value.
2. If such optimal performance is demonstrated, investigate implications derived from optimality including bounded network outputs and network robustness.
3. Quantify the degree of neural collapse in a network and relate this value as a function to quantified task performance.

Neural Collapse Behavior/Limitations Basic Research (Not Export Controlled):

1. Neural Collapse represents an end state; a neural network converges to the state but may never fully reach collapse. In addition, multiple layers in the network may reach an intermediate collapsed state [8, 12]. Define and justify what is quantitatively meant when a network should be declared to be in a collapsed state, and the implications in this declaration.
2. A network needs to be sufficiently large and have sufficient training to reach Neural Collapse. Quantify requirements that define when a network is capable of/qualified to reach a double descent/neural collapse state.
3. Quantify the resource costs and performance benefits associated with Neural Collapse. Are there performance benefits (Quantified with ROC/Precision and Recall/Confusion Matrix) associated with reaching Neural Collapse, and are there additional training/testing/inference/other costs associated with operating in a Neural Collapse state?

Results are expected through a software package, as well as in written form including reports and presentation, with likely submission to the DTIC database. Publication through conferences, articles, and press release is encouraged.

PHASE I: TECHNICAL OBJECTIVES:

1) Downselect imaging datasets for training a neural network-based detection system, including Defense/Directed Energy datasets and public, popular datasets. Successfully demonstrate Neural Collapse behavior on Directed Energy target datasets to demonstrate application, as well as popular public datasets, through network training and transfer learning.
2) Identify promising Neural Collapse research tasks for Phase II and conduct preliminary research demonstrating potential value in this tasking.

TECHNICAL OUTCOMES:

1) Neural collapse is confirmed as a phenomenon affecting neural networks and confirmed as relevant to Directed Energy applications.
2) Delivery of a software package demonstrating existence of the Neural Collapse phenomenon. The package should contain source code, build scripts and instructions, a software dependency list including acquisition and installation instructions, dataset acquisition instructions, and software documentation including structural and functional descriptions.

PROGRAM OUTCOMES:

1) Establish plans including statement of work, work breakdown, and software development documents for specific tasks to complete in Phase II, either from the Project Description, or self-developed.
2) Establish relationships and collaborations with interested Directed Energy and Defense partners

PHASE II: TECHNICAL OBJECTIVES:

1) Complete, demonstrate, and report on basic and applied research efforts to further project goals.

TECHNICAL OUTCOMES:

1) Basic Research: Inform the Applied Research effort and report on and publish results from task completion.
2) Applied Research: Demonstrate that Neural Collapse
3) Delivery of software package demonstrating the specifically researched Neural Collapse phenomenon. The package should contain source code, build scripts and instructions, a software dependency list including acquisition and installation instructions, dataset acquisition instructions, and software documentation including structural and functional descriptions.

PROGRAM OUTCOMES:

1) Demonstrate that Neural Collapse may have a significant impact on Directed Energy applications as well as broader detection/classification applications.

PHASE III DUAL USE APPLICATIONS:

ENTRY CRITERIA: TRL-3 or TRL-4

TECHNICAL OBJECTIVES:

1) Conduct statistical analysis using effort-specific data recordings from either a Directed Energy testbed such as BC TRAIL or a laboratory setup, demonstrating discovered Neural Collapse implications as applied to Directed Energy systems. These implications might include robustness, optimality or transferability, as discussed in the Project Description.

TECHNICAL OUTCOMES:

2) 1)Demonstration of Neural Collapse and its implications as a TRL-5 capability. If successful, this demonstration will enable integration with DE imaging systems and AI subsystems.

PROGRAM OUTCOMES:

1) Successful Integration of Neural Collapse concepts into DE AI system development, enabling compliance with orders, strategies, and regulations mandating trustworthy AI.

REFERENCES:

1. DoD Responsible AI Working Council, “DoD Responsible Artificial Intelligence Strategy and Implementation Pathway,” June 21, 2022
2. DoD Directive 3000.09, “Autonomy in Weapons Systems”, January 25, 2023
3. Biden, Joseph R. "Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence." (2023)
4. https://www.fda.gov/about-fda/oncology-center-excellence/oncology-therapeutic-and-diagnostic-devices;

KEYWORDS: Machine Learning; Artificial Intelligence; Applied Mathematics; System Performance; Directed Energy; Computer Vision; Image Processing

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AF24B-T003 TITLE: Quantum Algorithms for Military Cargo Transport

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Science; Sustainment & Logistics; 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: The objective of this topic is to develop and document quantum algorithms and quantum computer specifications for solving military cargo transport, as scaled from regional through full global coverage, on increasing forecast durations, while accommodating disruptions consistent with wartime operations.

DESCRIPTION: Military cargo transport and commercial package delivery are problems with similar structure and complexity. An example solution for the transport problem is a set of assignments within a particular forecast timeframe, such that each assignment associates payload, support materials (e.g., fuel), and aircrew with an aircraft, which is in turn assigned a particular route and destination. As the solution timeframe lengthens, so too increases the number of assignments associated with any specific aircraft. Any disruptions to the assignments, whether due to natural or man-made influences, incur a significant computational burden potentially accompanied by an operational halt.

Candidate transport assignments are generated from a combinatorial explosion of factors and quantities, and each candidate assignment must be validated for consistency and compatibility with constraints such as aircraft maintenance schedules, aircrew weekly hours, fuel availability, refueling duration, route availability, expected load/unload duration, and available hangar and/or ramp space. Any candidate solution requires its constituent assignments to be further checked against one another to prevent redundancy and mutual exclusivity. Full solution optimization via classical computing appears to be intractable (possibly NP-complete), requiring far more processing time than practical real-world operations allow.

Commercially available transport planning systems sacrifice optimality in favor of actionable solutions on relevant decision timelines. These systems – which reduce but do not escape the underlying computationally intensive resource allocation – achieve their goals by carefully restructuring the problem for example with additional constraints (e.g., shorter forecast duration, reduced geographic coverage) or through efficient heuristics (e.g., data-driven predictive assignment models).

Processing power is a continual critical enabler for practical planning systems. Quantum computing shows promise for resource allocation problems and with the right quantum algorithm(s) could even make optimal solutions achievable on operationally relevant timelines. However, the nature of the cargo transport planning problem may be such that some or all sub-problems are best solved with classical computing techniques. Critical investigations within this activity include 1) the military cargo transport problem and how its overall complexity is influenced by the scale of key factors (e.g., number of aircraft, time horizon, number of sites), 2) which elements of the overall military cargo transport problem and what quantum algorithm(s) are most likely to exhibit quantum advantage, 3) what real-world measurements and user inputs must be accommodated by a quantum algorithm for military cargo

transport, 4) at what scale quantum advantage is likely to be achieved for military cargo transport as a whole and/or for key sub-problems within a hybrid quantum-classical solution, and 5) how the choice of quantum computing architecture influences the quantum system specifications required to execute the quantum algorithm(s) solving military cargo transport.

PHASE I: Awardee(s) will analyze the military transport resource allocation problem, identifying and documenting key factors and scalability impacts influencing complexity. Awardee(s) will develop quantum algorithms or a hybrid set of classical and quantum algorithms providing optimal solutions -- or improved approximations to the optimal solution -- to military cargo transport at all scales and timelines of military interest; developed algorithms must provide computational advantage over the currently fielded state of the art. Awardee(s) will recommend specifications for one or more quantum computing architectures capable of executing the developed quantum algorithms for military cargo transport at operationally relevant scales.

PHASE II: Awardee(s) will prototype or develop approaches to prototype the recommended quantum or hybrid quantum-classical system. Awardee(s) will develop practical approaches to assess system utility and assess quantum advantage at multiple operationally relevant problem scales. Awardee(s) will execute the developed assessments as state of the art permits.

PHASE III DUAL USE APPLICATIONS: Awardee(s) can expect to develop a strategy for transitioning the technology, with appropriate consideration for critical technology thresholds and scale at which quantum advantage applies.

REFERENCES:

1. * 1. *S. Yarkoni et al. “Solving the shipment rerouting problem with quantum optimization techniques,” International Conference on Computational Logistics 2021, pp 502-517. https://doi.org/10.1007/978-3-030-87672-2_33;
2. * 2. *A. M. Dalzell et al, "Quantum algorithms: A survey of applications and end-to-end complexities", arXiv, 2023. https://arxiv.org/abs/2310.03011;
3. * 3. *DARPA, “Quantifying utility of quantum computers”, 2021. https://www.darpa.mil/news-events/2021-04-02;

KEYWORDS: quantum algorithms; quantum computing; logistics; military transport

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SF24B-T004 TITLE: Data-Centric AI in Multi Domain Awareness

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 objectives of this topic are a) to develop, test, and demonstrate a data-centric AI solution for processing Multi Domain Awareness data and b) identify and illustrate the potential negative effects of insufficient training data in automated processing of multi-domain data streams.

DESCRIPTION: Enhanced situational awareness and flight safety support in the space domain within and beyond geosynchronous orbit (GEO) is achievable given sufficient data strategies. Observational evidence of spacecraft anomalies is manifested in multiple data types to include raw EO/IR imagery features, astrometric and photometric features, and features associated with their radio-frequency/RF payload. When this data is collected in great volume, from multiple modalities, and geographic locations, there is significant opportunity to enable reliable automated alerting. Today defining normal operations in space so that abnormal behavior can be flagged and more deeply observed is an area of research which addresses fundamental developments required to begin to define a baseline for real-time automated alerting for increasingly crowded orbit neighborhoods, as well as inform how this baseline may be extended to support missions in orbits beyond GEO. This is a significant need as new activities in cislunar space are planned for the coming years. This topic seeks to:

1) Define data-driven methods to drive the development and testing of an ontology of automated alerts in support of government and commercial applications and
2) Develop foundational mathematical solutions needed to enable these mappings on multiple timescales and to properly quantify the uncertainty in these mappings to effectively support decision making.

This includes mapping high frequency and geometrically diverse collection data to:

a) Specify/classify maneuver alerts as station-keeping or not,
b) Specify observed anomaly types and classify them on the basis of astrometric, photometric and RF features observed, and
c) c.) Quantify confidence/uncertainty in the mapping from input data to selected alerts.

To develop an explainable alert ontology, the awardee(s) will develop a supervised learning approach which combines feedback from experts in space domain awareness with Generative Adversarial Networks (GANs) and Convolutional Neural Networks (CNNs). The awardee(s) will show the regrets associated with insufficient training of SDA models and compare the assessed results of their solution at different levels and qualities of training using available SDA data. Importantly the awardee(s) will identify various forms of “data cascades” which can occur when insufficient data work is performed in the development of automated processing routines applied to the interpretation of SDA data. When do leaks and false alarms manifest into undesired downstream effects?

PHASE I: Awardee(s) will conceive of, develop, and demonstrate multiple methods for automated processing of SDA data which result in meaningful conclusions regarding the observed operations of

spacecraft. Awardee(s) will exercise these algorithms using available SDA data. GFE will not be provided.

PHASE II: Awardee(s) will extend these methods to fuse multiple modalities and evaluate when and where errant conclusions can be made and what the underlying data conditions are that lead to these non-ideal conclusions.

PHASE III DUAL USE APPLICATIONS: Awardee(s) will develop a strategy to transition prototype residual capabilities and incremental proliferation based on operational requirements.

REFERENCES:

4. Press, G. (2021, June 16). Andrew Ng launches a campaign for data-centric AI. Forbes. https://www.forbes.com/sites/gilpress/2021/06/16/andrew-ng-launches-a-campaign-for-data-centric-ai/?sh=2f32fc6674f5
5. Radecic, D. (2022, March 23). Data-centric vs. model-centric AI? The answer is clear. Medium. https://towardsdatascience.com/data-centric-vs-model-centric-ai-the-answer-is-clear-4b607c58af67
6. Sambasivan N., Kapania S. and Highfill H., "Everyone wants to do the model work not the data work: Data cascades in high-stakes AI", Proc. CHI Conf. Hum. Factors Comput. Syst., pp. 1-15, 2021.;

KEYWORDS: machine learning; artificial intelligence; data fusion; space domain awareness;

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SF24B-T005 TITLE: Multiple Hypothesis Management

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 methodology and prototype software to enable autonomous hypothesis management and resolution of potential courses of action based on available data.

DESCRIPTION: As technology advances, services and capabilities become computerized, and an increasing number of processes are conducted electronically, there as an increasing need for real-time decision-making systems with many capabilities in various decision spaces. With intelligence gathering rapidly growing in size and sensors producing increasing amounts of data, manual inspection of the data quickly becomes infeasible. A common mantra in information fusion is that "analysts are drowning in data but starving for information," and this is readily apparent across several domains. The focus of this effort will be to develop a method to manage large decision spaces where several hypotheses must be considered and analyzed both spatially and temporally. Owing to the decision space of different types of situational awareness, such decision support systems must concentrate on and nominate specific decision tracks or rank multiple tracks representing the hypothesis. A commander's options during a mission span a large decision space, requiring understanding possible courses of action (COAs) for both red and blue forces and domain and problem complexities.

A scalable method is sought to assist decision makers through various analysis and modeling techniques that automate the evaluation of options to take at any given state while presenting the best alternatives clearly and concisely. A key aspect is to manage a decision space that could grow exponentially, while maintaining the most plausible and impactful COAs over the life of the mission.

PHASE I: Develop methodology for hypothesis management. Conduct analysis of alternatives and develop architecture for proposed solution. Develop use case in one or more domains and identify available and required data to support hypothesis management. GFE will not be provided.

PHASE II: Develop prototype software solution that implements chosen methodology for chosen use case. Integrate available data types and sources and output metrics that rank or score the likelihood of each plausible hypothesis. Test performance using real-world data. GFE will not be provided.

PHASE III DUAL USE APPLICATIONS: The Phase III effort may include implementation of the prototype software in operational environments for assessment by analysts against real-world, real-time data. Solution performance may be evaluated against the current state of the art. Military uses include enemy course of action determination across multiple domains. Expected TRL at Phase III entry is 5.

REFERENCES:

1. Haberlin, Richard, da Costa, Paulo, Laskey, Kathryn, "Hypothesis Management in Support of Inferential Reasoning", Fifteenth International Command and Control Research and Technology Symposium, May, 2010. https://apps.dtic.mil/sti/citations/ADA525233;

2. Gordon, J., Shortliffe, E.H. (2008). A Method for Managing Evidential Reasoning in a Hierarchical Hypothesis Space. In: Yager, R.R., Liu, L. (eds) Classic Works of the Dempster-Shafer Theory of Belief Functions. Studies in Fuzziness and Soft Computing, vol 219. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-44792-4_12;

KEYWORDS: hypothesis management; hypothesis resolution; courses of action; domain awareness; situational awareness

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SF24B-T006 TITLE: Probabilistic 3D Outer Zone Radiation Belt Model

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: The objective of this topic is to create an accurate predictive 3 dimensional radiation belt model which can support a capability that can provide an actionable forecast for "All Clear" or give the likelihood of an internal charging hazard. This will require forecasts of flux levels at a range of energies from as low as 500 keV to >2MeV electrons. The forecasts should be for up to 7 days, with probabilities and confidence levels. While the confidence levels at higher that 2 or 3 days out will likely be small given the current level of science, this will give us a base to work from for future improvements.

DESCRIPTION: The outer-zone radiation belts are a highly variable and dynamic population of very energetic electrons that exist between about 10,000 km and 40,000 km above the Earth's surface at the equator, but penetrate to Low Earth Orbit at high latitudes. They can penetrate satellite surfaces and deposit their charge into or near the interior electronics, which can lead to damaging discharges. With the recent National Defense Strategy's emphasis on resilient satellites, it is important to develop specification and forecast capabilities that can provide good estimates of the current and near future radiation belt threat levels to allow decision makers the best knowledge of the environment when planning upcoming operations. A knowledge of the environment also allows satellite operators the ability to quickly determine the probability of space environment contributions to anomalies, and more readily ascertain the possibility of pacing competitor "gray zone" activities that could lead to satellite malfunctions.

Current operational specification and forecast models such as the Spacecraft Environmental Anomalies Expert System – Real time (SEAESRT) and the Relativistic Electron Forecast Model used by the National Oceanic and Atmospheric Administration/Space Weather Prediction Center (NOAA/SWPC) only address geosynchronous orbit. Current science addresses the full outer-zone electron radiation belts, and should be able to significantly improve upon the existing capability. Some example 3D radiation belt models are the AFRL model [1], Dynamic Radiation Environment Assimilation Model (DREAM) [2], the British Antarctic Survey Radiation Belt Model [3] and others. For forecasting there are current efforts from simple approaches such as The Satellite Risk Prediction and Radiation Forecast System (SaRIF), to sophisticated efforts like SafeSpace model [5].

This is a call for new capabilities that can specify and forecast the energetic electron fluxes in the outer-zone for up to 7 days. These nowcasts and forecasts should include the probabilities of different flux levels at locations within the region and the confidence level of each probability. These fluxes will be used to drive a hazard specification capability.

PHASE I: Demonstrate a capability that can accurately specify hazardous radiation belt fluxes for energies in the range from 0.75 to 6 MeV and >2MeV using operational data.

1. The fluxes must be specified throughout the outer radiation belt zone using accuracy and bias metrics which will be provided and for periods of time which will be specified.

2. There will also be a demonstration that the capability can make accurate 24 and 48 hour forecasts of the same fluxes throughout the radiation belts with acceptable probabilities and confidence levels, using the provided metrics.

AFRL will specify the observations to be used for the truth data.

PHASE II: Phase II will have X objectives:

1. Demonstrate that the performance in Phase I can be obtained with a real-time model that only uses operational data.
2. The specification will be demonstrated for a more significant time period, as will the original forecast.
3. The forecast with probabilities and confidence levels will be extended to 7 days, we will look for a reasonable fall-off in accuracy with time.
4. The capability will be compared with a model being developed by a partner.

AFRL will specify the observations to be used for the truth data.
If the results are satisfactory, we will recommend this model to our customers, who will be following the effort, for a phase III transition.

PHASE III DUAL USE APPLICATIONS: The phased III will have as objectives:

1. Further validation of the model to provide our customer with a more complete understanding of the model's strengths and weaknesses.
2. Where time and resources permit, there may be further upgrades to the model based on the previous validation results.
3. The main effort in phase III will be to produce an Algorithm Theoretical Basis Document and provide support to the team transitioning the capability to operations.

REFERENCES:

1. Albert, J. M., N. P. Meredith, and R. B. Horne (2009), Three-dimensional diffusion simulation of outer radiation belt electrons during the 9 October 1990 magnetic storm, J. Geophys. Res., 114, A09214, doi:10.1029/2009JA014336.
2. Reeves, G. D., Chen, Y., Cunningham, G. S., Friedel, R. W. H., Henderson, M. G., Jordanova, V. K., Koller, J., Morley, S. K., Thomsen, M. F., and Zaharia, S. (2012), Dynamic Radiation Environment Assimilation Model: DREAM, Space Weather, 10, S03006, doi:10.1029/2011SW000729.
3. Glauert, S. A., Horne, R. B., and Meredith, N. P. (2014), Three-dimensional electron radiation belt simulations using the BAS Radiation Belt Model with new diffusion models for chorus, plasmaspheric hiss, and lightning-generated whistlers, J. Geophys. Res. Space Physics, 119, 268–289, doi:10.1002/2013JA019281.
4. Horne, R. B., Glauert, S. A., Kirsch, P., Heynderickx, D., Bingham, S., Thorn, P., et al. (2021). The satellite risk prediction and radiation forecast system (SaRIF). Space Weather, 19, e2021SW002823. https://doi.org/10.1029/2021SW002823
5. Brunet, A., Dahmen, N., Katsavrias, C., Santolík, O., Bernoux, G., Pierrard, V., et al. (2023). Improving the electron radiation belt nowcast and forecast using the SafeSpace data assimilation modeling pipeline. Space Weather, 21, e2022SW003377. https://doi.org/10.1029/2022SW003377
6. Brunet, A., Dahmen, N., Katsavrias, C., Santolík, O., Bernoux, G., Pierrard, V., et al. (2023). Improving the electron radiation belt nowcast and forecast using the SafeSpace data assimilation

modeling pipeline. Space Weather, 21, e2022SW003377. https://doi.org/10.1029/2022SW003377;

KEYWORDS: Radiation Belts; Outer-Zone; Forecast; Prediction

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SF24B-T007 TITLE: Finding Guaranteed RL Control for Satellite Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; 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: The focus of this topic is to discover and design machine learning or reinforcement learning architectures for use within a satellite control context which are capable of providing guaranteed closed-loop behavior in a nonlinear controls context.

DESCRIPTION: Machine or reinforcement learning techniques have proven their usefulness in creating control schemes that can handle complicated inputs and maneuver vehicles as intended. One of the fundamental drawbacks of these controllers is how quickly their capabilities have grown in comparison to the theoretical guarantees normally required to ensure their safety. At the moment, machine learning-based controllers are rapidly being adopted despite the lack of guaranteed safety. The future of satellite autonomy may involve these types of controllers, but these controllers must be shown to be safe for flight with guaranteed closed-loop behavior if they are to be implemented in space. This topic aims to discover whether certain control structures, activation functions, and training results for machine/reinforcement learning controllers exist that can provide formal guarantees for a satellite's behavior and, if so, what they may be.

PHASE I: Awardee(s) will conduct a comprehensive review of current research in machine/reinforcement learning techniques and architectures capable of providing performance guarantees within a control context. Awardee(s) will investigate and compile the possible requirements for a satellite controller as well as the necessary theorems needed to demonstrate guaranteed behavior. Awardee(s) will devise a test plan capable of demonstrating the use of the control systems using machine/reinforcement learning techniques and allowing the comparison of them between theory and practice.

PHASE II: Awardee(s) will design the theorems and control structures that illustrate what type of machine learning-based models and training approaches can be shown to provide provable stability guarantees under certain conditions. Implement these control systems on multiple vehicles, including a representative satellite, showcasing the adherence of these controllers to their theoretical guarantees.

PHASE III DUAL USE APPLICATIONS: In cooperative efforts with one or more satellite software manufacturers and military satellite system developers, awardee(s) should expect to integrate the proposed control algorithms with satellite software. Awardee(s) should expect to demonstrate the control system performance with it running on board a satellite. Awardee(s) should expect to evaluate transition opportunities for utilization in approved Government civilian applications.

REFERENCES:

1. RL uncertainty characterization still relies on statistical estimation: Clements, William R., et al. "Estimating risk and uncertainty in deep reinforcement learning." arXiv preprint arXiv:1905.09638 (2019);

2. Trained RL agents still suffer from brittleness and data issues: Lockwood, Owen, and Mei Si. "A Review of Uncertainty for Deep Reinforcement Learning." Proceedings of the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment. Vol. 18. No. 1. 2022;
3. State of the art guarantees still exist at most only for linear models: Z. Marvi and B. Kiumarsi, "Reinforcement Learning With Safety and Stability Guarantees During Exploration For Linear Systems," in IEEE Open Journal of Control Systems, vol. 1, pp. 322-334, 2022, doi: 10.1109/OJCSYS.2022.3209945.;

KEYWORDS: Reinforcement learning; nonlinear controls; optimization; satellite control; autonomy

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SF24B-T008 TITLE: Self-Regulating Heaters for Satellites

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: The objective of this topic is to develop and commercialize self-regulating (positive temperature coefficient, PTC) heaters for use on
satellites in any earth orbit.

DESCRIPTION: Self-regulating heaters are heaters with a designed-in temperature setpoint that exists as a property of the resistor material. They are 'smart' heaters, automatically and independently warming each region of the heater circuit to the designed setpoint without a temperature sensor. The electrical resistance of the heater material jumps substantially at the setpoint, inhibiting electric flow and production of heat above the setpoint temperature. Self-regulating heaters are in use in the petrochemical and automotive industries for pipe freeze protection and seat warmers. The space industry needs self-regulating heaters for propellant system heaters where allowable temperature ranges are tight and thermal environments vary in both time and space. Conventional solutions to propellant system thermal control are resource intensive, requiring much engineering design and touch labor as well as much hardware and burdening the flight computer to control the circuits. Self-regulating heaters reduce all of these resource demands. Self-regulating heaters can also provide similar benefits for other satellite heaters such as those for batteries, mechanisms, and antennas.

Existing self-regulating heaters are not suited for space applications for several reasons:

1) the form factor is too large and inflexible: existing self-regulating heaters are a stiff cable while satellite self-regulating heaters must be a thin-film heater such as adhesively-applied polyimide heaters commonly used on satellites. Additionally, these heaters must be suitable to install on two orthogonal bend axes: a 1/8" bend radius and a 3" bend radius,
2) existing self-regulating heaters provide their resistance transition via a melt expansion process to break the percolating path; this means that existing self-regulating heaters cannot be exposed to temperatures greater than their setpoint temperature,
3) Existing self-regulating heaters are not designed to handle the space environment; specifically: vacuum, ionizing radiation, and wide thermal cycles.

This topic solicits proposals to develop and commercialize self-regulating heaters for space applications that address these aforementioned insufficiencies of existing self-regulating heaters. Additionally, the materials design must be capable of tuning during manufacturing of the material for setpoint temperatures between -5 and 20 C. A 30:1 (threshold) and 100:1 (objective) turndown ratio between the electrical resistances above and below the setpoint temperature must be achieved. The technology must be capable of yielding designs operating with any voltage between 12 and 100 VDC, and must be capable of producing designs yielding 1 to 10 W/in2 heat flux at the fully ON condition. Capable to withstand exposure to environments in all of the following orbits: 5 years in low earth orbit (LEO), 10 years in

middle earth orbit (MEO), or 15 years in geosynchronous earth orbit (GEO) including vacuum, ionizing radiation, and thermal cycling. Radiation environments should assume the technology receives 40 mils of spacecraft Aluminum shielding (threshold) or no additional shielding (objective); radiation shields incorporated in the heater will be considered but radiation-hardened heater materials are strongly preferred. Thermal cycles between -5 and 40 C, with LEO 60k cycles, MEO 15k cycles, and GEO 6k cycles. Also survive up to 10 thermal cycles from -40 to 70 C. The material should always remain a solid. The manufacturing process should be scalable, e.g. screen printing techniques; the installation process should minimize touch labor. Proposers must demonstrate a strong intent and capability to commercialize the technology. Proposers are strongly encouraged to form teams with manufacturing partners and systems integrators for technology transition.

PHASE I: Awardee(s) will demonstrate by modeling and analysis and/or test the feasibility of the concept to meet all requirements. Develop and test the performance of prototype hardware.

PHASE II: Awardee(s) will further develop the prototype to increase performance, manufacturability and scalability of the hardware. Awardee(s) will test environmental capability of the hardware. The culmination of the Phase II effort shall include the hardware delivery of 10 functional, tested self-regulating heaters demonstrating a variety of sizes and mounting configurations.

PHASE III DUAL USE APPLICATIONS: Awardee(s) can expect to develop, produce, and bring to market a fully flight qualified self-regulating heater product line; transition the technology to at least one satellite integrator.

REFERENCES:

1. Gilmore, D. G., Spacecraft Thermal Control Handbook Volume I: Fundamental Technologies, 2nd Ed, The Aerospace Press, El Segundo, CA, 2002;
2. Arco Engineering. Chromalox Electrical Heat Tracing Systems Design Guide. Retrieved from Arco Engineering;
3. Chen, Zheng, et al. "Fast and reversible thermoresponsive polymer switching materials for safer batteries." Nature Energy 1.1 (2016): 15009;
4. Dudon, Jean-Paul, et al. "Flexible Self-Regulating heater (FSRH) using PTC effect: A promising technology for future spacecraft thermal control." 46th International Conference on Environmental Systems, 2016. KEYWORDS: Thermal Control, Thermal Management, Satellites, Heaters, Self-Regulating Heaters CONTACT(S): Jon Allison AFRL/RVSV 5058533080 jonathan.allison.1@spaceforce.mil;

KEYWORDS: Thermal Control, Thermal Management, Satellites, Heaters, Self-Regulating Heaters

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SF24B-T009 TITLE: Cultivating PWSA Innovations Through Collaboration

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

OBJECTIVE: Provide novel and innovative new technology to bolster the United States Space Force (USSF) Space Development Agency's (SDA) advancement of the Proliferated Warfighter Space Architecture (PWSA). SDA seeks proposals encompassing novel mission, system, value and warfighting engineering concepts, technologies, and capabilities which facilitate leap-ahead improvements for planned PWSA segments, layers and tranches or enable the creation of new missions and capabilities to address emerging warfighter needs. This effort aligns with the imperative to fortify space capabilities, ensuring their resilience against potential attacks, and to counter adversaries' advancements in space-based military capabilities targeting terrestrial assets, especially high-value power projection assets.

DESCRIPTION: SDA is actively seeking innovative proposals to advance the PWSA and create additional capability for the warfighter while maintaining affordability and resilience across the architecture. This call encompasses a wide array of themes, ranging from integrating commercially-sensed data into the transport layer by advancing SDA-standard compatible Optical Inter-Satellite Link (OISL) technologies, to networking, in-space processing, power enhancement for commoditized spacecraft buses, and robust multi-level security and cross domain solutions. These themes aim to drive advancements in affordability, capability, viability and interoperability. The goal is to bolster the resilience and capabilities of space assets while enabling new layers of capabilities to address evolving warfighter needs in a dynamic and challenging space environment.

PHASE I: The focus of Phase I is to identify and demonstrate the feasibility of novel technologies aimed at bolstering the PWSA via a collaborative feasibility study in partnership with a Research Institution (RI). Leveraging the collective expertise of the research institution and the proposing small business, the emphasis should be on using analytical or computational methods to move beyond first principles and document proposed advancements, culminating in a demonstrative product that establishes the approach's viability and enables Phase II planning. While a complete production-level simulation may not be necessary, the computational intensity of the effort necessitates an unequivocal demonstration of the proposed methods, even if access to supercomputing resources is limited. This phase's goal is to affirm the potential and practicality of the outlined technological approaches, validating their computational foundations to efficiently create new warfighting capabilities enabled by a set of interoperable resilient, global, proliferated low Earth orbit spaceborne constellations. The successful collaboration between SDA, a small business, and an RI should contribute to widespread applications within the space enterprise, offering enhanced security and resilience for space-based architectures, and potentially extending benefits to broader national security interests.

PHASE II: Phase II builds upon the validated feasibility from Phase I by transitioning toward technology maturation and integration within operational contexts. Leveraging the established collaborative partnership between the Space Development Agency (SDA), a small business, and a Research Institution (RI), Phase II focuses on refining and advancing the demonstrated technological approaches. This phase emphasizes rigorous testing and validation, aiming to develop a prototype or functioning model that substantiates the viability of the proposed methods in practical settings. The emphasis remains on computational validation and real-world applicability, ensuring the technology's readiness for integration into Space Force systems. Alongside technical advancements, Phase II targets engagement with specialized government transition programs like Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Transition (STP) or Rapid Innovation Fund (RIF) to facilitate the technology's integration into operational environments. This phase aims for a seamless transition from research and development to operational readiness, ultimately contributing to enhanced security and resilience for space-based architectures, aligning with broader national security imperatives.

PHASE III DUAL USE APPLICATIONS: In Phase III, the focus remains on refining the technology developed within Space Force operational environments. Funded through non-SBIR/STTR sources, this phase builds upon validated prototypes and successful Phase II outcomes. The emphasis lies in advancing the technology for operational readiness via comprehensive testing, validation, and operational assessments. Leveraging established partnerships, Phase III is dedicated to transitioning the technology into established Space Force programs or operational systems. While SBIR/STTR applications may not fund this phase, engagement with government transition programs like the Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Transition (STP) or Rapid Innovation Fund (RIF) remains crucial for securing necessary resources and funding to seamlessly integrate the technology into existing defense programs. Ultimately, Phase III aims for the successful deployment of this technology to bolster the security, resilience, and operational capabilities of space-based architectures, aligning with broader national security objectives and the Space Force's mission imperatives.

REFERENCES:

1. https://www.sda.mil/home/work-with-us/resources/;

KEYWORDS: Cryptography; Networking; Resilience; Interoperability; Affordability; Mission; Warfighting

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AF24B-T010 TITLE: GHz burst mode ultrashort pulse laser

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: The Air Force seeks the development of robust, compact, extreme repetition rate, high per pulse energy ultrashort pulse lasers with pulse on demand capability. Specifically, we seek advancements towards developing a turn-key GHz or higher repetition rate in a burst mode system. Ideally this system has a tunable rep-rate. It is desirable to have two operational modes: one that is externally trigger-able to sub-millisecond timing that yields a series of a few bursts and another that allows the system to continuously fire bursts at 1 Hz or better for up to several seconds. The resulting system at minimum should be compact or clearly scalable to compact package and be maintainable by non-specialists or minimal maintenance from laser experts.

DESCRIPTION: The Air Force Research Laboratory seeks to find novel ways to counter rf and EO/IR sensors and effectively ablate materials. The Air Force is seeking innovations towards developing burst mode lasers with tunable pulse trains of 1-20 GHz rep rate with individual pulses on the order of 100 mJ, pulse durations on the order of 1 ps, and bursts of 10 pulses or better. The Air Force seeks development of a system that operates in two modes: externally triggerable 'on-demand' burst mode with sub-millisecond trigger delay, and a continuous mode that allows for burst to occur at 1 Hz or better for several seconds. This system would allow the Air Force to further explore the feasibility of adopting such technology for military utility. A successful project will document, design, and test a laser system that meets these specifications. Such a solution may include commercial-off-the-shelf components, however will require novel laser engineering to achieve the desired burst pulse characteristics. A successful system should be compact and require minimal maintenance. Basic day to day operation should be achievable by a non-expert, e.g. turn on and shut down of system does not require a laser engineer to realign system frequently, changing frequencies should not require manual moving of optical components. If proposers find that the requirements in all parameters are infeasible, they should propose to what they believe can be achieved and evaluations will be scored accordingly. Intra-burst rep rate tunability and pulse-on-demand are the highest air force priorities for this effort, although the high frequency rep rate target values should be as-achievable. Pulse duration, number of pulses per burst, inter-pulse rep rate, and energy requirements are more flexible, but should be sufficient to demonstrate desired nonlinear laser-plasma interactions for air force applications. In addition to demonstration of laser technology goals, calibrated measurement of tunable rf resulting from the laser plasma, burn through rates on selected samples, and characterized supercontinuum in selected samples will be considered major milestones for the final product.

PHASE I: Phase I will consist of designing, costing, and specifying components needed for the planned system. Periodic updates will be required to ensure team is on track to meeting project objectives. System design should be supported by modeling and engineering calculations to support the design feasibility. Model should provide clear performance goals for the final laser specifications (ie pulse profiles, wavelength, energy, trigger modes) that the system should aim to meet in Phase II. Applicants should provide proof of concept/breadboard demonstration for novel and/or high risk concepts key to phase II

success. Applicants should detail a statement of work with timelines of system development and personnel required for its successful completion.

PHASE II: Phase II should continue to build off the foundation laid in Phase I. Awardee(s) should execute design proposed in Phase I and benchmark system's capabilities. During this time applicants should continue to iterate and improve on design to better meet the goal of tunable GHz burst mode laser with ~100 mJ, and ~ps individual pulses. The end of Phase II should result in a prototype that meets the goals of this project that is compact, or with clear paths to being compact, and operable by non-experts. An ideal final system will not require manual movement of optical components by personnel to change the laser operation. In addition to demonstration of a laser system that meets goals of the project, calibrated measurement of tunable rf resulting from the laser plasma, burn through rates on selected samples, and characterized supercontinuum in selected samples will be considered major milestones.

PHASE III DUAL USE APPLICATIONS: If laser-material interaction milestones of phase II are sufficiently promising, the air force will seek phase III funds to further develop and acquire a laser system that is compact, ruggedized, and commercially available and which meets thresholds requested by the topic. We anticipate TRL 3 at entry of Phase III. Depending on magnitude of RF demonstration milestone in phase II, DAF demonstration follow-on funding may be sought to support phase III development and transition to TRL 6.

REFERENCES:

1. G. Blair, P. Sprangle. "Generation of rf radiation by low-intensity laser pulse trains in air," in Phys. Rev. E, vol. 108, pp. 015203, 2023.;
2. Danielle Reyes, Haley Kerrigan, Jessica Peña, Nathan Bodnar, Robert Bernath, Martin Richardson, and Shermineh Rostami Fairchild, "Temporal stitching in burst-mode filamentation," J. Opt. Soc. Am. B 36, G52-G56 (2019);

KEYWORDS: burst mode laser; ultrashort pulse; high repetition rate; pulsed laser; high average power

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Defense Threat Reduction Agency (DTRA)
DoD 2024.B Small Business Technology Transfer (STTR) Program
Proposal Submission Instructions

INTRODUCTION

The Defense Threat Reduction Agency (DTRA) mission is to enable the DoD, the U.S. Government, and International Partners to counter and deter Weapons of Mass Destruction (WMD) Chemical Biological, Radiological, Nuclear) and Improvised Threat Networks. The DTRA STTR program is consistent with the purpose of the Federal SBIR/STTR Program, i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns and through Federal-funded research or research and development (R/R&D).

The approved FY24.B topic(s) solicited for the Defense Threat Reduction Agency (DTRA) Small Business Technology Transfer (STTR) Program are included in these instructions followed by the full topic description. Offerors responding to this Broad Agency Announcement (BAA) must follow all general instructions provided in the related Department of Defense Annual Program BAA and submit proposals by the date and time listed in this release. Specific DTRA requirements that add to or deviate from the DoD Annual Program BAA instructions are provided below with references to the appropriate section of the DoD document.

Proposers are encouraged to thoroughly review the Annual Program BAA and register for the DSIP Listserv to remain apprised DoD of important programmatic and contractual changes.
• The DoD Annual Program BAA is located at: https://www.defensesbirsttr.mil/SBIRSTTR/**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.

The DTRA Small Business Technology Transfer (STTR) Program is implemented, administered, and managed by the DTRA SBIR/STTR Program Office. Specific questions pertaining to the administration of the DTRA STTR program and these proposal preparation instructions should be directed to:

Mr. Mark D. Flohr
DTRA SBIR/STTR Program Manager
Mark.D.Flohr.civ@mail.mil
Tel: (571) 616-6066

Defense Threat Reduction Agency
8725 John J. Kingman Road
Stop 6201
Ft. Belvoir, VA 22060-6201

For technical questions about specific topic requirements during the pre-release period, contact the DTRA Technical Point of Contact (TPOC) for that specific topic. To obtain answers to technical questions during the formal BAA open period, visit: https://www.dodsbirsttr.mil/submissions/login. For questions regarding the Defense SBIR/STTR Innovation Portal, contact DSIP Support at: dodsbirsupport@reisystems.com.

Proposals not conforming to the terms of this announcement will not be considered. DTRA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DTRA will be funded.

DTRA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD announcement and DTRA instructions carefully prior to submitting your

proposal as there have been significant updates to the requirements.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) STTR Program BAA. DTRA 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 DTR STTR Program and these proposal preparation instructions should be directed to: Mr. Mark Flohr, DTRA SBIR/STTR Program Manager; (mark.d.flohr.civ@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 STTR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed a 20-page limit and must follow the formatting requirements provided in the DoD STTR Program BAA. Any pages in the technical volume over 20 pages will not be considered in proposal evaluations.

Content of the Technical Volume

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/learningsupport/firm-templates.

Offerors should follow the DoD STTR Program BAA guidelines regarding Technical Volume content.

Cost Volume (Volume 3)

The Phase I Base amount, notwithstanding the amount allocated for TABA, must not exceed $200,000.00. All costs must be clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3. DTRA requires the use of an excel spreadsheet for the Cost Volume The cost template becomes visible to the offeror when the Cost Volume is initiated.

Important: when completing the cost volume, enough information should be provided to allow the agency to understand how you plan to use the requested funds if a contract is awarded.
Itemized costs of any subcontract or consultant should be provided to the same level as for the prime small business. If an unsanitized version of costs cannot be provided with the proposal, the Government may request it during negotiations if selected. Refer to the instruction provided in the DoD Annual STTR program BAA for additional details on the content of the Cost Volume.
Note: Cost for travel funds must be justified and related to the needs of the project.

Please review the updated Percentage of Work (POW) calculation details included in the DoD Program BAA. DTRA normally will not accept any deviation to the POW requirements however if discovered

during review in Contracting the offeror may be allowed to revise the cost proposal to be in line with the POW requirements.

Page Limit, Cost and Duration:

Project Phase	Technical Vol Page Limit	Cost	Duration
Phase I	20 pages	$200,000.00	7 Months
Phase II	40 pages	$1,300,000.00	24 Months

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 STTR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DTRA during proposal evaluations.

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). Please refer to the DoD Program BAA for more information as to additional supporting documents or information that may be included in 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

   Note 1: Offerors having any concerns pertaining to mandatory requirements number 2 as stated above should provide a mitigation plan addressing the concerns.

   Note 2: 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 included with the proposal submission.

DIRECT TO PHASE II PROPOSAL GUIDELINES
The Defense Threat Reduction Agency does not participate in the Direct to Phase II (DP2) proposal submission program.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees.
Those small business concerns submitting a Phase II proposal should plan to submit a fully developed proposal into the DSIP proposal system within thirty (30) days after the end of the Phase I period of performance. The small business concern may or may not be automatically notified of the recommended proposal due date.

The Phase II proposal Technical Volume should generally follow the outline and structure of the Phase I to include benefits or lessons learned from the Phase I effort.

DTRA plans on a Phase II project not to exceed $1,300,000.00 notwithstanding TABA, and two (2) years duration.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA) In accordance with the Small Business Act (15 U.S.C. 632), DTRA will authorize the recipient of a Phase I or Phase II STTR award to purchase Discretionary Technical & Business Assistance services, such as 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, for the purpose of assisting in areas such as:

- making better technical decisions concerning such projects;
- solving technical problems which arise during the conduct of such projects;
- minimizing technical risks associated with such projects;
- developing/ commercializing new commercial products/processes resulting from such projects; and,
- meeting cyber security requirements.

If you are proposing use of Discretionary Technical and Business Assistance (TABA), you must provide a cost breakdown in the Cost Volume under "Other Direct Costs (ODCs)" and provide a one-page description of the vendor you will use and the Technical and Business Assistance you will receive. For the Phase I project, the amount for TABA may not exceed $6,500 per award. For the Phase II project, the TABA amount may be less than, equal to, but not more than $50,000 per project. The description should be included in Volume 5 of the proposal.
Approval of Discretionary Technical and Business Assistance is not guaranteed and is subject to review of the contracting officer.
For Discretionary Technical and Business Assistance, small business concerns may propose one or more vendors. Additionally, business-related services aimed at improving the commercialization success of a small business concern may be obtained from an entity, such as a public or private organization or an agency or other entity established or funded by a State that facilitates or accelerates the commercialization of technologies or assists in the creation and growth of private enterprises that are commercializing technology.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD STTR 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. DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

Notifications.
Following the EA decision, the DTRA SBIR/STTR office will release notification e-mails of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. The E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official.
Offerors may request a debriefing of the evaluation of their not selected proposal and should submit this request via email to: dtra.belvoir.RD.mbx.sbir@mail.mil and include "STTR 24.D / Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or without opportunity for revision for proposals that are reasonable and

complete.

DTRA Support Contractors
Select DTRA-employed support contractors may have access to contractor information, technical data or computer software that may be marked as proprietary or otherwise marked with restrictive legends. Each DTRA support contractor performs under a contract that contains organizational conflict of interest provisions and/or includes contractual requirements for nondisclosure of proprietary contractor information or data/software marked with restrictive legends. These contractors require access while providing DTRA such support as advisory and assistance services, contract specialist support, and support of the Defense Threat Reduction Information Analysis Center (DTRIAC). The contractor, by submitting a proposal or entering into this contract, is deemed to have consented to the disclosure of its information to DTRA's support contractors.

The following are, at present, the prime contractors anticipated to access such documentation: Broadleaf Inc. (contract specialist support); Kent, Campa and Kate, Inc. (contract closeout support), ARServices (Program Management Advisory and Assistance Services--A&AS), Systems Planning and Analysis, Inc. (Subject Matter Expertise A&AS), Amentum (A&AS), Polaris Consulting (Small Business Program Support), Seventh Sense Consulting, LLC (Acquisition Support), Savantage Solutions (Accounting and Financial Systems Support); TekSynap Corporation and Kapili Services, LLC (DTRIAC).. This list is not all inclusive (e.g., subcontractors) and is subject to change.

Protests.
Refer to the DoD STTR 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:
(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed to Mr. Herbert Thompson, Contracting Officer, as follows) by obtaining written and dated acknowledgment of receipt from (if mailed letter) Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 1680 Texas Street, Kirtland AFB, NM 87117. If Federal Express is used for the transmittal, the appropriate address is: Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 8151 Griffin Avenue SE, Building 20414, Kirtland AFB, NM 87117-5669.

AWARD AND CONTRACT INFORMATION
DTRA plans on Phase I projects for a seven (7) month period of performance with six months devoted to the research and the final month for the final report. The award size of the Phase I contract is no more than $200,000.00 notwithstanding a maximum of $6,500.00 for Discretionary Technical and Business Allowance (TABA). For a Phase II project, DTRA plans on a 24-month period of performance. The award size of a Phase II contract is no more than $1,300,000.00 notwithstanding a maximum of $50,000.00 for Discretionary Technical and Business Allowance (TABA) for the entire project.

ADDITIONAL INFORMATION
The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/ddtc_public.
The technology within some DTRA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and

commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. **The offeror must ensure that their firm complies with all applicable export control regulations.**

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

Cyber Security
Any Small Business Concern receiving an SBIR award is required to provide adequate security on all covered contractor information systems. Specific security requirements are listed in DFARS 252.204.7012, and compliance is mandatory.

Feedback
In an effort to encourage participation in, and improve the overall SBIR award process, offerors may submit feedback on the SBIR solicitation and award process to: dtra.belvoir.RD.mbx.sbir@mail.mil for consideration for future SBIR BAAs.

END

DTRA STTR 24.B Topic Index

DTRA24B-001 TITLE: Mobile Objective Vehicle Emulator (MOVE)

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

OBJECTIVE: DTRA seeks innovative approaches to develop an agile, scalable, all-electric vehicle emulator to enable Counter-WMD sensing techniques using non-line-of-sight Seismic, Acoustic, and Magnetic phenomenologies. The emulator shall be all-electric, scalable, and capable of replicating the Seismic, Acoustic, and Magnetic signatures of various sized vehicle classes for both near-field and far-field MASINT sensor testing. The selected proposal winners will be provided with recorded Seismic, Acoustic, and Magnetic data from three different source-vehicle types to help with the Phase I design and engineering phase. The vehicle data will be of a standard passenger vehicle, a medium-sized truck, and a very large, over 40-ton class wheeled vehicle. The Phase II objective demonstration is of an all-electric test vehicle that is able to traverse a straight tunnel at speeds up to 15 mph while transmitting a simultaneous combination of the source-vehicle Acoustic, Magnetic, and Seismic signatures for a sustained period of at least 10 minutes while moving back and forth underground.

Additionally, a variation of this capability would enable a novel magnetic transmitter/receiver pair where the transmitter can be located inside a tunnel and a receiver can be located outside and above the tunnel at ranges of 100 meters or more. The magnetic vehicle emulator, acting as a signal transmitter, shall be able to modulate a unique bit sequence that can be demodulated at a magnetic receiver to uniquely identify or "fingerprint" the signal. Both the transmitter and receiver are to be all-electric, capable of using new/novel renewable energy generation and storage techniques. Performers may choose to create Phase II/III prototypes that use the magnetic simulator signals to create and demonstrate this transmitter/receiver concept. Phase III commercialization opportunities include future applications of modular/scalable all-electric testbeds for self-driving vehicles, city/county traffic management, and logistics delivery tracking services.

DESCRIPTION: The Department of Defense (DOD) and Intelligence Communities require a multitude of target vehicles for Counter-WMD tests and operational exercises. Acquiring real vehicles can be difficult, cost prohibitive, and slow. Contractors can design and build realistic vehicle simulators but that will be expensive and a lengthy process. The cost for logistics, operation, maintenance, and sustainment of large vehicles is also steep. A mobile, all-electric vehicle emulator that can simulate many of the required target vehicle signatures will be cheaper and safer to operate in various environments. An all-electric vehicle emulator will facilitate its use in indoor and underground facilities and produce zero emissions. A scalable, all-electric, multi-phenomenology vehicle emulator will enable an innovative underground sensor testing capability against advanced threats.

A novel method is sought to create multi-pole near-field and far-field magnetic signatures that closely replicate actual vehicles that will likely be bounded by the following assumptions. The system may require a gimbaled solenoid to orient the DC magnetic field, and a method to control current strength. 100-200 A/m2 per ton of steel is assumed as a general guide depending on the amount of steel in the vehicle. Smaller vehicles are defined to be 6 tons/axle (single wheeled) or 12 tons/axle (dual wheeled) Department of Transportation (DOT) ratings for roads. For an example design approach, a 500 ft spool of 4-gauge wire (0.25 Ω/1000 ft) with about 42 turns plus some extra wire and about 0.125 Ω, 65 lbs. Eight 42-turn coils (336 total turns) wired in series is 1 Ω to the DC power supply. A 50 V DC power supply could potentially deliver a maximum of 50 A to the coils, producing 16,800 A/m2 using 2.5 kW (30 A, 120 VAC or 20 A, 240 VAC power source). This indicates the challenge is at least feasible for an all-electric replication of signals as follows:
1. Baseline of a small vehicle, 2-ton pickup/SUV (300 A/m2) requires only 893 mA and 893 mV, or 797 mW.
2. Simulating a 10-ton truck (1500 A/m2) requires approximately 4.5 A and 4.5 V, or about 20 W.

3. Simulating a mid-sized 20-ton vehicle (3000 A/m2) requires approximately 8.93 A and 8.93 V, or 80 W.
4. Simulating a large 40-ton vehicle (6000 A/m2) requires approximately 17.86 A and 17.86 V, or about 320 W.
5. Simulating a very large 80-ton vehicle (12,000 A/m2) requires approximately 35.7 A and 35.7 V, or about 1276 W.

Lighter wire gauges allow more turns, but give higher resistance, heat, and require higher supply voltages. Additionally, a method of modulating a signal on top of the magnetic simulator to demonstrate communications of a detectable bit sequence over short (tens of meters) distances is desired.

PHASE I: Create a proposed design, develop and test an all-electric prototype vehicle emulator which mimics small, medium, and large vehicles with shaped magnetic, acoustic, and seismic phenomenologies using playback of recordings fed into one or more Helmholtz coil or similar magnetic, acoustic, and seismic sources and/or other techniques to replicate within 10% the acoustic and magnetic profile of threat vehicles. A trailer may be used that can be towed by an electric powered vehicle into tree covered tunnels. It is recognized that there can be significant coupling between acoustic and seismic signatures and therefore seismic emulation can be achieved with acoustic sources. Nevertheless, reference material indicates possible approaches to create more accurate vehicle seismic signatures beyond acoustic-only coupling. The all-electric vehicle emulator will allow testing in tunnels too small and too unsafe to house actual full-sized internal combustion engine vehicles of interest. Phase I shall also include applicable electrical and other applicable safety and hazard assessments and proposed risk mitigation as appropriate.

PHASE II: Develop and test a scaled down working prototype that emulates the smaller class vehicle type. After test and evaluation and data analysis, demonstrate a scaled-up version of the prototype to address mid and/or large vehicle emulation objectives. Additionally, a variation of this capability could enable a novel magnetic transmitter/receiver pair where the transmitter can be located inside a tunnel and a receiver can be located outside and above the tunnel. Phase II shall include a design variation proposal that would add modulation to the magnetic vehicle simulator, to modulate a bit sequence that can be demodulated at the receiver to uniquely identify or "fingerprint" the signal. Both the transmitter and receiver are to be all-electric, capable of using new/novel renewable energy generation and storage techniques. Deliver all design and test results in a final Phase II report. The final Phase II report should also include an updated design plan, if needed, to scale the prototype to meet full Phase III requirements.

PHASE III DUAL USE APPLICATIONS: Phase III will demonstrate a fully capable all-electric vehicle simulator system within an underground facility. Performers may choose to create Phase III prototypes that use the magnetic simulator signals to create and demonstrate this transmitter/receiver concept. Phase III commercialization opportunities include future applications of modular/scalable all-electric testbeds for self-driving vehicles and city/county traffic management and logistics delivery tracking services. All data collected during the demonstration and analysis of the final system will be included in the final report along with a user's manual and a data package on all critical system components.

REFERENCES:

1. "FDTD Seismic Simulation of Moving Tracked Vehicle" Stephen A. Ketcham*, Mark L. Moran*, Roy J. Greenfield, USACE Engineer Research and Development Center, Cold Regions Research and Engineering, Laboratory (ERDC-CRREL), 72 Lyme Rd, Hanover, NH 03755, Stephen.A.Ketcham@erdc.usace.army.mil, Department of Geosciences, Penn State University, University Park, PA 16802, roy@geosc.psu.edu
2. Moran, M., and Greenfield, R., 1997, "Seismic Detection of Military Operations," 97-CEP-511-1, U.S. Army Maneuver Support Battle Laboratory, Ft. Leonard Wood, MO.

3. IEEE Proceedings of the Users Group Conference (DOD_UGC'04) "Seismic Waves from Light Trucks Moving Over Terrain,"Stephen A. Ketcham Mark L. Moran, and James Lacombe USACE Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory (ERDC-CRREL), Hanover, NH {Stephen.A.Ketcham, Mark.L.Moran, James.Lacombe}@erdc.usace.army.mil
4. "Novel System for Underground Tunnels Detection" S. Tapuchi and D. Baimel, Shamoon College of Engineering, Beer Sheva, Israel
5. "Research of Distorted Vehicle Magnetic Signatures- Recognitions, for Length Estimation in Real Traffic Conditions" Donatas Miklusis, Vytautas Markevicius, Dangirutis Navikas, et. al.
6. Won, M. "Intelligent Traffic Monitoring Systems for Vehicle Classification: A Survey." IEEE Access 2020, 8, 73340–73358. [CrossRef]
7. Gheorghiu, R.A.; Iordache, V.; Stan, V.A. "Urban traffic detectors—Comparison between inductive loop and magnetic sensors." Proceedings of the 2021 13th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), Pitesti, Romania, 1–3 July 2021; pp. 1–4.
8. M. Roberson, D. Hull, S.Vinci "Advanced Anomaly Detection," Proceedings of the Military Sensing Symposium (MSS) on Battlespace Acoustic, Seismic, Magnetic, and Electric-Field Sensing (BAMS), October 2022
9. S. Vinci, Z. Drummond, et. al., "Low-SWaP-C sensing for Battlefield Anomaly Detection," Proceedings of the MSS-BAMS, 2022.
10. M. Roberson, J. White, D. Hull, S. Vinci, "Extensions to Advanced Anomaly Detection", Proceedings of the MSS BAMS, November 2023.
11. "Magnetometer Modeling and Validation for Tracking Metallic Targets," Niklas Wahlstrom, F. Gustafsson, Published 1 February 2014, IEEE Transactions on Signal Processing, vol 62, pp 545-556
12. Q. Zhang , et al, "Detection of vehicle tracks by a three-axis magnetometer," Sensors and Actuators A: Physical, Volume 276, 15 June 2018, Pages 83-90
13. "Classification of Vehicles Using Magnetic Dipole Model," Prateek G V, Rajkumar V, Nijil K and K.V.S. Hari, IEEE TENCON 2012, Cebu, Philippines, 21st November 2012

KEYWORDS: Seismic, Acoustic, Magnetic Phenomenology; Helmholtz Coil;
Counter WMD (C-WMD); Vehicle Emulator

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DTRA24B-002 TITLE: Tools and Methodologies to Transition DTRA High Fidelity Codes to Leverage Heterogeneous Accelerated Processing Units

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

OBJECTIVE: The objective of this project is to develop a performance analysis toolkit that developers can use to transition their codes to leverage Accelerated Processing Units (APUs). The toolkit must be part of a mature performance tools framework, providing other related performance analysis methodologies. A significant portion of the theoretical peak performance of several Exascale systems is attributed to APUs. Preparing DTRA's High-Fidelity (HF) computer codes to leverage APUs is of high importance. While advancements in technology, such as NVIDIA's Heterogeneous Memory Management (HMM), and Advanced Micro Devices (AMD)'s CDNA2 Coherent Memory Architecture demonstrate the industry's efforts to simplify the offloading of codes to APUs by enabling shared or unified memory access between CPUs and GPUs, there remains a substantial amount of work. Significant code refactoring and optimization efforts will still be required to performantly "map" DTRA's HF codes to DoD High Performance Computing Modernization Program (HPCMP) systems equipped with APUs. Such efforts can be intelligently guided by workload performance characterization and analysis tools, which inspect the behavior of large-scale HF codes and suggest refactoring and optimization strategies, such as which computational loops could benefit from offloading to the APUs.

DESCRIPTION: DTRA uses HF codes on DoD HPCMP systems to investigate weapon effects phenomenology and techniques for countering WMD. End-to-end HF simulations in support of the DTRA projects require calculations including multiple phenomena that occur in vastly different time scales (μs to hours). With DTRA's growing reliance on HF codes tasks, the efficient use of current computational resources and the strategic planning for upcoming architectures are essential. The existing best practices for offloading large codes to leverage APUs might not be directly applicable to HF codes. Many of these are legacy codes, developed over decades, and may require initial evaluation for modernizing their programming model, such as transitioning from an MPI-Only to a hybrid MPI+OpenMP and MPI+OpenMP+APU-Offload model, or adopting a more portable cross-platform programming framework. As such, collaborating with a DTRA HF code team to understand the requirements for developing the envisioned toolkit is highly encouraged. In addition, approaches that are portable to different APU offerings from different vendors are desired. Offerors must meet all DoD HPCMP user requirements for access to these systems which includes, but is not limited to, possessing a Security Clearance, or having a National Agency Check with Inquiries (NACI). DTRA will provide an allocation of HPC system resources and assistance in obtaining successful offeror's user accounts on DoD HPCMP system(s).

PHASE I: Investigate the existing open-source solutions in terms of the applicable programming frameworks (such as RAJA and KOKKOS) for HF codes. Document potential gaps in existing performance analysis tools that limit their abilities to provide metrics of interest for HF codes on heterogenous systems (including those that provide shared/unified memory accesses across CPUs and APUs.) Understand the benefits and limitations of shared/unified memory access feature and the accompanying programming model. Generate a feature-list for the envisioned toolkit tailored for HF codes and how it fits into an overall mature performance tools framework. Identify key concepts and methods that, when implemented, will provide non-intrusive cross-platform tools that can effectively operate on complex HF codes by collaborating with DTRA code developers. The proposers may use an open-source proxy code in Phase I to demonstrate the feasibility.

PHASE II: Develop a production ready cross-platform toolkit based on the Phase I approach and integrate within the overall tool framework. Demonstrate the use of the tools on DOD HPCMP systems on a broad range of HF codes that include compressible flow (blast, high-explosives, chemistry), incompressible

flow (dispersion), multiphase flow (melting and evaporating particles), fluid-structure interaction, and large-deformation, explicit structural dynamics (cracking, spallation, contact).

PHASE III DUAL USE APPLICATIONS: The performance tools developed for use on very demanding application codes will be well suited, once refined, for use on more general HPC workloads on Exascale architectures. Improvements in this phase are expected to involve ease of use enhancements and hardening of the profiling tools for use on a wide range of application software used in Government research and industry.

REFERENCES:

1. https://developer.nvidia.com/blog/simplifying-gpu-application-development-with-heterogeneous-memory-management/;
2. https://computing.llnl.gov/projects/raja-managing-application-portability-next-generation-platforms;
3. https://kokkos.org/;
4. https://nowlab.cse.ohio-state.edu/static/media/workshops/presentations/espm2_23/PublicSC23ESPM2ProgrammingAMDInstinctMI300A.pdf;
5. https://centers.hpc.mil/users/index.html#accounts;

KEYWORDS: High Performance Computing; HPC; Accelerated Processing Units; APU; Message Passing Interface; MPI; Open Multi-Processing; OpenMP; High-Fidelity; graphics processing unit; GPU;

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Missile Defense Agency (MDA)
24.B Small Business Technology Transfer (STTR)
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 Technology Transfer (STTR) Program is implemented, administered, and managed by the MDA Small Business Innovation Research (SBIR)/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) STTR Program BAA. MDA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the MDA STTR 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

Your proposal must conform to the terms of this announcement. MDA reserves the right not to consider any or all non-conforming proposals. MDA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by MDA will be funded. MDA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues). Only United States small businesses and certain individuals are eligible to participate in the SBIR/STTR programs. A small business must meet the eligibility requirements set forth in 13 CFR 121.702. Please see the Small Business Administration (SBA) SBIR/STTR website: https://www.sbir.gov/about#eligibility

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 STTR 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 STTR 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 STTR 24.B 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 percentage of work 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 STTR 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. Request for TABA using the MDA Phase I TABA form (optional).
4. Letters of support (optional).

If including a request for TABA, the MDA Phase I TABA Form MUST be completed and uploaded using the "Other" category within Volume 5 of DSIP.

If including letters of support, they MUST be uploaded using the "Letters of Support" category within Volume 5 of DSIP. A qualified letter of support is from a relevant commercial or Government Agency procuring organization(s) working with MDA, articulating their pull for the technology (i.e., what MDS need(s) the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program. Letters of support shall not be contingent upon award of a subcontract.

Any documentation other than required documents listed in the DoD STTR 24.B BAA and letter(s) of support 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 Program Management Office 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 STTR firm may acquire the technical assistance services described above on its own. Firms must request this authority from MDA and demonstrate in its STTR 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 STTR 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 STTR awardees in:
1. Making better technical decisions on STTR projects;
2. Solving technical problems that arise during STTR projects;
3. Minimizing technical risks associated with STTR 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 STTR Program BAA. Selections will be based on best value to the Government considering the evaluation criteria listed in the DoD STTR 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.

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 Program Management Office will distribute selection and non-selection email notices to all firms who submit an MDA STTR 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. Only firms that receive a non-selection notification are eligible for written feedback. Refer to the DoD STTR Program BAA for procedures to protest the announcement.

As further prescribed in Federal Acquisition Regulation (FAR) 33.106(b), and in accordance with FAR clause 52.233-3 Protest after Award, any 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 SBA's 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 contractor shall provide all necessary documentation for evaluation prior to STTR 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.

A Phase I is not intended for any formal end-item contract delivery nor 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 // STTR 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 support contractors and FFRDCs (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 STTR awards in the STTR 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 general OCI rules for Contractors that support development and oversight of STTR topics are

covered in FAR 9.505-1 through FAR 9.505-4 and DFARS 209.505 through DFARS 209.571-8 as the means of avoiding, neutralizing, or mitigating organizational conflicts of interest.

All applicable rules under the FAR Section FAR 9.5 and DFARS 209.5 apply.

If you, or another employee in your company, developed or assisted in the development of any STTR 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 STTR 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 STTR 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.

All MDA STTR topics are subject to ITAR and/or EAR. Your company will 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) (see Attachment), DFARS 252.204-7000 (Disclosure of Information), DFARS clause 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting), DFARS clause 252.204-7020 (NIST SP 800-171 DoD Assessment Requirements), MDA clause H-09 (Organizational Conflict of Interest) (see Attachment), MDA clause H-27 (Foreign Persons) (see Attachment), and MDA clause H-28 (Distribution of Control Technical Data) (see Attachment). 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 STTR contracts and subcontracts without exception. Any information relative to the work performed by the contractor under all MDA STTR 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 National Industrial Security Program Operations Manual (DoD 5220.22-M), 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, the 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/STTR Program (DFARs 252.227-7018)
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 STTR 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 STTR contract must use the security classification guidance provided under that contract to verify new STTR 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).

Attachment – Standard MDA Mandatory Flowdown Local Clauses

H-08 PUBLIC RELEASE OF INFORMATION (MAR 2020)

a. In addition to the requirements of National Industrial Security Program Operations Manual (DoD 5220.22-M), 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, the Missile Defense Agency (MDA) will perform a pre-publication 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 Procuring Contracting Officer (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. (Additional distribution emails can be added by the Program Office to ensure proper internal coordination and tracking of PR requests.)

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.

H-09 ORGANIZATIONAL CONFLICT OF INTEREST (Apr 2020)

a. Purpose: The purpose of this clause is to ensure that:

(1) the Contractor is rendering impartial assistance and advice to the Government at all times under this contract and related Government contracts;

(2) the Contractor's objectivity in performing work under this contract or related Government contracts is not impaired; and

(3) the Contractor does not obtain an unfair competitive advantage by virtue of its access to non-public Government information, or by virtue of its access to proprietary information belonging to others.

b. Scope: The Organizational Conflict of Interest (OCI) rules, procedures and responsibilities described in FAR 9.5 "Organizational and Consultant Conflicts of Interest", FAR 3.101-1 "Standards of Conduct – General, DFARS 209.5 "Organizational and Consultant Conflicts of Interest," and in this clause are applicable to the prime Contractor (including any affiliates and successors-in-interest), as well as any co-sponsor, joint-venture partner, consultant, subcontractor or other entity participating in the performance of this contract. The Contractor shall flow this clause down to all subcontracts, consulting agreements, teaming agreements, or other such arrangements which have OCI concerns, while modifying the terms "contract", "Contractor", and "Contracting Officer" as appropriate to preserve the Government's rights.

c. Access to and Use of Nonpublic Information: If in performance of this contract the contractor obtains access to nonpublic information such as plans, policies, reports, studies, financial plans, or data which has not been released or otherwise made available to the public, the Contractor agrees it shall not use such information for any private purpose or release such information without prior written approval from the Contracting Officer.

d. Access to and Protection of Proprietary Information: The Contractor agrees to exercise due diligence to protect proprietary information from misuse or unauthorized disclosure in accordance with FAR 9.505-4. The Contractor may be requested to enter into a written non-disclosure agreement with a third party asserting proprietary restrictions, if required in the performance of the contract.

e. In accordance with FAR 3.101-1, the Contractor shall also take all appropriate measures to prevent the existence of conflicting roles that might bias the Contractor's judgement, give the Contractor an unfair competitive advantage, and deprive MDA of objective advice or assistance that can result from hiring former Government employees. (See Health Net Fed. Svcs, B-401652.3).

f. Restrictions on Participating in Other Government Contract Efforts.

g. OCI Disclosures: The Contractor shall disclose to the Contracting Officer all facts relevant to the existence of an actual or potential OCI, using an OCI Analysis/Disclosure Form which the Contracting Officer will provide upon request. This disclosure shall include a description of the action the Contractor has taken or plans to take to avoid, neutralize or mitigate the OCI.

h. Remedies and Waiver:

(1) If the contractor fails to comply with any requirements of FAR 9.5, FAR 3.101-1, DFARS 209.5, or this clause, the Government may terminate this contract for default, disqualify the Contractor from subsequent related contractual efforts if necessary to neutralize a resulting organizational conflict of interest, and/or pursue other remedies permitted by law or this contract. If the Contractor discovers and

promptly reports an actual or potential OCI subsequent to contract award, the Contracting Officer may terminate this contract for convenience if such termination is deemed to be in the best interest of the Government, or take other appropriate actions.

(2) The parties recognize that the requirements of this clause may continue to impact the contractor after contract performance is completed, and that it is impossible to foresee all future impacts. Accordingly, the Contractor may at any time seek an OCI waiver from the Director, MDA by submitting a written waiver request to the Contracting Officer. Any such request shall include a full description of the OCI and detailed rationale for the OCI waiver.

H-27 FOREIGN PERSONS (Jun 2010)

1. "Foreign National" (also known as Foreign Persons) as used in this clause 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(a)(3).

"Lawful permanent resident" is a person having 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 and such status not having changed.

"Protected individual" 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."

2. Prior to contract award, the contractor shall identify any lawful U.S. permanent residents and foreign nationals expected to be involved on this project as a direct employee, subcontractor or consultant. For these individuals, in addition to resumes, 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 contract. Supplemental information provided in response to this clause will be protected in accordance with Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)). After award of the contract, the Contractor shall promptly notify the Contracting Officer and Contracting Officer's Representative with the information above prior to making any personnel changes involving foreign persons. No changes involving foreign persons will be allowed without prior approval from the Contracting Officer. This clause does not remove any liability from the contractor to comply with applicable ITAR and EAR export control obligations and restrictions. This clause shall be included in any subcontract."

H-28 DISTRIBUTION CONTROL OF TECHNICAL INFORMATION (AUG 2014)

a. The following terms applicable to this clause are defined as follows:

1. DoD Official. Serves in DoD in one of the following positions: Program Director, Deputy Program Director, Program Manager, Deputy Program Manager, Procuring Contracting Officer, Administrative Contracting Officer, or Contracting Officer's Representative.

2. Technical Document. Any recorded information (including software) that conveys scientific and technical information or technical data.

3. Scientific and Technical Information. Communicable knowledge or information resulting from or pertaining to the conduct or management of effort under this contract. (Includes programmatic information).

4. Technical Data. As defined in DFARS 252.227-7013.

b. Except as otherwise set forth in the Contract Data Requirements List (CDRL), DD Form 1423 the distribution of any technical documents prepared under this contract, in any stage of development or completion, is prohibited outside of the contractor and applicable subcontractors under this contract unless authorized by the Contracting Officer in writing. However, distribution of technical data is permissible to DOD officials having a "need to know" in connection with this contract or any other MDA contract provided that the technical data is properly marked according to the terms and conditions of this contract. When there is any doubt as to "need to know" for purposes of this paragraph, the Contracting Officer or the Contracting Officer's Representative will provide direction. Authorization to distribute technical data by the Contracting Officer or the Contracting Officer's Representative does not constitute a warranty of the technical data as it pertains to its accuracy, completeness, or adequacy. The contactor shall distribute this technical data relying on its own corporate best practices and the terms and conditions of this contract. Consequently, the Government assumes no responsibility for the distribution of such technical data nor will the Government have any liability, including third party liability, for such technical data should it be inaccurate, incomplete, improperly marked or otherwise defective. Therefore, such a distribution shall not violate 18 United States Code § 1905.

c. All technical documents prepared under this contract shall be marked with the following distribution statement, warning, and destruction notice identified in sub-paragraphs 1, 2 and 3 below. When it is technically not feasible to use the entire WARNING statement, an abbreviated marking may be used, and a copy of the full statement added to the "Notice To Accompany Release of Export Controlled Data" required by DoD Directive 5230.25.

1. DISTRIBUTION - [PCO, Insert the appropriate distribution statement and complete the statement, if necessary, to include the applicable controlling office.]

2. WARNING - This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751, et seq.) or the Export Administration Act of 1979 (Title 50, U.S.C., App. 2401 et seq), as amended. Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DoD Directive 5230.25

3. DESTRUCTION NOTICE - For classified documents follow the procedures in DOD 5220.22-M, National Industrial Security Program Operating Manual, February 2006, Incorporating Change 1, March 28, 2013, Chapter 5, Section 7, or DoDM 5200.01-Volume 3, DoD Information Security Program: Protection of Classified Information, Enclosure 3, Section 17. For controlled unclassified information

follow the procedures in DoDM 5200.01-Volume 4, Information Security Program: Controlled Unclassified Information.

d. The Contractor shall insert the substance of this clause, including this paragraph, in all subcontracts.

MDA STTR 24.B Topic Index

MDA24B-T001 TITLE: Generative Artificial Intelligence Algorithm Development for Glide Phase Hypersonic Interceptors

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

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 Glide Phase Intercept (GPI) Interceptors Actively Responsive to Artificial Intelligence (AI) Guided Hypersonic Threats.

DESCRIPTION: Adversary use of AI in hypersonic weapons employment & operations will outstrip and negate US hypersonic interceptor capabilities for interception and kill.

PHASE I: Develop strategic approach and commence evaluating feasibility of proposed solutions. As relevant, leverage physics-driven computational models and validate the ability of generative artificial intelligence (GAI) use in models to predict impact points, tracks leading to intercept, or failure to track/intercept a target. Establish the technical basis through small-scale validation and theoretical analysis.

PHASE II: Updated strategic approach developed in Phase I and continue evaluations to assess the feasibility of proposed solutions. Continue maturation and validation of physics-driven computational models. Down select any competing technologies and provide more extensive testing.

PHASE III DUAL USE APPLICATIONS: Develop or transition the technology to pilot-scale strategic approach as developed in Phase II. Evaluate physics based computational models for transition. Prepare documentation for technology transition and training.

REFERENCES:

1. DoD Joint Artificial Intelligence Center (JAIC) https://www.ai.mil/
2. DoD Data, Analysis, and Artificial Intelligence Adoption Strategy 2023 https://media.defense.gov/2023/Nov/02/2003333300/-1/-1/1/DOD_DATA_ANALYTICS_AI_ADOPTION_STRATEGY.PDF

KEYWORDS: Artificial Intelligence; Algorithm; Glide Phase Interceptor; Hypersonic

TPOC-1: Erwin Myrick
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MDA24B-T002 TITLE: Hypersonic Kill Vehicle Range Extension Research

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: Significantly enhance hypersonic vehicle range performance by using in-flight shape, configuration or control surface configuration changes that maximize and adapt to varying flight conditions that optimize the aerodynamics, control or propulsion properties of the vehicle.
Perform basic, first principles research into these concepts that extend the effective intercept range of a hypersonic kill vehicle in basic defensive mission engagements.

DESCRIPTION: Current defensive hypersonic interceptor approaches are limited in battle space range and combat effectiveness by basic factors such as propulsion capability, flight dynamics, lethality methods and concept of operations. Hypersonic aerodynamics are a significant part of range limitations of a kill vehicle to achieve required end-game vehicle maneuverability. Improving aerodynamic performance would permit improving a number of crucial hypersonic weapon system performance parameters simultaneously.

PHASE I: Develop and execute a first-principles research approach in optimal lift-to-drag methods and vehicle control geometries. Also, identify materials for high temperatures and mechanical strain with long term abilities to tolerate hypersonic flight conditions. Consider high bandwidth vehicle control mechanisms and flight control algorithms that optimize and increase flight ranges. Leverage new state-of-the-art research in materials and aerodynamic sciences. Use digital models to achieve insights into potential non-traditional hypersonic flight dynamics. Adopt an innovative approach for evaluating feasibilities of proposed solutions.

PHASE II: Build on and evolve the physics-based and engineering solutions developed in Phase I involving typical hypersonic basics: Lift, Lift-to-drag ratios leading to long range; high agility and maneuverability; high efficiency propulsion concepts and wide flight envelopes; materials tolerating temperature on leading edges and vehicle body.
Continue evaluations to assess the feasibility of proposed approaches. Utilize and validate functional computational models. Down-select technologies and provide concluding approaches for vehicle range extensions.

PHASE III DUAL USE APPLICATIONS: Dual-use applications could be offensive hypersonic weapons for both tactical and strategic use. Materials sciences under considerations could be utilized in space flight and hypersonic civilian airliner development.

REFERENCES:

1. Hypersonic Aerodynamics – VT - https://archive.aoe.vt.edu/mason/Mason_f/ConfigAeroHypersonics.pdf
2. High-enthalpy hypersonic flows – Shang & Yan, 7 Aug 2020 https://aia.springeropen.com/articles/10.1186/s42774-020-00041-y

3. The physical characteristics of hypersonic flows, Urzay, July 2020
https://web.stanford.edu/~jurzay/hypersonicsCh2_Urzay.pdf

KEYWORDS: Hypersonic interceptor; Extend Interceptor Range; Aerodynamic Research; high temperature materials

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MDA24B-T003 TITLE: Tailored Refractory Metal Alloys for Additive Manufacturing

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

OBJECTIVE: Use computational tools to develop new refractory alloy compositions for use in additive manufacturing of high temperature hypersonic flight components.

DESCRIPTION: This topic seeks the development of novel refractory metal alloy compositions that enhance reliability and additive manufacturability of components for hypersonic flight vehicles. Extreme environmental conditions require structural components of hypersonic flight vehicles such as pintles, nosecones, and control surfaces to exhibit high specific strength and temperature resiliency. This has led to renewed interest in refractory metal alloys (e.g., tungsten, molybdenum), as they can withstand these temperatures and loads. Moreover, additive manufacturing (AM) is of particular focus for such alloys due to the advantages of enabled complex geometries, fewer tooling costs, and reduced scrap rate. Challenges to broad adoption of refractory alloy AM within the Missile Defense System are twofold. First, most existing alloys were developed for wrought and powder metallurgical processes. AM build variables such as thermal cycling, gradients, and alloy properties are known to induce solidification cracking, excess grain growth, and transition across the ductile-to-brittle transition mid-build. Second, many refractory ore or refinery locations are such that defense supply chains may become contested in the event of regional conflicts.

As such, alternative refractory alloy compositions that help allay these manufacturing and supply chain hurdles are needed, with application to both test targets and interceptors. Integrated computational materials engineering (ICME) tools have demonstrated the ability to conduct rapid evaluation and optimization of candidate materials based on desired properties, resulting in appreciable cost and time savings compared to traditional “guess and check” methodologies of development.

Performance criteria for evaluating refractory alloy candidates include, but are not limited to, thermophysical properties such as thermal expansion, thermal conductivity, and specific heat; specific strength; and additive manufacturing quality metrics such as build density vs. bulk value and build defect prevention. The developed alloys should show the ability to perform in environments representative of hypersonic flight. Consideration of geographic locations for both ore extraction and primary metal production facilities of constituent alloy elements is also important, specifically large production in either the United States or North America. Lastly, the developed alloys must be cost effective with a well-developed technology transition plan for powder or wire feedstock production sufficient for meeting the emerging needs of the hypersonic industrial base.

PHASE I: Demonstrate the feasibility of the proposed alloy development approach via program implementation and algorithm testing. The algorithms must consider cost, material performance, and supply chain resiliency, with rationale provided regarding their respective weights. Performers should identify firms or in-house capabilities for maturing production of novel AM powders and obtain rough order of magnitude pricing for initial powder batches or wire feedstock. Provide test plans for determining AM parameters and material properties, and obtain rough order of magnitude pricing for initial batch powder or wire production.

PHASE II: Procure or produce initial batches of powder of downselected candidate alloys and manufacture representative laboratory test coupons. Test such coupons in accordance with test plans and determine level of agreement of material performance with predictions. Refine and optimize the alloy composition based on experimental results. Conduct manufacturing assessments to determine statistical

parameters for quality and repeatability. Provide the test data to the Government along with preliminary cost, initial raw material sourcing, and schedule projections for pilot-scale powder production.

PHASE III DUAL USE APPLICATIONS: Develop or transition the technology to pilot-scale feedstock production. Advance maturity of the AM process for these feedstocks, providing data on quality and repeatability of the both production and printing processes. Manufacture representative components for hypersonic or propulsion applications.

REFERENCES:

1. Gradl, P.; Mireles, O.R.; Katsarelis, C.; et al. Advancement of Extreme Environment Additively Manufactured Alloys for Next Generation Space Propulsion Applications. Acta Astronautica 2023, 211, 483-497.
2. Pollock, T.M.; Clarke, A.J.; Babu, S.S. Design and Tailoring of Alloys for Additive Manufacturing. Metallurgical and Materials Transactions A 2020, 51, 6000-6019.
3. Bose, A.; Schuh, C.A.; Tobia, J.C.; et al. Traditional and Additive Manufacturing of a New Tungsten Heavy Alloy Alternative. International Journal of Refractory Metals and Hard Materials 2018, 73, 22-28.
4. Wang, X.; Xiong, W. Uncertainty Quantification and Composition Optimization for Alloy Additive Manufacturing through a CALPHAD-Based ICME Framework. NPJ Computational Materials 2020, 6, 188.

KEYWORDS: Additive Manufacturing; Refractory Alloys; Integrated Computational Materials Engineering; Alloy Development

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MDA24B-T004 TITLE: High ISP Controllable Solid Propellant

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: Develop high-slope solid propellants with higher specific impulse (Isp) than state of the art for use with controllable solid propellant rockets.

DESCRIPTION: As controllable solid rocket material technologies advance, high-slope propellants with higher specific impulse can be developed to maximize the performance of thrusters. The burn rate of propellants is an exponential function of chamber pressure. Because the burn rate as a function of pressure is normally graphed on a log-log plot where the burn rate would be linear, propellants with high exponent values are commonly called high slope propellants. This topic seeks new propellants or improvements to existing propellant formulations to maximize specific impulse while achieving high burn rate exponents at a wide range of pressures. Additional factors to consider are communications interference and high melting point by-products that may solidify on motor components during operation. For these reasons, reduced smoke propellants typically trade more favorably than smoky propellants. Desired applications include throttling axial motors and divert and attitude control systems.

PHASE I: Develop a class 1.3 propellant optimized for high specific impulse, burn rate exponents greater than 0.7, and stable combustion at wide range of pressures. Proposers may demonstrate the combustion temperature and specific impulse of the proposed propellant by analysis, but must physically demonstrate actual burn rates at multiple pressures. Low fidelity burn rate measurements like strand burning are acceptable for Phase I. A propellant whose combustion gas composition minimizes partial pressures of oxidizing species like oxygen and water is desired but not required. Partnership with a propulsion system manufacturer would help significantly to guide Phase I goals for desired pressure ranges, combustion temperatures, and other values.

PHASE II: Determine the burn rate of the propellant developed in Phase I through small scale motor burn rate testing for the pressures tested in Phase I. Demonstrate repeatable production of propellant or ingredients using scalable production methods. The proposed propellant must have a shelf-life of more than 20 years as determined by aging data. Thermal structural analysis, testing, or a combination of both must demonstrate that the proposed propellant can survive storage in temperatures as low as -40 °C.

PHASE III DUAL USE APPLICATIONS: Partner with a controllable solid propellant thruster manufacturer to test the propellant. Demonstrate that the burn rate of the proposed propellant is reproducible at ambient temperature with a variation less than 10% at the pressures specified by a manufacturer. During Phase III the effect of initial motor temperature on the burn rate of the propellant must be determined.

REFERENCES:

1. G. P. Sutton and O. Biblarz, Rocket Propulsion Elements, New York: Wiley, 2001.
2. A. E. Oberth, Principles of Solid Propellant Development, Fair Oaks, 1986.

3. R. L. Lou and A. Katsakian, Fast-Burning Rate/High Slope Propellant Technology Program, AD0514877

KEYWORDS: propellant; controllable solid propulsion; specific impulse

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MDA24B-T005 TITLE: Using Cognitive Digital Twin Framework for Autonomous Target Discrimination

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Integrated Sensing and Cyber; Emerging Threat Reduction

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: Seek the Cognitive Digital Twin technology to develop a novel method for fusion of heterogeneous multi-sensor information to characterize and understand environment, identify high interest objects, and support intelligent decision-making.

DESCRIPTION: To protect the United States and allies from current ballistic missiles and preparing to defend against future increasingly more complex threats, the BMDS assigned the high priority to advance current architecture models to incorporate novel methodologies and techniques. This architecture model advancement can be also performed in the commercial domain and the obtained results transferred to military applications.

One of the most critical characteristics of many military and commercial assets is its ability to utilize all the available information from deployed sensors and the state-of-the art Machine Learning (ML) and Artificial Intelligence (AI) algorithms to perform their important functions as scene characterization and understanding, target selection and decision-making. To boost quality of these tasks, an autonomous system needs to be designed and developed that employs an information fusion scheme with contextual adaptation, a time-evolving ML/AI discrimination of high priority objects, and fire engagement decision-making procedures derived from estimated classification confidence.

Current machine learning approaches to information fusion and decision-making in both military and commercial often have no means of properly handling differences in sensor resolution and coverage, disparate phenomenology, and limited viewing geometry, as well as the inherent uncertainty of the collection of observed data or/and of exploiting the available higher level contextual information on the threat evolution and environment.

Due to the development of new-generation information and digitalization technologies, more data can be collected, which in turn require better ways for the deep application of these data. As a result, the concept of Digital Twin (DT) has aroused much attention and is developing rapidly. DT is typically described as consisting of a physical system, its virtual replica, and the data connections between them. It is increasingly being explored as a means of describing and improving the performance of physical systems through leveraging various computational techniques including ML and AI algorithms. The advantage of DT over simulations is that it creates an active virtual environment capable of involving several simulations, utilizing real-time data and a two-way flow of information between the twin and the data sensors. The DT technology becoming increasingly prevalent in many fields, including the autonomous systems industry.

Characterizing and identification of incurring military or commercial objects in complex environments using diverse sensing has a number of significant challenges. Typically, data may be sparse, collection times are limited, a priori information is incomplete and/or may be in error, additionally, unexpected events and objects may appear. Though DT technology can support many of the necessary integration and correlation procedures, it needs to fuse all available data with information and knowledge related to the scene characterization and target identification. Hence, it becomes necessary to augment the DT with cognitive capabilities. Semantic technologies such as ontology and knowledge graphs could provide potential solutions by empowering DTs with reasoning abilities.

The Cognitive Digital Twin (CDT) concept has been recently proposed which reveals a promising evolution of the current DT concept towards a more intelligent, comprehensive and full lifecycle representation of complex systems. It is intended to harness a high level of intelligence that can replicate human cognitive processes and execute conscious actions autonomously, with minimal or no human intervention. The CDT structure provides an excellent framework to greatly improve the effectiveness of autonomous system actions. The novel fusion and decision-making system structured as a cognitive digital twin can be suitably integrated with relevant digital twins developed by many developers via its capabilities of communication, analytics, and cognition. Consequently, it will perfectly support development and evolution of capabilities for autonomous systems.

A CDT based fusion system would replace and/or improve legacy and current approaches like Dempster-Schafer theory, rule-based expert systems, Bayesian networks, probabilistic relational models, etc.
In summary, the successful proposal will address all the technical challenges in designing and developing an onboard CDT based fusion and decision-making system including:
1. Appropriate handling differences in sensor resolution and coverage, disparate phenomenology, and limited viewing geometry, as well as the inherent uncertainty of the collection of observed data;
2. Exploiting the available higher level contextual information on the threat evolution and scenery;
3. Optimizing real-time data collection and minimizing the required data transmission;
4. A time-evolving, adaptive ML/AI important entities identification algorithms providing class probabilities of high priority items as well as dealing with absence of information on some objects;
5. Commitment decision-making procedures derived from estimated classification confidence and contextual reasoning;
6. Supporting future evolution of capabilities of autonomous systems in complex and evolving environments.

PHASE I: Demonstrate proof of principle with a cognitive digital twin prototype for an innovative fusion, classification, and decision-making concept. Utilizing surrogate objects generation, their data, and contextual information, conceptualize, develop, and model near real-time solutions that satisfy the problem objectives and requirements.

PHASE II: Using realistic, relevant threat data, refine and implement designs from Phase I. Validate concept with available test data.

PHASE III DUAL USE APPLICATIONS: The topic has numerous military and commercial applications, where fusion of available time-evolving information can assist with scene description and its understanding to support optimal decision-making, e.g., advanced assistance systems and autonomous vehicle development.

REFERENCES:

1. Li, Luning, et al. "Digital twin in aerospace industry: A gentle introduction." IEEE Access 10 (2021): 9543-9562.

2. Hossain, S M Mostaq, et al. “A New Era of Mobility: Exploring Digital Twin Applications in Autonomous Vehicular Systems.” 2023 IEEE World AI IoT Congress IEEE, (2023): 493-499.
3. Eirinakis, Pavlos, et al. "Enhancing cognition for digital twins." 2020 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC) IEEE, (2020): 1-7.
4. Sahlab, Nada, et al. "Extending the Intelligent Digital Twin with a context modeling service: A decision support use case." Procedia CIRP 107 (2022): 463-468.
5. Maurer, Donald E., et al. "Sensor fusion architectures for ballistic missile defense." Johns Hopkins APL technical digest 27.1 (2006): 19-31.
6. Domingos, Pedro and Richardson, Matthew. "Markov logic: A unifying framework for statistical relational learning." Statistical Relational Learning (2007): 339-344.

KEYWORDS: Target Discrimination; Remote Sensing; Information Fusion; Digital Twin; Cognitive Process; Machine Learning; Artificial Intelligence; Autonomous System; Decision-making

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MDA24B-T006 TITLE: Over-the-Horizon Radar (OTHR) Waveform Design for Maneuvering Targets

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: Develop a methodology or algorithm for developing an ensemble of waveforms for OTHR applications against fast and maneuvering targets in endo environments that provide thumbtack range/Doppler resolution, resilient range/Doppler sidelobe suppression, and enable spectrum tailoring. OTHRs provide detection and tracking capabilities against potential threats within the atmosphere (aircraft, cruise missiles, hypersonic missiles, etc.) by refracting radio frequency (RF) energy within the ionosphere to extend radar coverage beyond line-of-sight. Waveforms must be resilient to ionospheric propagation effects including natural and human-made electromagnetic interference. Secondary objective is to understand the inherent electronic protection features of these waveforms.

DESCRIPTION: New types of waveforms are needed to support the high frequency (HF) continuous wave (CW) transmitter that the government is developing for the OTHR Testbed, which will support US Air Force acquisition of a national OTHR system. The testbed would demonstrate and mature key technologies for NORTHCOM and INDOPACOM OTHR acquisitions in defense of against hypersonic threats.

PHASE I:
•Develop a methodology or algorithm for defining multiple coded HF CW transmitter waveforms that produce thumbtack-type matched-filter response – no range or Doppler ambiguities
•Matched-filter range/Doppler sidelobe peaks should be at least 1/TBP below the peak response where TBP is the time-bandwidth product of a single dwell
•Matched filtering must accommodate high-speed targets such that target Doppler offset is significantly greater than Waveform Repetition Rate
•Waveform-generation algorithm should include provision for tailoring transmitted spectrum of waveform such as enforcing suppression of out-of-band emissions
•Report potential electronic protection features of proposed waveforms

PHASE II:
•Demonstrate resilience of Range/Doppler sidelobe suppression to ionospheric propagation effects including natural and human-made electromagnetic interference
•Model target returns and provide interface to Government furnished signal processing and tracking algorithm simulation. Compare relative performance between nominal linear frequency modulated (LFM) waveforms and representative substantiations of the thumbtack response waveform
•Delineate implementation requirements for real-time operation including throughput and buffering

PHASE III DUAL USE APPLICATIONS: Integrated waveforms in OTHR transmitter testbed

REFERENCES:

1. Y. Abramovich, D. Dickey and V. Abramovich, "Spectrum-Controlled Waveforms Design with the Thumb-Tack Ambiguity Function for HF OTH Radars," 2023 IEEE Radar Conference (RadarConf23), San Antonio, TX, USA, 2023, pp. 1-6, doi: 10.1109/RadarConf2351548.2023.10149799
2. Y. Abramovich, D. Dickey and V. Abramovich," Spectrally Limited Periodic Waveforms for HF OTHR Applications," https://www.researchgate.net/publication/365189135_Spectrally_Limited_Periodic_Waveforms_for_HF_OTHR_Applications, November 2022
3. "Radar Spectrum Engineering and Management," NATO Science and Technology Organization TR-SET-182, April 2017, https://apps.dtic.mil/sti/pdfs/AD1039816.pdf Approved for Public Release 24-MDA-11708 (5 Mar 24)

KEYWORDS: over the horizon radar; OTHR; waveform; maneuvering; hypersonic; cruise missile; high frequency; HF; transmitter

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National Geospatial-Intelligence Agency (NGA)
24.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

INTRODUCTION

NGA is a Department of Defense (DoD) combat support agency and a member of the U.S. Intelligence Community (IC). NGA develops imagery and map-based intelligence solutions for U.S. national defense, homeland security, and safety of navigation. NGA's mission is to "provide timely, relevant, and accurate geospatial-intelligence in support of national security." Today, NGA manages the National System for Geospatial-Intelligence (NSG), which provides the foundation for correlating U.S. intelligence activities to the location of the Earth.

Geospatial intelligence, or GEOINT, is the exploitation and analysis of imagery and geospatial information to describe, assess and visually depict physical features and geographically referenced activities on the Earth. GEOINT consists of imagery, imagery intelligence and geospatial information. Additional information pertaining to the NGA mission and high-level course can be obtained by viewing the agency's website at https://www.nga.mil and NGA's strategy documents at https://www.nga.mil/about/strategy.html.

NGA Research supports the NSG and National Security Strategy by solving hard defense and intelligence problems for the IC and DoD in three broad areas: Foundational GEOINT; Advanced Phenomenologies; and Analytic Technologies. NGA Research works with customers on early concepts through to advanced developments in operating systems and environments.

Offerors responding to a topic in this BAA must follow all general instructions provided in the DoD STTR Program BAA, as applicable. NGA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the NGA STTR Program and these proposal preparation instructions should be directed to:

National Geospatial-Intelligence Agency
Attn: SBIR Program Manager, RE, MS: S75-RA
7500 GEOINT Dr., Springfield, VA 22150-7500
Email: SBIR@nga.mil

Proposers responding to a topic in this BAA must follow all general instructions provided in the DoD STTR Program BAA. NGA 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 NGA Program and these proposal preparation instructions should be directed to: sbir@nga.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.

Technical Volume (Volume 2)
The technical volume is not to exceed 20 pages and must follow the formatting requirements provided in the DoD STTR Program BAA. The Government will not consider pages in excess of the page count limitation. Number all pages of your proposal consecutively.

Content of the Technical Volume
The offeror shall not propose option period(s).

(6) Commercialization Strategy. In addition, the Commercialization Strategy shall also address Section 508 compliance as noted below:

Section 508 Compliance

The contractor shall ensure that all systems, hardware, software, software engineering, and information technology associated with this effort is made in a manner that is accessible for people with the standards for people with disabilities as directed in the NGA Instruction 8400.4 and Section 508 of the Rehabilitation Act of 1973 as amended in 1998 (Section 508). Specifically, all Information and Communications Technology (ICT) associated with this contract, may use the Web Content Accessibility Guidelines (WCAG) 2.1 to comply with the Section 508 or use alternative designs or technologies which result in substantially equivalent or greater access to and use of the product for people with disabilities. Furthermore, the contractor shall pursue human centered design and usability guidelines to ensure that all services associated with this Topic Area are accessible by as many users as possible and to drive modernization, innovation, and enhance mission support.

As part of the offeror's proposal, the offeror should include an outline of specifically how Section 508 compliance will be achieved in the design of the ICT product. The proposal for Phase II should provide an explicit, detailed description of the approach, indicate what is planned, how and where the work will be carried out, a schedule of major events, how the solution will be Section 508 Compliant, and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. If a determination is made that a Section 508 exception request is justified, the rationale for the exception request must be made and submitted as a part of the proposal.

Cost Volume (Volume 3)
Unless otherwise stated in the individual topic announcement, the Phase I amount must not exceed $100,000 for up to a six (6)-month period of performance. Costs must be separated and 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. NGA 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 STTR Program BAA for full details on this requirement. Information contained in the CCR will be considered by NGA during proposal evaluations.

Supporting Documents (Volume 5)
All proposing small business concerns are REQUIRED to submit the following documents in 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

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. Small business concerns shall provide a proposal no later than 30 calendar days prior to the expiration of their NGA Phase I contract period of performance to be considered for a Phase II award. For improved continuity, NGA encourages Phase I awardees to submit their Phase II proposals 60 days prior to the expiration of their NGA Phase I contract period of performance.

Sequential Phase II proposals (for related work after completion of the initial NGA Phase II or Direct to Phase II contract) will normally be required within 30 calendar days of: 1) NGA's review of the provider's prototype and final report, 2) NGA's determination that additional work is desired and funding is available; and 3) NGA's determination that the required work is not suitable for a Phase III contract. NGA expects to complete these actions within 30 calendar days of final report receipt. The precise proposal due date will be annotated in Section F of the original Phase II or Direct to Phase II contract.

NGA may entertain Phase II proposals to continue related work on non-NGA Phase I contracts of interest, subject to the original government contracting entity's approval. There are no pre-established due dates for these proposals.

Phase II proposal format, content, and submission instructions are identical to those described in the "DIRECT TO PHASE II PROPOSAL INSTRUCTIONS" above, except that the Technical Volume will only contain a Technical Proposal of up to 20 pages. Do not submit Part A – Feasibility Documentation.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

NGA does not provide TABA.

EVALUATION AND SELECTION
All Phase I proposals will be evaluated in accordance with the evaluation criteria listed in the DoD STTR Program BAA.

The individual named as the Corporate Official on the Proposal Cover Sheet will receive an email for each proposal submitted from the NGA Contracting Officer/Specialist with their official notification of proposal selection or non-selection within 90 days of the closing date of the BAA or the timely submission date of their Phase II proposal. The notices will be binned into 3 categories: (1) proposals selected for award, (2) proposals not selected for award, and (3) disqualified proposals.

Refer to the DoD STTR 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: Joylene Burton at Joylene.U.Burton@nga.mil and Gregory Whaley at Gregory.L.Whaley@nga.mil.

AWARD AND CONTRACT INFORMATION
Unless otherwise stated in the individual topic announcement:

- Phase I awards are capped at $100,000 each over a maximum nine (9)-month period of performance.
- Phase II awards are capped at $1,000,000 each over a maximum 24-month period of performance.

NGA caps sequential Phase II contracts (those proposed near the completion of the initial Phase II or Direct to Phase II contract) at the then current Small Business Administration (SBA) "without seeking SBA approval" ceiling over a maximum 24-month period of performance. See https://www.sbir.gov/about for the most recent information.

NGA typically provides a firm fixed price contract for its awards within 180 days of the proposal due date. The type of contract is at the discretion of the Contracting Officer.

ADDITIONAL INFORMATION

CONTROLLED UNCLASSIFIED INFORMATION (CUI)

Controlled Unclassified Information (CUI) is information that requires safeguarding or dissemination controls pursuant to and consistent with applicable law, regulations, and government-wide policies but is not classified under Executive Order 13526 or the Atomic Energy Act, as amended.

Executive Order 13556 "Controlled Unclassified Information" (the Order), establishes a program for managing CUI across the Executive branch and designates the National Archives and Records Administration (NARA) as Executive Agent to implement the Order and oversee agency actions to ensure compliance. The Archivist of the United States delegated these responsibilities to the Information Security Oversight Office (ISOO).

32 CFR Part 2002 "Controlled Unclassified Information" was issued by ISOO to establish policy for agencies on designating, safeguarding, disseminating, marking, decontrolling, and disposing of CUI, self-inspection and oversight requirements, and other facets of the Program. The rule affects Federal executive branch agencies that handle CUI and all organizations (sources) that handle, possess, use, share, or receive CUI—or which operate, use, or have access to Federal information and information systems on behalf of an agency.

During performance of this contract, if the government provides the offeror a dataset that is not publicly released, the offeror must be CUI Compliant to receive it. For more information on this compliance please see DFARS Clauses 252.204.7008 and 252.204-7012, NIST Special Publication SP 800-171 and the National Archives and Records Administration (NARA) website (https://www.archives.gov/cui/about).

See each individual topic for guidance.

NON-DISCLOSURE AGREEMENTS (NDA)

Subject to any vetting of uncleared individuals involved in the project per the DoD STTR Program BAA, all eligible contractor and subcontractor personnel requiring access to Protected Information and Computer Software shall sign an NDA prior to accessing such information. See 5X52.209-9003, Protection of Information and Nondisclosure Agreements (JUN 2009) below for additional details.

INFORMATION HANDLING

Contractor personnel will comply with the NGA, DoD, and IC policies and regulations (to include, but not limited to, the CoNGA Security Classification Guide) to properly mark (to include portion marking) classified and unclassified documentation, media, etc.

Markings will be in accordance with the lowest security classification possible to ensure the confidentiality and integrity for the greatest release to partners in accordance with NGA and mission partner marking guides for classified information.

Information management will be in accordance with applicable security policy and regulations, and NGA compliance documents.

All Government-furnished information released to the Contractor or created in the performance of this contract will be destroyed or returned by the Contractor to NGA upon contract termination or when no longer required for contract performance. The determination to destroy or return will be at the direction of the NGA CO or COR.

CLASSIFIED WORK PERFORMANCE SECURITY REQUIREMENTS (Not applicable to UNCLASSFIED ONLY contracts)

Contractor personnel performing Top Secret/Sensitive Compartmented Information (TS/SCI) work on the STTR contract are required to have active TS/SCI clearances for access to NGA facilities, when performing duties within TS/SCI environments, and for access to TS/SCI NGA computer systems. Contractors are subject to a Counterintelligence Polygraph as requested by the Government. NGA will sponsor TS/SCI security clearances, NGA Badges, Common Access Cards (CAC) and other items (example: parking hangtag) for required contract personnel.

Contractors must abide by the DD Form 254 - Contract Security Classification Specification and applicable security policies and regulations.

Contractor personnel shall follow all applicable NGA, IC, and DoD information security and operational security policies and guidance when accessing and transmitting data over networks during performance of agreement requirements.

The contractor shall inform the Government when its employees no longer support the contract (see DD254). The Government desires notification prior to the day the individual no longer supports the contract, but requires notification no later than the day support ends. If contractor personnel will no longer be supporting NGA via an NGA contract, any debriefing paperwork, notifications, and/or requests for further direction from the COR or Industrial Security shall be turned into the NGA Workforce Support Center, NGA Site Security Office, or the COR. If contract personnel are unable to turn these items into the NGA Workforce Support Center, NGA Site Security Office, or COR then it is the contractor's security office's responsibility to collect the items from the individual. If the contractor debriefs the employee, the contractor shall send a

copy of the debriefing statement, plus any Government items (i.e. NGA Badge, CAC, Courier Card, parking hangtags, etc.) within four (4) business days (timeline may be extended with authorized documented exceptions by NGA Security) to an NGA Site Security Office or the NGA Workforce Support Center.

All classified work performed at a non-NGA facility must be approved by the COR.

Cleared contractor personnel may be authorized to hand-carry contract-related classified information as authorized by the COR. Contract personnel will obtain NGA courier authorization prior to hand-carry of contract-related classified data. Contract personnel will be limited to hand-carry classified information between the contractor facilities and NGA facilities only.

Any classified work performed at collaborator sites must be performed in either an NGA accredited SCIF or an Other Government Agency (OGA) SCIF that has either a Memorandum of Agreement (MOA), Memorandum of Understanding (MOU), Joint Use Agreement or Co-Use Agreement with NGA for this contract.

Contract personnel are forbidden from bringing in prohibited, unauthorized, and/or Portable Electronic Devices (PEDs) items into any NGA installation or any office/working location covered under this agreement. A list of PEDs includes but is not limited to cell phones, cameras, two-way pagers, laptops, recorders (digital, tape, etc.), flash drives, or any other kind of removable media, without prior approval and approval paperwork from NGA. See NGA instructions/regulations/policy for a full list of prohibited and unauthorized items. Security violation repercussions will be determined on the severity of the violation.

DISCLOSURE OF INFORMATION

(1) The Contractor shall not release to anyone outside the Contractor's organization any unclassified information, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract, unless-

(a) The Contracting Officer has given prior written approval;
(b) The information is otherwise in the public domain before the date of release; or
(c) The information results from or arises during the performance of a project that involves no covered defense information (as defined in the clause at DFARS 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting) and **has been scoped and negotiated by the contracting activity with the contractor and research performer and determined in writing by the contracting officer to be fundamental research* (which by definition cannot involve any covered defense information)**, in accordance with National Security Decision Directive 189, National Policy on the Transfer of Scientific, Technical and Engineering Information, in effect on the date of contract award and the Under Secretary of Defense (Acquisition, Technology, and Logistics) memoranda on Fundamental Research, dated May 24, 2010, and on Contracted Fundamental Research, dated June 26, 2008 (available at DFARS PGI 204.4).

(2) Requests for approval under paragraph (a)(1) shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Contractor shall submit its request to the Contracting Officer at least 10 business days before the proposed date for release.

(3) The Contractor agrees to include a similar requirement, including this paragraph (c), in each subcontract under this contract. Subcontractors shall submit requests for authorization to release through the prime contractor to the Contracting Officer.

***Note: This has to be negotiated prior to award of the contract. A request for determination after award will not be entertained and will result in the clause being pushed down to all subcontracts. Non-performance could result in cancelation of contract.**

Clauses

52.204-7 System for Award Management.

As prescribed in 4.1105(a)(1), use the following provision:

SYSTEM FOR AWARD MANAGEMENT (OCT 2018)

(a) Definitions. As used in this provision—

"Electronic Funds Transfer (EFT) indicator means a four-character suffix to the unique entity identifier. The suffix is assigned at the discretion of the commercial, nonprofit, or Government entity to establish additional System for Award Management records for identifying alternative EFT accounts (see subpart 32.11) for the same entity.

Registered in the System for Award Management (SAM) means that–

(1) The Offeror has entered all mandatory information, including the unique entity identifier and the EFT indicator, if applicable, the Commercial and Government Entity (CAGE) code, as well as data required by the Federal Funding Accountability and Transparency Act of 2006 (see subpart 4.14) into SAM

(2) The offeror has completed the Core, Assertions, and Representations and Certifications, and Points of Contact sections of the registration in SAM;

(3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The offeror will be required to provide consent for TIN validation to the Government as a part of the SAM registration process; and

(4) The Government has marked the record "Active".

Unique entity identifier means a number or other identifier used to identify a specific commercial, nonprofit, or Government entity. See www.sam.gov for the designated entity for establishing unique entity identifiers.

(b)

(1) An Offeror is required to be registered in SAM when submitting an offer or quotation, and shall continue to be registered until time of award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.

(2) The Offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "Unique Entity Identifier" followed by the unique entity identifier that identifies the Offeror's name and address exactly as stated in the offer. The Offeror also shall enter its EFT indicator, if applicable. The unique entity identifier will be used by the Contracting Officer to verify that the Offeror is registered in the SAM.

(c) If the Offeror does not have a unique entity identifier, it should contact the entity designated at www.sam.gov for establishment of the unique entity identifier directly to obtain one. The Offeror should be prepared to provide the following information:

(1) Company legal business name.

(2) Tradestyle, doing business, or other name by which your entity is commonly recognized.

(3) Company physical street address, city, state, and Zip Code.

(4) Company mailing address, city, state and Zip Code (if separate from physical).

(5) Company telephone number.

(6) Date the company was started.

(7) Number of employees at your location.

(8) Chief executive officer/key manager.

(9) Line of business (industry).

(10) Company headquarters name and address (reporting relationship within your entity).

(d) Processing time should be taken into consideration when registering. Offerors who are not registered in SAM should consider applying for registration immediately upon receipt of this solicitation. See https://www.sam.gov for information on registration.

(End of Provision)

52.204-27 Prohibition on a ByteDance Covered Application.

As prescribed in 4.2203, insert the following clause:

PROHIBITION ON A BYTEDANCE COVERED APPLICATION (JUN 2023)

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

Covered application means the social networking service TikTok or any successor application or service developed or provided by ByteDance Limited or an entity owned by ByteDance Limited.

Information technology, as defined in 40 U.S.C. 11101(6)—

(1) Means any equipment or interconnected system or subsystem of equipment, used in the automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency, if the equipment is used by the executive agency directly or is used by a contractor under a contract with the executive agency that requires the use—

(i) Of that equipment; or

(ii) Of that equipment to a significant extent in the performance of a service or the furnishing of a product;

(2) Includes computers, ancillary equipment (including imaging peripherals, input, output, and storage devices necessary for security and surveillance), peripheral equipment designed to be controlled by the central processing unit of a computer, software, firmware and similar procedures, services (including support services), and related resources; but

(3) Does not include any equipment acquired by a Federal contractor incidental to a Federal contract.

(b) *Prohibition*. Section 102 of Division R of the Consolidated Appropriations Act, 2023 (Pub. L. 117-328), the No TikTok on Government Devices Act, and its implementing guidance under Office of Management and Budget (OMB) Memorandum M-23-13, dated February 27, 2023, "No TikTok on Government Devices" Implementation Guidance, collectively prohibit the presence or use of a covered application on executive agency information technology, including certain equipment used by Federal contractors. The Contractor is prohibited from having or using a covered application on any information technology owned or managed by the Government, or on any information technology used or provided by the Contractor under this contract, including equipment provided by the Contractor's employees; however, this prohibition does not apply if the Contracting Officer provides written notification to the Contractor that an exception has been granted in accordance with OMB Memorandum M-23-13.

(c) *Subcontracts*. The Contractor shall insert the substance of this clause, including this paragraph (c), in all subcontracts, including subcontracts for the acquisition of commercial products or commercial services.

(End of clause)

5X252.204-7000-90 PUBLIC RELEASE OF INFORMATION (MAR 2023)

(a) Except as provided in paragraph (b) of this clause, information pertaining to this contract shall not be released to the public unless authorized by the Contracting Officer in accordance with DFARS 252.204-7000, Disclosure of Information. Requests for approval to release information pertaining to this contract shall be submitted to the Contracting Officer by means of NGA Form 5230-1, National Geospatial-Intelligence Agency Request for Clearance for Public Release.

(b) The contractor may provide past performance information regarding this contract, without completing an NGA Form 5230-1 and without Contracting Officer approval, when submission of such information is to the Office of the Director of National Intelligence (ODNI), the Central

Intelligence Agency (CIA), the National Reconnaissance Office (NRO), the National Security Agency (NSA), the Defense Intelligence Agency (DIA), and NGA to support source selections at those agencies. The contractor is responsible for the proper classification and handling of such information, and shall provide a copy of the information provided to the Contracting Officer.

(End of Clause)

5X52.209-9003: PROTECTION OF INFORMATION AND NONDISCLOSURE AGREEMENTS (JUN 2009)

(a) Definitions. As used in this clause only:

(1) Protected Information and Computer Software means, unless specifically excluded by paragraph below, all information and computer software, in any form or media, that in the course of performing work under this contract are disclosed to the Contractor, its subcontractors, or their employees, or to which those persons otherwise are given access to, by:

(i) NGA,

(ii) Other government agencies,

(iii) Foreign governments, or

(iv) Other contractors while directly supporting NGA, which is accompanied by written legends identifying use or disclosure restrictions or disclosed under circumstances that the Contractor knows are subject to use or disclosure restrictions established in writing by the Government.

(2) Protected Information and Computer Software does not include information that:

(i) Has been released to the general public through no action of the undersigned in breach of this agreement or through no action of any other party in breach of any other obligation of confidentiality owing to the Government or the owner of the protected information or computer software;

(ii) Has been lawfully obtained by the recipient outside the course of the performance of this contract;

(iii) Has been properly licensed or provided directly by the owner (or other authorized source) of the information or computer software to the recipient to the extent so licensed or provided;

(iv) Is owned by the recipient or was developed independently of the disclosure hereunder; or

(v) Has been disclosed to the recipient by the Government with explicit authorization to use or disclose the information for another purpose, to the extent so authorized.

(b) Use and disclosure restrictions. The Contractor shall use and disclose Protected Information and Computer Software only as necessary for the performance of the requirements of this contract. Protected Information and Computer Software may not be used or disclosed for any other purpose, including bid or proposal preparation or business marketing, without the written

approval of the Contracting Officer. Furthermore, unless otherwise directed by the Contracting Officer, the Contractor shall comply with all restrictions set forth in any legends, licenses or instructions provided to the Contractor or accompanying Protected Information and Computer Software or other written directives of the Government known to the Contractor. The use and disclosure obligations imposed by this paragraph shall expire as follows:

(1) There shall be no expiration date for the following Protected Information and Computer Software:

(i) Technical data or computer software containing Limited Rights, Restricted Rights, Government Purpose Rights, Special License Rights, or Unlimited Rights legends;

(ii) information or software marked Limited Distribution (LIMDIS);

(iii) information or software marked Source Selection Information;

(iv) contract proposal information marked pursuant to FAR 52.215-1(e) limiting its use for proposal evaluation purposes only;

(v) information and computer software marked Contractor Proprietary or a similar legend;

(vi) data known by the Contractor to be protected by the Privacy Act; and

(vii) information and software marked Controlled Unclassified Information (CUI) or For Official Use Only (FOUO).

(2) For other information or software accompanied at time of disclosure by a written legend identifying use or disclosure restriction time periods, the expiration date shall be as stated in or derived from the legend.

(3) For all other Protected Information and Computer Software, the expiration date shall be 3 years from the date the information or software is first disclosed to the Contractor.

Notwithstanding the above obligations, the Contractor is not in breach of this agreement if the Contractor uses or discloses Protected Information and Computer Software in response to an order of a court or administrative body of competent jurisdiction, but only to the extent permitted by that authority and only if the Contractor gives the Contracting Officer, to the extent practical, notice of the tribunal's order before the use or disclosure is made that allows NGA a reasonable time to object to the order.

(c) Unauthorized Use or Disclosure. The Contractor shall immediately notify the Contracting Officer of any unauthorized use or disclosure known by the Contractor of Protected Information and Computer Software in violation of the obligations contained in this clause.

(d) Disposition. At the conclusion of performance of work under this contract, the Contractor shall immediately return to the Government all Protected Information and Computer Software in its possession. Furthermore, if an employee of the Contractor who has had access to Protected Information and Computer Software is terminated or reassigned and thus is no longer performing work under this contract, the Contractor shall immediately return all Protected Information and Computer Software in the employee's possession. Moreover, if a Contractor's employee is dedicated to support a specific NGA Office or Directorate or NGA program under this contract, but is subsequently reassigned to support another NGA Office or Directorate or NGA program under this contract, the Contractor shall immediately return all Protected Information or

Computer Software in the employee's possession previously furnished by the prior NGA Office or Directorate or NGA program. In lieu of returning Protected Information and Computer Software, the Contracting Officer or Contracting Officer's representative may authorize the destruction of the information or the transfer of the information to another employee of the Contractor working under the contract. Finally, this clause shall not be interpreted as preventing the Contractor from retaining records required by statutes or other clauses of this contract, such as FAR 52.215-2 Audit and Records--Negotiations.

(e) Third party beneficiaries. This clause is executed for the benefit of the Government and the owners of Protected Information and Computer Software. The Government and the owners of Protected Information and Computer Software (and their delegatees, successors and assignees) are third party beneficiaries of the obligations contained in this clause who, in addition to any other legal rights they may have, are intended to have the rights of direct action against the Contractor or any person to whom the Contractor has disclosed or released Protected Information and Computer Software, to seek damages from any breach of this clause, or to otherwise enforce this clause.

(f) Duration. The above obligations imposed by this clause shall survive the termination or completion of this contract.

(g) Classified Information. This clause is in addition to and in no manner abrogates requirements, obligations or remedies regarding the protection of classified information and does not supersede the requirements of any laws, regulations, other directives or nondisclosure agreements regarding classified information.

(h) Other Restrictions. This agreement does not abrogate any other obligations currently placed upon the Contractor or which may be imposed upon the Contractor in the future by the Government or other persons; or remedies afforded those persons regarding those obligations.

(i) Nondisclosure agreements. The Contractor shall require and ensure that each of its employees who may receive or be given access to Protected Information and Computer Software signs the nondisclosure agreement provided by attachment to this contract prior to the employee performing work under this contract covered by the nondisclosure agreement. The Contractor shall maintain copies of signed nondisclosure agreements for a period of at least three years after final payment under this contract. At the direction of the Contracting Officer, the Contractor shall make those agreements available for inspection by the Contracting Officer and will furnish the Contracting Officer copies of those agreements at no additional cost to the Government if requested by the Contracting Officer.

(j) The Contractor shall include the substance of this clause in all subcontracts under this contract in which subcontractors may be disclosed or granted access to Protected Information and Computer Software.

(End of Clause)

5X52.227-9000 UNAUTHORIZED USE OF NGA NAME, SEAL AND INITIALS (JUN 2006)

(a) As provided in 10 U.S.C. Section 425, no person may, except with the written permission of the Director, National Geospatial-Intelligence Agency, knowingly use the words “National Geospatial-Intelligence Agency”, “National Imagery and Mapping Agency” or “Defense

Mapping Agency", the initials "NGA", "NIMA" or "DMA", the seal of the National Geospatial-Intelligence Agency, National Imagery and Mapping Agency, or the Defense Mapping Agency, or any colorable imitation of such words, initials, or seal in connection with any merchandise, retail product, impersonation, solicitation, or commercial activity in a manner reasonably calculated to convey the impression that such is approved, endorsed, or authorized by the Director, NGA.

(b) Whenever it appears to the U.S. Attorney General that any person is engaged or about to engage in an act or practice which constitutes or will constitute conduct prohibited by paragraph (a), the Attorney General may initiate a civil proceeding in a district court of the United States to enjoin such act or practice. Such court shall proceed as soon as practicable to hearing and determination of such action and may, at any time before such final determination, enter such restraining orders or prohibition, or take such other action as is warranted, to prevent injury to the United States, or to any person or class of persons whose protection the action is brought.

(End of Clause)

5X52.232-9000: Submission of Invoice-Federal Payment Center (FPC) (OCT 2017) – For use in contracts paid by the FPC vendor pay office.

(a) The contractor shall prepare each invoice in accordance with the Prompt Payment Act and email one copy of the invoice to the DOD/FPC Scott AFB, IL at FMFOINSP@nga.mil. The DOD/FPC at Scott AFB, IL requires an email copy, but will accept a hard copy that is mailed to Federal Payment Center, P.O. Box 25767, Scott AFB, IL 62225.

(b) At the same time of submission of the invoice to the FPC vendor pay office, the contractor shall fax or email one copy to **[Contracting Officer]**, and one copy to **[Contracting Officer Representative]**. The contractor shall ensure that the invoice submitted to the payment office is the same invoice that is submitted to the CO and the COR without alteration.

(c) Upon receipt of the invoice, the COR will complete the receiving report and submit via the RRPT database tool. A copy of the completed receiving report shall also be provided to the Contracting Officer shown on the face of this contract/order.

(d) Contractors wishing to check the payment status of their vouchers may do so by calling FPC Vendor Support at 636-321-5251. In addition, questions may be directed to the Contracting Officer's Representative (COR). In the absence of a COR, contact the Procurement Contracting Officer (PCO), whose name and contact information appear on the face page of this contract/order.

(End of Clause)

5X52.237-9001 CONTRACTOR IDENTIFICATION (JAN 2012)

The contractor shall ensure that contractor personnel, including their sub-contractor personnel, identify themselves as contractor personnel, by introducing themselves or being introduced as contractor personnel when:

(1) attending meetings with Government personnel or contractors performing under a contract awarded to support NGA requirements,

(2) answering government telephones,

(3) providing any type of written or electronic mail correspondence, and

(4) working in any other situation where their actions could be construed as an official Government act or representation of the Government.

The contractor shall ensure that contractor personnel possess and properly display Government-issued identification badges when on NGA property or when attending NGA meetings not located on NGA property.

The contractor will ensure that contractor personnel, when performing in a contractor capacity, refrain from using their retired or reserve component military rank or title in all written and verbal communications.

The Government may include the results of the contractor's ability to adhere to this clause in quality assurance surveillance plans and award fee plans as part of the overall administration of this contract.

(End of Clause)

5X52.37-9000 Contractor Employee Data for Access to NGA Facilities or Sensitive Systems (OCT 2005)

1. This clause defines the contractor's responsibilities for providing accurate contractor data, and providing updates to that data, for NGA's Human Capital Management System (HCMS). NGA requires that all contractors provide initial and timely updates to HCMS data for all personnel performing under this contract who have access to NGA facilities or sensitive systems, as determined by the contracting officer.

2. The Contractor shall:

a. Provide the Contracting Officers Representative (COR) a Point of Contact (POC) for providing and maintaining contractor personnel data for the HCMS database. The POC shall be provided to the COR, in writing, within 10 days of contract award (or modification inserting this clause). For contracts with an on-site Project Lead or Program Manager, this person shall serve as the POC.

b. Provide the COR initial HCMS data for their personnel within 10 days of contract award or modification. The information that is to be provided for HCMS shall include: persons full legal name, social security number, citizenship status, NGA contract number, prime contractor name, NGA location and organization where the person will be working, and a 24/7 emergency contact point for the contractor.

c. Notify the COR of all contractor data changes within 10 days of the change. Changes include new or departing contractor personnel and any change to information provided in paragraph b above. If the contract number under which a contractor or its personnel work changes, the POC for the contract receiving the personnel shall notify the COR within 10 days of the change.

d. Provide response to all inquiries made by NGA as to the validity and completeness of contractor data records in the HCMS database within two weeks of date of request.

e. Ensure all employees attend in-processing and out-processing briefings.

(End of Clause)

5X52.246-9000 - Contractor Compliance with all applicable National Geospatial-Intelligence Agency (NGA) and U.S. Government installation regulations, directives,

instructions, rules, policies and procedures. (MAR 2023)

A. The Contractor shall comply with, and shall ensure that its personnel, to include subcontractors, comply with all applicable NGA regulations, directives, instructions, rules, policies and procedures. The Contractor may request copies from the Contracting Officer's Representative (COR), the Contracting Officer or their designated representative(s).

B. The Contractor shall comply with, and shall ensure that its personnel, to include subcontractors, comply with regulations, directives, instructions, rules, policies, procedures and other applicable requirements issued by the U.S. Government Installation Commander where NGA is a tenant activity, including, but not limited to, those relating to force protection, security, health and safety. The Contractor may request copies from the Contracting Officer's Representative (COR), the Contracting Officer or their designated representative(s).

C. The Contractor shall institute and implement an effective program to ensure their employees and subcontractors, comply with all applicable requirements in accordance with paragraphs A and B above as well as paragraphs E and H below.

D. The specific requirements covered in paragraphs A, B, E, and H may be specified in the Performance Work Statement, elsewhere in the contract, or in NGA and/or Government installation regulations, directives, instructions, rules, policies and procedures. Specific requirements may include, but are not limited to categories such as:

- Security in/out processing
- Personnel in/out processing
- Facility access, parking, and in/out processing
- Information technology access and in/out processing
- PeopleSoft access, updates and in/out processing
- Periodic and special training requirements

E. Facility Access and Badging. The following criteria must be met in order to be issued an NGA IC badge and to gain access to an NGA-controlled facility:

(1) NGA IC badges will only be issued to those contractors who provide direct charge support on an active TS/SCI NGA contract, even when seated at corporate locations outside of NGA Government facilities. Green badges must be used at least once during a one-month period at an NGA Government facility. Failure to use an NGA IC badge may result in suspension or termination of the badge for lack of activity. The badges will expire at the end of the supported contract. Note: NGA IC badges will not be issued to any contractor who does not need access to an NGA facility, i.e., Corporate VIPs, etc. Infrequent visitors must report to the Visitor's Center.

(2) Notwithstanding the above, NGA badges will be issued to contractors, who are required by contract, to gain access to an NGA facility in the event of an emergency or when after-hours access is required. The Government POC or Contracting Officer's Representative (COR) coordinates the submission of an application for an NGA badge; establishment of a PeopleSoft

record of SCI accesses; completion of NGA Form 5212- 7A, “Request for Identification/Building Access Picture Badge”; and submission of the application to the appropriate Site Security Office for approval. (Reference NGA Instruction 5210.8, Physical Security Program)

F. The Contracting Officer may direct the Contractor, at its own expense, to remove and replace any Contractor personnel who fail to comply with or violate applicable requirements of this clause. Such action may be taken at the Government’s discretion without prejudice to its rights under any other provision of this contract, including the Termination for Default clause.

G. The Contracting Officer may include the results of the Contractor’s ability to adhere to this clause in past performance reports, quality assurance surveillance plans and award fee plans as part of the overall administration of this contract.

H. NGA Inspector General.

(1) The contractor must report to the NGA Inspector General (IG), DoDIG, or Intelligence Community IG any and all possible violations of federal law or illegal intelligence activities related to this contract by individuals charging directly or indirectly to this contract.

(2) The IG shall have access to any individual charging directly or indirectly to this contract whose testimony is needed for the performance of the IG’s duties. In addition, the IG shall have direct access to all records, reports, audits, reviews, recommendations, documents, e-mails, papers, or other material that relate to this contract with respect to which the IG has responsibilities. Failure on the part of any contractor to cooperate with the IG shall be grounds for administrative action by the Director, Office of Contract Services, including contractual remedies.

(3) NGA contractors and contractor personnel may report suspected instances of improper conduct through the NGA IG Hotline. Contractors shall make their employees aware of this Hotline: 571-557-4849, secure 578-4849, or toll free 1-800-380-7729 or by contacting the OIG at IG@nga.mil or secure at IG@nga.ic.gov.

(4) The contractor agrees to include the substance of this clause in all subcontracts exceeding the simplified acquisition threshold except those for commercial products or commercial services and those where the NGA association must be protected.

(5) This requirement is supported in the Federal Acquisition Regulation (FAR) clause 52.203-13, which requires timely disclosure to the Government of credible evidence of violation of law, and timely and complete response to OIG requests for documents and access to employees and information.

(6) This requirement is supported in NGA policy. NGAI 7410.1 requires all personnel, to include contractors, to cooperate fully with NGA OIG audits, inspections, and investigations.

(End of Clause)

END

OSD-NGA STTR 24.B Topic Index

OSD24B-001 TITLE: Image Quality and Task Complexity for Machine Learning

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: This announcement seeks proposals that relate task complexity to image quality and machine learned model capacity, where capacity is the ability to perform discrimination, using information theory. The outcome from this work generates a predictive analytic for machine learning performance from previously unseen image sources for any machine learned model. The focus here is on down-looking image detection and classification tasks, which is defined here collectively as discrimination. An example discrimination task is counting civilian vehicles in a factory parking lot. This work will be used to:

> *Triage*: Compare the task-relevant image information to the machine learned model's capacity for answering the specific intelligence question. Future efforts would then use the same strategy to perform tasking.
> *Analytics*: Update the model's decision confidence based upon the current image stream that might be different from the training data.

An individual machine learned model's ability to perform triage and analytics can be solved analytically. In practice, the sheer volume of machine learned models, their frequent update training, and variety of image sources make the problem intractable. We therefore seek a generalized description for behaviors that hold across a wide range of machine learning model, where its domain of applicability can be characterized. We expect this research to increase the opportunities to answer intelligence questions and the intelligence yield of the system.

DESCRIPTION: The current image quality equations (IQE) and National Imagery Interpretation Rating Scales (NIIRS) are based upon subjective human cognition, and neither effectively supports automation or machine learning (ML). This opportunity is accepting proposals to identify information-theoretic approaches that support automation within machine learning workflows. During Task 1, the performer reviews the state-of-the-art information-theoretic measures that predict ML discrimination performance with a compact set of descriptors given image quality and task complexity. Though Task 1 images are single band electro-optical, the performer should describe how their metric and process could be extended to two or more spectral bands. Task 1 deliverables are the literature review showing the application of information theory to task complexity; the information-theoretic metric algorithmic description with implementation strategy; and results using a mutually agreed upon down-looking image dataset. Task 2 applies the workflow laid out in Task 1 to a variety of image discrimination tasks, image quality, and model architectures. Task 2 extends the information-theoretic utility to unlabeled conditions. Finally, the performer will predict performance for additional task complexity and image quality conditions from known image and machine learned model relationships. The performer will critically assess the results across task complexity, image quality, and model capacity. From the assessment, the performer will identify suitable operational domains for their information-theoretic metric and quantify the limitations. The effort should justify the Phase II proposal, identify clear milestones, and include a strong test plan for assessing the performer's selected metric(s) against image quality and machine learned model capacity. Proposers are expected to demonstrate their expertise through a relevant publication record.

PHASE I: The performer will critically assess the results across task complexity, image quality, and model capacity. From the assessment, the performer will identify suitable operational domains for their information-theoretic metric and quantify the limitations.

PHASE II: The effort should justify the Phase II proposal, identify clear milestones, and include a strong test plan for assessing the performer's selected metric(s) against image quality and machine learned model capacity. Proposers are expected to demonstrate their expertise through a relevant publication record.

PHASE III DUAL USE APPLICATIONS: Follow-on activities are expected to expand these methods to characterize ML models, other image modalities, and analysis tasks. Ultimately, these technologies will support additional efficiencies in automated image workflow.

REFERENCES:

1. J. Irvine, "National imagery interpretability rating scales (NIIRS): overview and methodology," in SPIE Proceedings Volume 3128, Airborne Reconnaissance XXI, 1997.
2. I. Israel, S. Israel and J. Irvine, "Factors Influencing CNN Performance," in IEEE Applied Imagery Pattern Recognition Workshop (AIPR), 2021.
3. Z. Wang, A. Bovik, H. Sheikh and E. Simoncelli, "Image quality assessment from error visibility to structural similarity," IEEE Transactions on Image Processing, vol. 13, no. 4, pp. 600-612, 2014.

KEYWORDS: AI/ML, information content, quality metrics, task complexity

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