DEPARTMENT OF DEFENSE
Small Business Innovation Research (SBIR) Program

SBIR 25.1 Annual Program Broad Agency Announcement (BAA)

IMPORTANT DATES

December 4, 2024: Topics Pre-release
January 8, 2025: Topics Open; DoD begins accepting proposals in DSIP
January 22, 2025: DSIP Topic Q&A closes to new questions at **12:00 p.m. ET**
February 5, 2025: Topics Close; Deadline for receipt of proposals is **12:00 p.m. ET**

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1.0 PROGRAM DESCRIPTION

1.1 Objectives and Context

The Defense Small Business Innovation Research (SBIR) Program's objectives include stimulating technological innovation, strengthening the role of small business to meet DoD research and development (R&D) needs, fostering and encouraging minority and disadvantaged persons' participation in technological innovation, and increasing the commercial application of DoD-supported research or R&D results. DoD invites proposing SBCs with the capability to conduct R&D and commercialize the results in any of the defense-related topic areas described in this SBIR Program BAA to submit proposals.

The Small Business Administration (SBA), through its SBIR/STTR Policy Directive, purposely departs from normal government solicitation formats and requirements, which simplifies the SBIR/STTR award process and minimizes the regulatory burden on small business. Consistent with the SBA SBIR/STTR Policy Directive, DoD is soliciting proposals as a broad agency announcement (BAA). The guidelines in this BAA incorporate and make use of the SBA SBIR/STTR Policy Directive's flexibility to encourage scientific and technical approaches proposals most likely to yield significant results for DoD and the private sector.

This BAA is for research topics accepting Phase I or Direct to Phase II proposals. A separate BAA will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All proposing SBCs that receive a Phase I award from this BAA will be eligible to participate in Phase II competitions and potential Phase III awards. DoD Services/Components will notify Phase I awardees of the Phase II proposal submission requirements.

DoD is not obligated to make any awards under Phase I, Phase II, or Phase III, and all awards are subject to both a risk-based due diligence security review and funds availability. DoD is not responsible for any monies the proposing small business concern (SBC) spends before any award issuance. Proposals must conform to this announcement's terms. 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.

1.2 A Three Phased Program

The SBIR Program has three phases, Phases I, II, and III. Phase I determines, to the extent possible, an idea's scientific, technical, and commercial merit and feasibility within the SBIR program. Phase I and II awards are made adhering to current SBA Policy Directive guidelines.

The Phase I period of performance is generally between six to twelve months. Proposals should focus on Research or Research & Development (R/R&D)to prove the proposed effort's scientific and technical feasibility, and commercialization potential, the successful completion of which is a prerequisite for further DoD support in Phase II. Proposing SBCs are encouraged to consider whether the research or R&D being proposed to DoD Services/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 SBCs based on results of Phase I awards and the Phase II proposal's scientific merit, technical merit, and commercialization potential. The period of performance is generally 24 months. The objective of Phase II is to continue and further develop the R/R&D effort from the completed Phase I award.

Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by sources other than the SBIR Program. Under Phase III, the SBC should focus on commercializing previously SBIR-funded technology and is required to obtain funding from either the private sector, a non-SBIR federal source, or both, to develop the prototype into a viable product or non-R&D service for sale in military or private sector markets.

1.3 OUSD(R&E) Critical Technology Areas

Although each DoD Service/Component develops SBIR and STTR topics tailored to their mission needs, topics generally align with the Office of the Under Secretary of Defense, Research & Engineering (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, with a focus on accelerating key capabilities' transitions to the Military Services and Combatant Commands.

OUSD(R&E) critical technology areas include:

- 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 Services/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.

1.4 Eligibility and Performance Requirements

Each proposing SBC must qualify as an SBC as defined in 13 C.F.R §§ 701-705 at time of award and certify to this in the proposal's cover sheet. The eligibility requirements for the SBIR/STTR programs are unique and do not correspond to those of other small business programs.

a. Proposing SBC must meet eligibility requirements for Small Business Ownership and Control (see 13 CFR § 121.702).
b. The proposing SBC must conduct a minimum of two-thirds of the Phase I research and/or analytical work. For Phase II, the proposing SBC must perform no less than 50 percent of the research and/or analytical work. The work percentage is measured via direct and indirect costs. Occasionally, deviations from these SBIR requirements may occur with the Funding Agreement officer's written approval after consultation with the agency SBIR/STTR program manager/coordinator. For more information on the percentage of work calculation during proposal submission, refer to section 3.7.
c. For both Phase I and II, the principal investigator's primary employment must be with the proposing SBC at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the

small business (based on a 40-hour work week). Primary employment with an SBC precludes full-time employment at another organization. Deviations from this requirement or changes to the principal investigator are subject to the Funding Agreement officer approval.

d. For both Phase I and Phase II, the SBC and its subcontractors must perform all research or R&D work in the United States.

e. Joint ventures and limited partnerships are permitted, provided that the entity qualifies as small business in accordance with the ownership requirements in 13 CFR 121.702(a)(1)(iii) and the size requirements in 13 CFR 121.702(c)(6). Proposing SBC must disclose joint ventures with existing (or planned) relationships/partnerships with any foreign entity or any foreign government-controlled companies. See sections 2.6 and 3.7 for more detail.

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

Unless otherwise noted in the participating Service/Component instructions, proposing SBCs that are multiple venture capital operating companies (VCOCs), hedge funds, or private equity funds majority owned are **ineligible** to submit applications to or receive awards under this BAA. If a Service/Component authorizes such participation, any proposing VCOC, hedge fund, and/or private equity fund-owned SBC, whether in part or in whole, must identify each foreign national, foreign entity, or foreign government holding or controlling greater than a 5 percent, either directly or indirectly held, equity stake in the proposing SBC. The proposing SBC must also identify any ultimate parent owner(s) and other entities and/or individuals owning more than a 5 percent equity stake in its ownership chain.

In accordance with the requirements of 13 CFR 121.702(a)(2), no single venture capital operating company, hedge fund, or private equity firm may own more than 50 percent of the concern unless that single venture capital operating company, hedge fund, or private equity firm qualifies as a small business concern that is more than 50 percent directly owned and controlled by individuals who are citizens or permanent resident aliens of the United States.

1.6 Performance Benchmark Requirements/Increased Minimum Performance Standards for Experienced Firms

Proposing SBCs with multiple prior 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 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 benchmarks' application for more experienced firms. Find detailed information on benchmark calculations, increased performance standards for more experienced firms and consequence of failure to meet benchmarks here. SBA will notify companies failing either benchmark and the relevant officials at the participating agencies.

The SBIR/STTR Policy Directive defines the Departments of the Army, Navy, and Air Force each as its own federal agency, and the remaining DoD Components as an executive agency of the Department of Defense. Therefore, 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 combined – 20 total Phase I and Direct to Phase II awards

1.7 Direct to Phase II Program

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019,Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows DoD to make a SBIR Phase II award to an SBC with respect to a project, without regard to whether the SBC was provided a SBIR program Phase I award with respect to such project. DoD does not guarantee Direct to Phase II opportunities will be offered in future BAAs.

Each eligible topic requires proposing SBCs provide documentation to demonstrate feasibility described in the Phase I section of the topic has been met. **Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.** The proposing SBC and/or the principal investigator must have substantially performed the work submitted in the feasibility documentation. If technology in the feasibility documentation is subject to intellectual property (IP), the proposing SBC must demonstrate ownership or licensure of the IP associated with such technology prior to proposal submission to enable it and its subcontractors to legally carry out the proposed work.

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

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

1.8 Program on Innovation Open Topics

15 U.S.C. §638 (ww) requires DoD establish innovation open topic activities to:

a. increase the transition of commercial technology to the DoD;
b. expand the small business nontraditional industrial base;
c. increase commercialization derived from DoD investments; and
d. expand the ability for qualifying SBCs to propose technology solutions to meet DoD needs.

Unlike conventional topics, which specify the desired technical objective and output, open topics 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.

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

An SBC may only submit one proposal to each open topic. If an SBC submits more than one proposal for a single open topic, only the most recent certified proposal submitted prior to the submission deadline will receive an evaluation. All previously submitted proposals for the same open topic will be marked nonresponsive and will not receive an evaluation.

1.9 Discretionary Technical and Business Assistance (TABA)

DoD has not mandated the use of discretionary technical and business assistance (TABA). The proposing SBCs should review individual Service/Component-specific instructions to determine if TABA is offered by the Service/Component and follow instructions for requesting TABA funding.

1.10 Phase II Enhancement Policy

To further encourage the transition of SBIR research into both DoD acquisition programs and the private sector, certain DoD Services/Components developed their own Phase II Enhancement policies. Under this policy, the Service/Component will provide a Phase II awardee with additional Phase II SBIR funding if the proposing SBC can match the additional SBIR funds with non-SBIR funds from DoD acquisition programs or the private sector.

See Service/Component instructions for more details on Phase II Enhancement opportunities.

1.11 Commercialization Readiness Program (CRP)

The SBIR/STTR Reauthorization Act of 2011 established the Commercialization Pilot Program (CPP) as a long-term program called the Commercialization Readiness Program (CRP). Each Military Department (Army, Navy, and Air Force) has a CRP; please check the Service/Component instructions for further information.

The Defense SBIR/STTR Program also established the OSD Transitions SBIR Technology (OTST) Pilot Program as 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.

1.12 State and Other Available Assistance

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

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

Contact your State SBIR/STTR Support office for further information. SBCs may seek general administrative guidance from small and disadvantaged business utilization specialists located in various defense contract management activities throughout the continental United States.

1.13 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, Service members, and the public. 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 their website to submit a complaint. Mailed correspondence should be addressed to the Defense Hotline, The Pentagon, Washington, DC 20301-1900, or email addressed to hotline@dodig.mil.

2.0 CERTIFICATIONS AND REGISTRATIONS

2.1 System for Award Management (SAM) Registration

The System for Award Management (SAM) allows proposing SBCs to provide basic information on business structure, capabilities, and financial and payment information with the Federal Government. Proposing SBCs must register in SAM here. Registration in SAM will generate the Unique Entity ID (UEI) number and the Commercial and Government Entry (CAGE) code. The UEI is required for registration in the U.S. Small Business Administration's (SBA) Company Registry. A proposing SBC that is already registered in SAM should verify the registration is active, and its representations and certifications are current to avoid award delay.

2.2 SBA Company Registry

Proposing SBCs must be registered in the SBA Company Registry. SBCs will be required to verify registration by providing the SBC Control ID and Proof of Registration/Certification during proposal submission.

2.3 Defense SBIR/STTR Innovation Portal (DSIP) Registration

Individuals from proposing SBCs must be registered in the DSIP to prepare and submit proposals. Proposing SBCs submitting through this site for the first time will be asked to register. All users are required to have an individual user account to access DSIP. It is recommended proposing SBCs register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process.

DSIP user accounts are authenticated by Login.gov. Users who do not already have a Login.gov account will be required to create one. Users who already have a Login.gov account can link their existing Login.gov account with their DSIP account. Job Aids and Help Videos to walk you through the process are in the Learning & Support section of DSIP.

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

Registered SBCs will have a designated DSIP Firm Admin responsible for creating the Firm PIN, controlling access for other users in the SBC and completing and maintaining the Firm-level forms, which must be completed before any proposals can be submitted.

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

NOTE: 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.

2.3.1 DSIP Assistance and Support

For assistance with the DSIP application, please visit the Learning & Support section of DSIP. 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). Please include information on your SBC, 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 Service/Component that originated the topic following the Service/Component-specific instructions given at the beginning of that Service/Component-specific instructions.

2.4 Required Certifications

At the time of proposal submission, each SBC must certify via the Cover Sheet of the proposal that it meets the size, ownership, and other requirements of the SBIR Program. In addition, the Policy Directive includes certification requirements set forth in the SBIR and STTR Extension Act of 2022 (Public Law 117-183). SBCs are required to certify that they are meeting the Program's requirements during the life cycle of the funding agreement: at the time of the Phase I and Phase II award, prior to final payment on the Phase I award, prior to receiving 50 percent of the total Phase II award amount, and prior to final payment on the Phase II award.

2.5 Due Diligence Program to Assess Security Risks

15 U.S.C. §638 (vv) requires the DoD, in coordination with the SBA, to establish and implement a due diligence program to assess and, when possible, mitigate national security risks from SBCs seeking a federally funded award. The Department will use the proposal and information in response to the "Disclosures of Foreign Affiliations or Relationships to Foreign Countries" (proposal submission Volume 7) to conduct a risk-based due diligence review of the following areas: cybersecurity practices; patent analysis; employee analysis and foreign ownership, including the SBC's financial ties and obligations (which shall include surety, equity, and debt obligations); and SBC employees' ties to a foreign country, foreign person, or foreign entity. The Department will also assess proposals utilizing open-source analysis and analytical tools, for the purpose of confirming the accuracy of the information provided as well as determining if the proposing SBC failed to disclose the information set forth in 15 U.S.C. 638(g)(13).

After reviewing the proposing SBC's responses to the Disclosures of Foreign Affiliations or Relationships to Foreign Countries, if DoD determines it appropriate the Department may ask the SBC 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 the SBC's proposal submission.

The DoD may not make awards that pose an unacceptable risk to national security. If the risk-based due diligence review concludes that an SBC should not be eligible for the specific SBIR or STTR award due to a national security risk that cannot be adequately mitigated, the proposal will not receive consideration for possible award regardless of the results of the technical review of the proposal. Attachment 2: Defense SBIR and STTR Due Diligence Program Common Risk Matrix of the memo titled "Defense Small Business Innovation Research and Small Business Technology Transfer Due Diligence Program", dated 13 May 2024, provides details on the factors for assessing SBC risk during the due diligence review.

2.5.1 Training for Understanding FOCI

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. Hover over “Courses” in the Navigation Bar, and then select “FOCI” from the dropdown listing.
7. Copy the provided password.
8. Click on the “Understanding Foreign Ownership, Control, or Influence (FOCI)” course, which will open a new browser tab.
9. From the new tab, log in to Encite.io using your email address and the copied password.
10. Enroll in the course and click “Enter” to begin.

For Project Spectrum registration or access assistance, please email support@projectspectrum.io.

2.6 Joint Ventures

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 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 here and must be uploaded to Volume 5, Supporting Documents of the proposal submission in DSIP, if applicable.

2.7 Conflicts of Interest

Contract awards to an SBC 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.

2.8 Organizational Conflicts of Interest (OCI)

FAR 9.5 Requirements

In accordance with FAR 9.5, proposing SBCs are required to identify and disclose all facts relevant to potential organizational conflicts of interest (OCIs) involving the proposing SBC’s organization and any proposed team member (sub-awardee, consultant). The proposing SBC is responsible for providing this disclosure with each submitted proposal. The disclosure must include the proposing SBC’s, and as applicable, proposed team member’s OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposing SBC has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposing SBC’s judgment, and to prevent the proposing SBC 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
DoD Services/Components also 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, a proposing SBC must affirm whether the proposing SBC or any proposed team member (sub-awardee, consultant) is providing SETA, A&AS, or similar support to any DoD Service/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 or was provided to any DoD Service/Component office(s), the proposal must include:

a. The name of the DoD Service/Component office receiving the support;
b. The prime contract number;
c. Identification of proposed team member (sub-awardee, consultant) providing the support; and
d. 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 determine whether it is in the government's interest to grant a waiver. The U.S. Government will only evaluate OCI mitigation plans for proposals determined selectable under the BAA evaluation criteria and funding availability.

The government may require proposing SBCs provide additional information to support evaluation of the proposing SBC's OCI mitigation plan.

If the government determines a proposer failed to fully disclose an OCI; or failed to provide a government waiver as described above; or failed to reasonably provide additional information the government requested when evaluating the proposer's OCI mitigation plan, the government may reject the proposal and withdraw it from consideration for award.

2.9 Research Involving Human Subjects/Human Subject Research (RIHS/HSR)

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 5.2 and Appendix B).

Institutions receiving 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). The awarding DoD Service/Component may also request additional federal assurance documentation. 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 completed 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 SBCs should clearly segregate research activities involving human subjects from other R&D 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 that all investigators are appropriately trained 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, and data collection and analysis.

The amount of time required for the IRB to review and approve the protocol will vary based on 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 Service/Component will review the protocol and the IRB's determination to ensure that the research will be conducted in compliance with both DoD and Service/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 contract award delays.**

2.10 Research Involving Animal Subjects

All research, development, testing, experimentation, education, or training involving the use of animals shall comply with the applicable federal and agency rules on animal acquisition, transport, care, handling, and use (see Section 5.2 and Appendix B).

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 from a DoD veterinarian trained or experienced in laboratory animal medicine and science. **No animal research may be conducted using DoD funding until all 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 contract award delays.**

2.11 Research Involving Recombinant DNA Molecules

All research involving recombinant DNA molecules shall comply with the applicable federal and state law, regulation, and additional agency guidance. An institutional biosafety committee must approve the research.

In addition to the standard federal and DoD procurement certifications, the SBA SBIR Policy Directive requires the proposing business concerns provide certain information at time of award and during the award life cycle. Each proposing SBC 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 percent of the Phase II total award amount, and prior to final payment on the Phase II award.

2.12 Federal Acquisition Supply Chain Security Act Orders

FAR 52.204-29 Federal Acquisition Supply Chain Security Act (FASCA) Orders—Representation and Disclosures and FAR 52.204-30 FASCA Orders—Prohibition are included in this solicitation. In accordance with FAR 52.204-29 and FAR 52.204-30, proposing SBCs must review FASCSA orders here for covered articles, or any products or services produced or provided by a source, that an applicable FASCSA order prohibits.

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

The proposing SBC represents that, via proposal submission under this BAA, it conducted a reasonable inquiry, and it does not propose to provide or use any covered article, or any products or services produced or provided by a source, if an applicable FASCSA prohibited the covered article or the source effective this BAA's issue date.

3.0 PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

3.1 Introduction

The proposal must provide sufficient information to demonstrate to the evaluator(s) that the proposed work represents an innovative approach to an important scientific or engineering problem and is worthy of support under the stated criteria. The proposed research or R&D must be responsive to the chosen topic, although it does not need to use the exact approach specified in the topic. SBCs should consider the following:

a. Does the technical approach have a reasonable chance of meeting the topic objective?
b. Is this approach innovative, not routine, with potential for commercialization?
c. Does the proposing SBC have the capability to implement the technical approach or can it obtain the appropriate people and equipment for the task?

DSIP provides a structure for providing the following proposal volumes:

a. Volume 1: Proposal Cover Sheet
b. Volume 2: Technical Volume
c. Volume 3: Cost Volume
d. Volume 4: Company Commercialization Report
e. Volume 5: Supporting Documents
f. Volume 6: Fraud, Waste and Abuse Training
g. Volume 7: Disclosures of Foreign Affiliations or Relationships to Foreign Countries

Each Service/Component guidance on allowable proposal content may vary. A completed proposal submission in DSIP does NOT indicate that each proposal volume has been completed in accordance with the Service/Component-specific instructions. Accordingly, it is the proposing SBC's responsibility to consult the Service/Component-specific instructions for detailed guidance, including required proposal documentation and structure, cost and duration limitations, budget structure, TABA allowance and proposal page limits.

3.2 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 to an ITAR/EAR-marked topic receives an SBIR award.

3.3 Classified Proposals

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

3.4 Promotional Materials

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

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

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 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 and declared on the proposal cover sheet.

3.6 Marking Proprietary Proposal Information

Proposing SBCs that include data in their proposals they do not want disclosed to the public for any purpose, or only used for government evaluation purposes, shall:

a. 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 SBC 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

b. 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, support contractors may handle proposals and final reports submitted through DSIP for administrative purposes only; they are required to adhere to appropriate non-disclosure agreements.

3.7 Phase I Proposal Instructions

a. Proposal Cover Sheet (Volume 1)

The proposal cover sheet is prepared on DSIP. The cover sheet must include a brief technical abstract that describes the proposed R&D project and an anticipated benefits and potential commercial applications discussion. Each section should be no more than 3,000 characters.

<u>Do not include proprietary or classified information in the proposal cover sheet</u>. If your proposal is selected for negotiation and possible award, the technical abstract and anticipated benefits discussion may be publicly released online. DSIP will assign a proposal number once the cover sheet is saved. You may modify the cover sheet as needed until the BAA closes.

NOTE: the amounts listed in the percentage of work (POW) certification question on the proposal cover sheet are derived from SBC-entered information 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 funding agreement officer must upload either an explanatory letter or approval to the certification question to complete the submission. Some DoD Services/Components will not accept any deviations from the POW minimum requirements. Please refer to the Service/Component instructions regarding deviations acceptance to the POW requirements.

b. **Technical Volume Format (Volume 2)**

1. **File Type.** The Technical Volume must be a single PDF file, including graphics. Perform a virus check before uploading the technical volume file. If a virus is detected, the proposal may be rejected. **Do not lock, password protect 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 SBC's responsibility to verify that the technical volume does not exceed the page limit after upload to DSIP. Please refer to Service/Component-specific instructions for how a technical volume is handled if the stated page count is exceeded. Some Services/Components will reject the entire technical proposal if the proposal exceeds the stated page count.

3. **Layout.** Number all proposal pages consecutively. Submit a direct, concise, and informative research or R&D proposal (no type smaller than 10-point on standard 8-1/2" x 11" paper with one-inch margins, including the header). Each header on each page in the technical volume should contain the proposing SBC's name, topic number, and the DSIP-assigned proposal number from the cover sheet.

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

The Technical Volume should cover the following items <u>in the order given below</u>:

1. Identification and Significance of the Problem or Opportunity
2. Phase I Technical Objectives
3. Phase I Statement of Work
4. Related Work
5. Relationship with Future Research or Research and Development
6. Commercialization Strategy
7. Key Personnel
8. Foreign Citizens
9. Facilities/Equipment
10. Subcontractors/Consultants
11. Prior, Current, or Pending Support of Similar Proposals or Awards
12. Identification and Assertion of Restrictions on the Government's Use, Release, or Disclosure of Technical Data or Computer Software

A Phase I technical volume template is available in Appendix A to provide details and helpful guidelines for completing each section of your Phase I technical proposal.

Refer to the Service/Component-specific Direct to Phase II instructions for details on proposal preparation and technical volume content requirements.

d. **Cost Volume Content (Volume 3)**

Complete the cost volume using the DSIP cost volume form. Some items in the cost breakdown may not apply to the proposed project. There is no need to provide information on each individual item; make sure to provide enough information for evaluators to understand the requested funds' planned use if a contract is awarded.

1. List all key personnels' names and include their individual hours dedicated to the project as direct labor.
2. While special tooling and test equipment and material cost may be included under Phase I, equipment and material inclusion will be carefully reviewed relative to need and appropriateness for the work proposed. Special tooling and test equipment purchases must, in the Service/Component contracting officer's opinion, be advantageous to the U.S. Government and should relate directly to the specific topic. These may include such items as innovative instrumentation or automatic test equipment. Title to property the U.S. Government furnished or acquired with government funds will be vested with the DoD Service/Component, unless it is determined that title transfer to the contractor would be more cost effective than the DoD Service/Component equipment recovery.
3. Cost for travel funds must be justified and related to the project needs.
4. Cost sharing is permitted for proposals under this BAA; cost sharing is not required, nor will it be an evaluation factor in the Phase I proposal consideration.
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 subcontractor costs substantiation in your cost proposal. Supporting Documents (Volume 5) may be used if additional space is needed.

If a proposal is selected for negotiation and possible award, you must be prepared to submit further documentation to the Service/Component contracting officer to substantiate costs (e.g., a cost estimates explanation for equipment, materials, and consultants or subcontractors). For more information about cost proposals and accounting standards, see visit DCAA's website.

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

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

If the proposing SBC 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, the firm admin must download the CCR's PDF copy from SBIR.gov and upload it to DSIP's "Firm Forms" section. The DSIP firm admin completes the firm forms are completed and are applies them to all proposals the proposing SBC submits. To fulfill the DSIP CCR requirement complete 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, scroll to the "My Commercialization" section and click the "Create/Update Commercialization" tab under "Current Report Version." Please refer to the "Instructions" and "Guide" documents contained on 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 dashboard's "My Documents" section to download the CCR PDF.
5. Upload the CCR PDF (downloaded from SBIR.gov in previous step) to the "Company Commercialization Report" in DSIP's "Firm Forms" section. The firm admin must complete this upload action.

In Volume 4 of the DSIP proposal submission, the proposing SBC will be prompted to answer: "Do you have a new or revised Company Commercialization Report to upload?" There are three possible courses of action:

a. If the proposing SBC has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards and **has a new or revised CCR from SBIR.gov to upload to DSIP**, select YES.
   1. If the user is the firm admin, they can upload the CCR PDF 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 the proposing SBC submitted. 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.
   2. **<u>WARNING:</u>** Uploading a new CCR under the DSIP "Firm Forms" section or clicking "Save" or "Submit" in one proposal's Volume 4 is considered a change for ALL proposals under any open BAAs or CSOs. If a proposing SBC has previously certified and submitted any Phase I or Direct to Phase II proposals under ***any*** BAA or CSO ***still open***, those proposals will be automatically reopened. Proposing SBCs will have to recertify and resubmit affected proposals. If a proposing SBC does not recertify or resubmit affected proposals, they will not be considered fully submitted and will not be evaluated.

b. If the proposing SBC has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, and **no new or revised CCR from SBIR.gov to upload to DSIP**, select NO.
   1. If a prior CCR was uploaded to the "Firm Forms", the proposing SBC 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 SBC to confirm the firm admin uploaded the CCR.
   2. If no file dialog box appears at the bottom of the page **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 CCR PDF from

SBIR.gov and upload it to the DSIP "Firm Forms" to be included with all proposal submissions.

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

Please refer to the Service/Component-specific instructions for details on how the CCR information will be considered during proposal evaluations.

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

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

The following documents may be included in Volume 5, if applicable to the proposal. Refer to Service/Component-specific instructions for additional Volume 5 requirements. **Reminder: A completed proposal submission in DSIP does NOT indicate the mandatory supporting documents have been uploaded in accordance with the Service/Component-specific instructions.**

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, if applicable
8. DD Form 2345, Militarily Critical Technical Data Agreement, if applicable (see section 3.2)

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

The fraud, waste, and abuse (FWA) training is **required** for DoD SBIR/STTR 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. The training currently consists of a 3-page PDF, consistent with the tutorial provided by the SBA. This training material must be thoroughly reviewed once per year and can be found here and in the DSIP proposal submission module for Volume 6. Plan time to review the tutorial during completion of Volume 6, prior to the proposal submission deadline. One DSIP firm user for the proposing SBC with read/write access (Proposal Owner, Corporate Official or Firm Admin) must complete this training.

h. **Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7)**

In accordance with 15 U.S.C. §638 (vv) and the SBA SBIR/STTR Policy Directive, the DoD will review all proposals submitted in response to this BAA to assess security risks of SBCs seeking a federally funded award. SBCs must complete the DSIP Volume 7 webform "Disclosures of Foreign Affiliations or Relationships to Foreign Countries" (NOTE: PDF uploads are no longer accepted). The corporate official cannot certify and submit the full proposal until the Volume 7 webform is fully completed and submitted.

Please be aware that the “Disclosures of Foreign Affiliations or Relationships to Foreign Countries” form WILL NOT be accepted as a supporting document in DSIP’s Volume 5 proposal submission. Do not upload any previous versions of this form to Volume 5.

For additional details, please refer to Section 2.5. The disclosure questions are below:

1. Is any owner or covered individual of the applicant or awardee party to any malign foreign talent recruitment program? 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? 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? 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? If yes, disclose the foreign country.
5. Does the applicant or awardee have any venture capital or institutional investment? 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? 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? 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? 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? 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.

3.8 Phase II Proposal Information

Only Phase I awardees may submit Phase II proposals. Phase II proposals submission must follow individual Service/Component instructions. Awarding DoD Services/Component, either in the Phase I award or via subsequent notification, will provide details on Phase II proposal due date, content, and submission requirements. If a proposing SBC submits their Phase II proposal prior to the individual Service/Component's dates, it may be rejected without evaluation.

Due to specific limitations on the amount of funding and number of awards awarded to a particular proposing SBC 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.

SBIR/STTR Policy Directive Section 4(b)(1)(i) allows 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 SBC 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 it. The transition may be proposed prior to award or during the Phase II effort performance. 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 contracting officer-signed Phase II award or award modification that indicates the removal or addition of the research institution and the revised percentage of work requirements.

3.8.1 Phase II Commercialization Strategy

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

a. What will be the first product to use this technology?
b. Who will be the customers, and what is the estimated market size?
c. How much money is needed to bring the technology to market, and how will that money be raised?
d. Does the proposing SBC contain marketing expertise and, if not, how will the SBC acquire that expertise?
e. Who are the proposing SBC'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 at 1) one year after the Phase II project starts, 2) at Phase II completion, and 3) after Phase II completion (i.e., additional investment amount, sales revenue, etc.). After Phase II award, the proposing SBC is required to report actual sales and investment data in its SBA company commercialization report via SBIR.gov's "My Dashboard" on a minimum annual basis. Please refer to the Service/Component-specific instructions for guidance on formatting, page count and other details.

3.8.2 Phase II Adequate Accounting System

To reduce the small business's risk and avoid potential contracting delays, companies interested in pursuing Phase II SBIR contracts and other contracts of similar size with the DoD, must have an adequate accounting system in place per General Accepted Accounting Principles, Generally Accepted Government Auditing Standards, Federal Acquisition Regulation (FAR) and Cost Accounting Standards. The Defense Contract Audit Agency (DCAA) will audit the accounting system. See DCAA's website for requirements and standards, the audit process overview, and a pre-award system adequacy checklist.

4.0 METHOD OF SELECTION AND EVALUATION CRITERIA

4.1 Evaluation Process

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.

4.2 Evaluation Criteria

Proposals will be evaluated based on the criteria outlined below, unless otherwise specified in the Service/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 R&D 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. Do not assume reviewers are acquainted with the proposing SBC, key individuals, or any referenced experiments. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be included based on requirements listed in Service/Component-specific instructions.

4.3 Proposal Status & Feedback

Proposing SBCs will be notified of selection or non-selection status for an award by the DoD Service/Component that originated the topic <u>no later than 90 days</u> of the closing date for this BAA. Please refer to the Service/Component-specific instructions for details.

After final selection decisions have been announced, the SBC may be provided proposal feedback in the form of a written debrief. This debriefing process varies across the DoD Services/Components. Please refer to the Service/Component-specific instructions for details on the debriefing processes.

4.4 Award Denials

The DoD will not make an award under the SBIR program if it determines:

a. The SBC 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 DoD-supported activities to be carried out;
    ii. create duplication with DoD-supported activities;
    iii. present concerns about conflicts of interest;
    iv. were not appropriately disclosed to the DoD;
    v. violate Federal law or terms and conditions of DoD-awarded contracts or other agreements; or
    vi. pose a risk to national security.

4.5 Pre-Award and Post Award BAA Protests

Interested parties have the right to protest via procedures in FAR Subpart 33.1; protests exclusively related to this BAA's terms must be served to: osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil

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 Service/Component POC (post-selection/award decision ONLY) within one day of filing with the GAO. Protests of small business status of a selected proposing SBC may also be made to the SBA via the procedures in FAR § 19.302.

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.

5.0 ADDITIONAL CONSIDERATIONS

5.1 Award Information

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.

Each proposal selected for negotiation and possible award will be funded under negotiated contracts, purchase orders, or Other Transactions and will include a reasonable fee or profit consistent with normal profit margins provided to profit-making proposing SBCs 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.

Contract value varies among the DoD Services/Components; <u>it is important for proposing SBCs to review Service/Component-specific instructions regarding award size.</u>

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.

5.2 Contract Requirements

Upon contract award, the contractor will be required to make certain legal commitments through acceptance of U.S. Government contract clauses in the Phase I contract. The examples below are illustrative of the types of provisions the Federal Acquisition Regulation requires in the Phase I contract. This is not an exhaustive provisions list that could be included in Phase I contracts, nor does it contain specific clause wording. Appendix C of this BAA contains additional potential required Federal Acquisition Regulation (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS) 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 Funding Agreement must conform to high professional standards.
b. **Inspection.** Work performed under the Funding Agreement is subject to Government inspection and evaluation at all times.
c. **Examination of Records**. The Comptroller General (or a duly authorized representative) must have the right to examine any pertinent records of the Awardee involving transactions related to this Funding Agreement.
d. **Default**. The Federal Government may terminate the Funding Agreement if the contractor fails to perform the work contracted.
e. **Termination for Convenience**. The Funding Agreement may be terminated at any time by the Federal Government if it deems termination to be in its best interest, in which case the Awardee will be compensated for work performed and for reasonable termination costs.
f. **Disputes.** Any dispute concerning the Funding Agreement that cannot be resolved by agreement must be decided by the contracting officer with right of appeal.
g. **Contract Work Hours**. The Awardee may not require an employee to work more than 8 hours a day or 40 hours a week unless the employee is compensated accordingly (for example, overtime pay).
h. **Equal Opportunity**. The Awardee will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
i. **Equal Opportunity for Veterans**. The Awardee will not discriminate against any employee or application for employment because he or she is a disabled veteran or veteran of the Vietnam era.
j. **Equal Opportunity for People with Disabilities**. The Awardee will not discriminate against any employee or applicant for employment because he or she is physically or intellectually disabled.
k. **Officials Not to Benefit**. No Federal Government official may benefit personally from the SBIR/STTR Funding Agreement.
l. **Covenant Against Contingent Fees**. No person or agency has been employed to solicit or secure the Funding Agreement upon an understanding for compensation except bona fide employees or commercial agencies maintained by the Awardee for the purpose of securing business.
m. **Gratuities**. The Funding Agreement may be terminated by the Federal Government if any gratuities have been offered to any representative of the Government to secure the award.
n. **Patent Infringement**. The Awardee must report each notice or claim of patent infringement based on the performance of the Funding Agreement.
o. **American Made Equipment and Products**. When purchasing equipment or a product under the SBIR/STTR Funding Agreement, purchase only American-made items whenever possible.

5.3 Agency Recovery Authority and Ongoing Reporting

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

a. require an SBC receiving an award under its SBIR program to repay all amounts received from the federal agency under the award if,
   1. the SBC makes a material misstatement that the federal agency determines poses a risk to national security; or
   2. there is a change in the SBC’s ownership, entity structure, or other substantial change in circumstances that the federal agency determines poses a risk to national security; and

b. require an SBC receiving an award under its SBIR program to regularly report to the federal agency and the administration throughout the duration of the award on
   1. any change to a disclosure required under the Disclosures of Foreign Affiliations or Relationships to Foreign Countries form;
   2. any material misstatement made under paragraph (A) above; and
   3. any change described in paragraph (B) above.

5.4 Copyrights

With prior written permission of the contracting officer, the awardee may copyright (consistent with any appropriate national security considerations) 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.

5.5 Patents

SBCs normally may retain the principal worldwide patent rights to any invention developed with U.S. 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. 35 U.S.C. § 205 authorizes that 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 6.8, Invention Reporting.

5.6 Invention Reporting

SBIR awardees must report inventions to the Service/Component within two months of the inventor's report to the awardee, via either paper documentation submission, including fax, or through the Edison Invention Reporting System at www.iedison.gov for participating agencies.

5.7 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 U.S. Government obtains a royalty-free license to use such technical data only for government purposes during the period commencing with contract award and ending not less than twenty years after that date. 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 U.S. 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 government-operated items. 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 SBC 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 are approved.

5.8 Final Technical Reports - Phase I through Phase III

a. **Content**: A final report is required for each project phase. The reports must contain in detail the project objectives, work performed, results obtained, and estimates of technical feasibility. A completed SF 298, "Report Documentation Page," will be used as the first page of the report. The DoD Service/Component also may require monthly status and progress reports.

b. **SF 298 Form "Report Documentation Page" Preparation**:
   a. If desirable, the proposing SBC may also use language from its Phase II proposal to cover Phase I progress in the final report.

   b. For each unclassified report, the proposing SBC 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 Service/Component SBIR Program Office."

      Note: Data developed under a SBIR contract is subject to SBIR Data Rights, under which DFARS 252.227-7018 Class Deviation 2020-O0007 (see Section 5.7, Technical Data Rights) provides protection. The sponsoring DoD activity, after reviewing the proposing SBC'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) website.

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

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

c. **Submission**: In accordance with DFARS 252.235-7011, submit an electronic copy of the approved final scientific or technical report, not a summary, delivered under the contract to the Defense Technical Information Center (DTIC) through the web-based input system at https://discover.dtic.mil/submit-documents/ as required by DoD Instruction 3200.12, DoD Scientific and Technical Information Program (STIP). Include a completed Standard Form (SF) 298, Report Documentation Page, in the document, or complete the web-based SF 298. Additional submission resources are available here.

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

   Other requirements regarding reports and/or other deliverables submission will be defined in each contract's contract data requirements list (CDRL). Special instructions for submitting CLASSIFIED reports will be defined in the contract's delivery schedule.

   DO NOT email classified or controlled unclassified reports, or reports containing SBIR Data Rights protected under DFARS 252.227-7018 Class Deviation 2020-O0007.

6.0 PROPOSAL SUBMISSION

6.1 Submission Details

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 guidance on DSIP proposal submission is found here.

<u>Deadline for Receipt</u>: Complete proposals must be certified and submitted in DSIP no later than the close date listed on the cover page of this BAA. Proposals cannot be submitted in DSIP after the deadline is reached and will not be accepted or evaluated.

The final proposal submission includes successful completion of all firm level forms, all required proposal volumes, and electronic corporate official certification. 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 SBC for signatures prior to award. **Please plan to submit proposals as early as possible to allow time for troubleshooting any possible issues before the BAA close. DSIP Support is unable to assist with submission issues once a deadline has passed and cannot provide submission extensions. <u>DoD is not responsible for missed proposal submission due to system latency</u>.**

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 SBC may modify all proposal volumes prior to the BAA close date.

6.2 Technical Questions

a. **Direct Contact with Topic Authors**. During the pre-release period, the names of the topic authors, their phone numbers and/or email addresses are published with the topic on the DSIP Topics and Topic Q&A page. During this time, proposing SBCs can contact topic authors via telephone or email to ask technical questions about specific BAA topics. <u>Questions must be limited to specific information related to understanding a particular topic's requirements. Proposing SBCs may not ask for advice or guidance on solution approach and may not submit additional material to the topic author.</u>

   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 DSIP Topic Q&A.

   After the pre-release period, questions must be asked through DSIP Topic Q&A as described below. No further direct contact is allowed between proposing SBCs and topic authors, unless the topic author is responding to a question submitted during the pre-release period.

b. **DSIP Topic Q&A.** Proposing SBCs may submit written questions through DSIP Topic Q&A here, where all questions and answers are posted on a non-attribution basis for public viewing. DSIP Topic Q&A opens on the pre-release date and closes two weeks prior to the topic close date.

   Proposing SBCs may use the topic search feature on DSIP to locate a topic of interest. Use the form at the bottom of the topic description, enter and submit the question. Answers are generally posted within seven business days of question submission and also e-mailed directly to the inquirer.

   Questions submitted through the DSIP Topic Q&A are limited to technical information focused on understanding a topic's requirements. Any other questions, such as 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 are not appropriate and will not receive a response; for administrative questions, refer to a topic's Service/Component-specific instructions.

Once the BAA proposal submission closes, no communication of any kind is allowed either with the topic author or through topic Q&A regarding submitted proposals.

Throughout the BAA period, proposing SBCs should frequently monitor DSIP for updates and amendments to the topics and DSIP Topic Q&A for questions and answers.

7.0 Participating Component Instructions & Research Topics

The following section contains all Component-specific proposal preparation instructions and research topics this BAA.

DoD SBIR 25.1 BAA

December 4, 2024: Topics Pre-release
January 8, 2025: Topics Open; DoD begins accepting proposals in DSIP
January 22, 2025: DSIP Topic Q&A closes to new questions at **12:00 p.m. ET**
February 5, 2025: Topics Close; Deadline for receipt of proposals is **12:00 p.m. ET**

Participating Services/Components:

- Department of the Navy (Navy)
- Department of the Air Force (Air Force)
- Defense Health Agency (DHA)
- Missile Defense Agency (MDA)

VERSION 2

DEPARTMENT OF THE NAVY (DoN)
25.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to topics:**
  - **N251-001 through N251-073**

- Information on the 25.1 SBIR and 25.A STTR Topics Workshop can be found at https://navysbir.com/nw25_1.htm.

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

- The information provided in the DoN Proposal Submission Instructions takes precedence over the DoD Instructions posted for this BAA.

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

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

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

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

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

INTRODUCTION

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

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 on the DoD SBIR/STTR Innovation Portal (DSIP). Refer to the Proposal Submission 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 Submission 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
N251-001 to N251-005	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	sbir.admin@usmc.mil
N251-006 to N251-023	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N251-024 to N251-052	Mr. Jason Schroepfer	Naval Sea Systems Command (NAVSEA)	NSSC_SBIR.fct@navy.mil
N251-053 to N251-065	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@us.navy.mil

Topic Numbers	Point of Contact	SYSCOM	Email
N251-066 to N251-073	Mr. Jon M. Aspinwall III (Acting)	Strategic Systems Programs (SSP)	ssp.sbir@ssp.navy.mil

PHASE I SUBMISSION INSTRUCTIONS

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

(NOTE: Proposing small business concerns are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.)

DoD SBIR/STTR Innovation Portal (DSIP). Proposing small business concerns are required to submit proposals via the DoD SBIR/STTR Innovation Portal (DSIP); and 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 seven volumes are required.

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

- **Technical Proposal (Volume 2)**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed ten (10) pages, regardless of page content
    - Single column format, single-spaced typed lines
    - Standard 8 ½” x 11” paper
    - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - No font size smaller than 10-point
    - Include, within the ten-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified. Phase I Options are exercised upon selection for Phase II.
    - Work proposed for the Phase I Base must be exactly six (6) months.
    - Work proposed for the Phase I Option must be exactly six (6) months.

  - Additional information:

- A Phase I proposal template specific to DoN to meet Phase I requirements is available at https://navysbir.com/links_forms.htm
- A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, proposing small business concerns are cautioned that if the text is too small to be legible it will not be evaluated.

- **Cost Volume (Volume 3).**
  - Cost Volume (Volume 3) must meet the following requirements or the proposal will be REJECTED:
    - The Phase I Base amount must not exceed $140,000.
    - Phase I Option amount must not exceed $100,000.
    - Costs for the Base and Option must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.
    - For Phase I, a minimum of two-thirds of the work is performed by the proposing small business concern. The two-thirds percentage of work requirement must be met in the Base costs as well as in the Option costs. DoN will not accept deviations from the minimum percentage of work requirements for Phase I. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor (Total Subcontractor Costs (TSC)) as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator.
      - Proposing Small Business Concern Costs (included in numerator for calculation of the small business concern):
        - Total Direct Labor (TDL)
        - Total Direct Material Costs (TDM)
        - Total Direct Supplies Costs (TDS)
        - Total Direct Equipment Costs (TDE)
        - Total Direct Travel Costs (TDT)
        - Total Other Direct Costs (TODC)
        - General & Administrative Cost (G&A)

        NOTE: G&A, if proposed, will only be attributed to the proposing small business concern.
      - Subcontractor Costs (numerator for subcontractor calculation):
        - Total Subcontractor Costs (TSC)
      - Total Cost (i.e., Total Cost before Profit Rate is applied, denominator for either calculation)
    - **Cost Sharing: Cost sharing is not accepted on DoN Phase I proposals. If a value above or below $0.00 is entered in the Cost Sharing field the proposal will be deemed non-compliant and will be REJECTED by DoN.**

  - 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 Proposal Preparation Instructions and Requirements 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.

  - Proposing small business concerns must review and submit the following items, as applicable:
    - **Majority Ownership in Part.** Proposing small business concerns that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DoN topics advertised within this BAA. Complete the certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

  - Additional information:
    - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at https://navysbir.com/links_forms.htm to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
      - Additional Cost Information to support the Cost Volume (Volume 3)
      - SBIR/STTR Funding Agreement Certification
      - Data Rights Assertion
      - Allocation of Rights between Prime and Subcontractor
      - Disclosure of Information (DFARS 252.204-7000)
      - Prior, Current, or Pending Support of Similar Proposals or Awards
      - Foreign Citizens
    - 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) in Volume 5 (e.g., resumes, test data, technical reports, or publications). Such documents or information will not be considered.
    - A font size smaller than 10-point is allowable for documents in Volume 5; however, proposing small business concerns are cautioned that the text may be unreadable.

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

- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7)**. 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 complete the Disclosures of Foreign Affiliations or Relationships to Foreign Countries webform in Volume 7 of the DSIP proposal submission. Please refer to the Proposal Preparation Instructions and Requirements 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 Method of Selection and 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 ten (10) pages, regardless of page content
  - Single column format, single-spaced typed lines
  - Standard 8 ½” x 11” paper
  - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
  - No font size smaller than 10-point, except as permitted in the instructions above.
  - Include, within the 10-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified.
  - Work proposed for the Phase I Base must be exactly six (6) months.
  - Work proposed for the Phase I Option must be exactly six (6) months.

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

must be met in the Base costs as well as in the Option costs. DoN will not accept deviations from the minimum percentage of work requirements for Phase I.

- **Cost Sharing: Cost sharing is not accepted on DoN Phase I proposals. If a value above or below $0.00 is entered in the Cost Sharing field the proposal will be deemed non-compliant and will be REJECTED by DoN.**

- **Company Commercialization Report (CCR) (Volume 4).** The CCR (Volume 4) will not be evaluated by the DoN nor will it be considered in the 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.

- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7)**. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7) will be assessed as part of the Due Diligence Program to Assess Security Risks. Refer to the DoD SBIR/STTR Program BAA to ensure compliance with Volume 7 requirements.

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 Certifications and Registrations 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, 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 Management Office.

If the TABA request does not include the following items the TABA request will be denied.
- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform (to include the purpose and objective of the assistance)
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:
- Be subject to any indirect costs, profit, or fee by the SBIR proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA requests must be included in the proposal as follows:
- Phase 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 Navy SBIR Transition Program (STP), the DoN Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DoN provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must participate in the virtual Navy STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate.

STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

Disclosure of Information (DFARS 252.204-7000). In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this award, the proposing small business concern shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons (defined by National Security Decision Directive 189). A small business concern whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DoN Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DoN Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the Government Contracting Officer, noted in the contract.

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

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

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

System for Award Management (SAM). It is strongly encouraged that proposing small business concerns register in SAM, https://sam.gov, by the Close date of this BAA, or verify their registrations are still active and will not expire within 60 days of BAA Close. Additionally, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal. A small business concern selected for an award MUST have an active SAM registration at the time of award or they will be considered ineligible.

Notice of NIST SP 800-171 Assessment Database Requirement. The purpose of the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 is to protect Controlled Unclassified Information (CUI) in Nonfederal Systems and Organizations. As prescribed by DFARS 252.204-7019, in order to be considered for award, a small business concern is required to implement

NIST SP 800-171 and shall have a current assessment uploaded to the Supplier Performance Risk System (SPRS) which provides storage and retrieval capabilities for this assessment. The platform Procurement Integrated Enterprise Environment (PIEE) will be used for secure login and verification to access SPRS. For brief instructions on NIST SP 800-171 assessment, SPRS, and PIEE, please visit https://www.sprs.csd.disa.mil/nistsp.htm. For in-depth tutorials on these items, please visit https://www.sprs.csd.disa.mil/webtrain.htm.

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DoN does **not** recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DoN makes any award that involves an IRB or similar approval requirement, the proposing small business concern must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the DoN's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and recombinant DNA is included under a Phase I or Phase II proposal, please carefully review the requirements at: https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

Government Furnished Equipment (GFE). Due to the typical lengthy time for approval to obtain GFE, it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed, and it is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the technical merit of the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

SELECTION, AWARD, AND POST-AWARD INFORMATION

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

Debriefs. Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the proposal of the proposing small business concern within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

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

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

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

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

Contract Types. The DoN typically awards a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I. In addition to the negotiated contract award types listed in the section of the DoD SBIR/STTR Program BAA titled Additional Considerations, 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. 4021/10 U.S.C. 4022 and related implementing policies and regulations. The DoN may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Funding Limitations. In accordance with the SBIR and STTR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per small business concern per topic. The maximum Phase I proposal/award amount including all options is $240,000. The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. The maximum Phase II proposal/award amount including all options (including TABA) is $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 this BAA). The Phase I Final Report and Initial Phase II Proposal will be used to evaluate the small business concern's potential to progress to a workable prototype in Phase II and transition the technology to Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification.

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.

VERSION 2

Navy SBIR 25.1
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N251-065	Active Scenarios Learning of Evolving Situations, Multimodal Counterfactual Reasoning, and Explanations Toward Artificial Intelligence-assisted Wargaming
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N251-001 TITLE: Directional High Front to Back Ratio Low Frequency (< 90 MHz) Antenna

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

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

OBJECTIVE: Develop a compact lower frequency communications antenna in the High Frequency (HF) (3MHz – 90MHz) spectrum with the ability to direct gain in a desired direction and minimize the gain in the opposing direction. The antenna is to be lightweight, compact, and tactically relevant. The antenna should be employed near enemy forces such that it can transmit in the direction of friendly forces and in the opposing direction minimize the power radiated.

DESCRIPTION: The Marine Corps seeks a compact (less than 6ft long), lightweight, lower communications frequency antenna (High Frequency (HF)/Very High Frequency (VHF) Range). The ability to adjust the frequency (microelectronics or physically) is required to maintain a minimum size. The antenna must operate in the 1.5MHz to 90MHz range (Threshold) and it is desired to operate slightly below the HF and in the HF/VHF/Ultra High Frequency (UHF)/Extremely High Frequency (EHF) ranges (Objective). Antennas as described above are already available at larger lengths (10' Whip and Vertical Dipole 12' to 18'). It is required to use such an antenna connector that is already fielded/used antenna in HF radios. See references for HF radios and links for associated antenna.

Directional gain should be maximized in a given direction, and in the opposing direction minimized (180 degrees). A drop of 30dB in the opposing direction (Threshold), 60+dB in the opposing direction (Objective) is desired. Low frequency Radio Frequency (RF) has a low directivity making the drop in gain difficult. Adaptive structures are sought that would allow non-hazardous materials (Threshold) to be used. Materials used typically in anechoic chambers are hazardous (Absorptive Foam) and usually pyramidal, which is too large for tactical use. Therefore, it is desired that alternate materials or active structures be used to ground the RF energy. References discuss the types of material absorption that may work and current research into this area.

Antenna form factors are usually vertical polarized using a dipole antenna. Thus, a structure suited to controlling energy in a compact (6ft or less) antenna are desired. The thickness of the material required should be less than 2" to reduce the operational impact (Threshold) and less than 0.25" is desired (Objective) and could be some type of antenna coating or grounded shielding that allows directional radiation. Thin materials that can absorb or ground the RF energy in a certain direction while minimizing the effect on the dipole antenna are required. The use of a directive low frequency antenna use case is limited to military use thus very little research has been done to provide directive HF antennas. Advanced material research is deemed necessary, partnership with a university or research institution on advanced materials is encouraged.

PHASE I: Define and develop concepts for a device to absorb RF energy in the opposing direction of the directive gain for a compact antenna. Using modeling and simulation, determine the technical feasibility of the design of such a device. Describe the method and recommended materials required to build a structure and how it can be used tactically with HF radio antennae. Provide a Phase II development plan with performance goals and key technical milestones that will address technical risk reduction and includes development of a prototype.

PHASE II: Develop a scaled prototype integrated with a representative RF antenna that covers the frequency range and provides the required directivity and front to back (180 degree) power drop in a desired direction. Evaluate the prototype to determine its capability in meeting the performance goals defined in the Phase II development plan and Marine Corps requirements for HF transmission with a military radio. Demonstrate radio performance in the desired direction, and drop in detectability in the undesired direction in a prototype demonstration. Use evaluation results to refine the prototype into an initial design that will meet Marine Corps (tactical use) requirements and satisfies MIL-STD-810 environmental factors. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for their use. Develop the antenna directivity solution for evaluation to determine its effectiveness in an operationally relevant environment. Support the Marine Corps for testing and validation to certify and qualify the system for Marine Corps use.

The compact antenna has use in the commercial and amateur radio market based on its ease of use. The directivity capability could be used to improve communications (reduce interference) in a particular direction.

REFERENCES:
1. "Radiation-absorbent material." https://en.wikipedia.org/wiki/Radiation-absorbent_material
2. Ruiz Perez, Fernando. "Carbon-based, radar absorbing materials: A critical review." Journal of Science Advanced Materials and Devices 7(3):100454, April 2022. DOI:10.1016/j.jsamd.2022.100454. https://www.researchgate.net/publication/359886052_Carbon-based_radar_absorbing_materials_A_critical_review
3. "AN/PRC-160(V) Wideband Hf/Vhf Manpack Radio." L3Harris. https://www.l3harris.com/all-capabilities/an-prc-160v-wideband-hf-vhf-manpack-radio
4. "L3Harris' High-frequency Radio Solutions Provide On-the-Move Communications in Satellite-denied Environments." L3Harris Spectrum Magazine, October 2020. https://issuu.com/l3harrisspectrum/docs/spectrum_magazine_ausa_2020_9oct2020/s/11138710

KEYWORDS: High Frequency (HF); Advanced Materials; Radiation absorbent materials (RAM); Radio Frequency (RF); absorption of RF; Directivity; Very High Frequency (VHF); Ultra High Frequency (UHF); Extremely High Frequency (EHF)

N251-002 TITLE: Amphibious Combat Vehicle Weight Reduction

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

OBJECTIVE: Develop lightweight components using advanced materials or innovative design to replace heavier components on the ACV that can withstand the harsh environmental conditions of use in the littorals.

DESCRIPTION: The Amphibious Combat Vehicle (ACV) is an amphibious armored vehicle designed to transport Marines on land and in the water. There are several versions of the vehicle. The ACV – Personnel (ACV-P), ACV Command and Control (ACV-C), the ACV Medium Caliber Cannon (ACV-30), and the ACV Maintenance and Recovery (ACV-R). The ACV-30 and ACV-R are the heaviest variants but all variants would see performance improvements by reducing weight. Components identified as having potential for weight reduction include engine access covers, drive shafts, ramp door, ramp, hatches, external fuel tanks, external metallic and metallic/composite add-on-armor components, suspension, turret exterior panels, and bow plane. Proposed material changes must address corrosion issues expected from use in and around salt water. Weight reduction will improve fuel efficiency and can lower the Center of Gravity and Center of Buoyancy. Reduction of un-sprung mass will improve ride quality. Weight reduction without loss of performance also enables trades in other ACV performance areas to increase readiness or capabilities. The Program Office has set a goal of no more than $20 (production cost) per pound of weight savings and a minimum threshold of 2000lbs total reduction.

PHASE I: Review the vehicle drawings to identify components for potential weight reduction. Produce a preliminary conceptual design to evaluate weight savings and potential cost of production and installation. Use Finite Element Analysis (FEA), as appropriate, to confirm design parameters. Provide the following required Phase I deliverables: a report on the results of modeling and simulation and an initial proposal for a Phase II effort.

PHASE II: Using results from Phase I, fabricate and validate prototypes. Demonstrate the prototypes' ability to meet requirements in the Description through lab testing. Evaluate the results of the demonstration and refine the design as necessary. Conduct on-vehicle testing in a relevant environment. Evaluate and compare the results to Marine Corps requirements. Prepare a Phase III development plan to transition the technology for Marine Corps use. Deliver the prototypes at the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Provide support to the Marine Corps in transitioning the technology to the ACV through an Engineering Change Proposal (ECP) process. Refine the system for further evaluation and determine its effectiveness in an operationally relevant environment. Support the Marine Corps test and evaluation program to qualify the system for Marine Corps use.
Commercial applications include combat vehicles used by other services and other countries. The developed technology could also be used in the Commercial Truck Industry and Recreational Vehicle (RV) market.

REFERENCES:

1. "Combat Vehicle Weight Reduction by Materials Substitution." National Academies of Sciences, Engineering, and Medicine. 2018. Proceedings of a Workshop. Washington, DC: The National Academies Press. https://doi.org/10.17226/23562.
https://nap.nationalacademies.org/catalog/23562/combat-vehicle-weight-reduction-by-materials-substitution-proceedings-of-a
2. "Lightweight Materials for Cars and Trucks."
Office of Energy Efficiency & Renewable Energy, Vehicle Technologies Office.
https://www.energy.gov/eere/vehicles/lightweight-materials-cars-and-trucks

VERSION 2

KEYWORDS: Amphibious Combat Vehicle; ACV; Weight Reduction; Advanced Materials; Composites; Corrosion Resistant; Armored Vehicle

N251-003 TITLE: Amphibious Combat Vehicle Improved Heating Ventilation and Cooling (HVAC) System

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

OBJECTIVE: Develop a heating, ventilation, and cooling (HVAC) system that meets the HVAC requirements for onboard personnel (Ref 1), functions within space, weight, and power (SWaP) limitations, has minimal impact on vehicle noise levels (Ref 2), and does not introduce a significant maintenance burden.

DESCRIPTION: The Amphibious Combat Vehicle (ACV) is an amphibious armored vehicle designed to transport Marines on land and in the water. The vehicle is closed during water and combat operations so outside air must be supplied from above the vehicle. There are several variants of the vehicle.

1. The Personnel variant (ACV-P) has a crew of 3, carries 13 Infantry Marines, and requires the most volume/quantity of fresh air from outside the vehicle.

2. The Command-and-Control variant (ACV-C) has a crew of 3 and accommodates, in the troop compartment, up to 7 command staff members who conduct command and control (C2) tasks that require computer, servers, and communication equipment that generate heat and must be kept within acceptable temperatures.

3. The 30mm gun variant (ACV-30) has a crew of 3, carries 8 Infantry Marines, and has a 30mm Mk. 44 Bushmaster II Automatic Cannon. The ACV-30 requires air filtration or other ways to avoid bringing noxious fumes into the vehicle.

4. The recovery variant (ACV-R) has a crew of 4, all of whom are from the Maintainer Military Occupational Specialty (MOS), and has craning, winching, and repair capabilities.

When operating, the ACV variants' noise levels can exceed single hearing protection levels. Noise level testing indicates that the current Environmental Control System (ECS) is one of the main culprits for excessive noise levels in the cabin. The system must not prevent the ACV from meeting MIL-STD-1474 guidelines for hearing protection and have minimal impact on weight.

The ACV-P is required to supply 20 cubic feet per minute of fresh air per person (320 cfm) and maintain an interior temperature below 90 degrees F in ambient conditions up to 110 degrees F, with a 1,120 W/m2 solar radiation load, doors and hatches closed, and engine running (estimated to require ~55,000 BTUs of cooling). The ACV-C requires 20 cubic feet per minute of fresh air per person (200 cfm) and ~55,000 BTUs of cooling. The ACV-30 needs a filtration system that will not introduce noxious fumes into the cabin and will provide 20 cubic feet per minute of fresh air per person (220 cfm).

The current HVAC system does not properly cool the space per requirements in MIL-STD 1472H. There is large variability across workstations within the vehicle and even within a given workstation (temperature variability between head and feet locations). The HVAC is located on the left side of the vehicle approximately 1/3 of the way back in the troop compartment and has no duct system or other means to distribute conditioned air evenly through the compartment, especially to locations in the far corners of the vehicle.

The current system requires its refrigerant lines to be emptied and the refrigerant captured when the vehicle engine is removed. Engine removal occurs frequently which causes significant maintenance delays. When the engine is re-installed, the lines must be reconnected, a vacuum pulled, and the refrigerant refilled. This greatly increases the time required to remove and reinstall the engine for maintenance.

PHASE I: Review the vehicle drawings or models and conduct a site visit to study an ACV to determine technical feasibility of a single system to meet the requirements of all four variants. Develop a concept for a new HVAC system or modification of the current system design. Demonstrate compliance through a combination of modeling, analyses, and bench top demonstration.

In addition to the Phase I deliverables described in the BAA, the awardee is expected to deliver at least 1 in-process design review with meeting minutes, report on results of modeling and simulation, and an initial Phase II proposal.

PHASE II: Using results from Phase I, fabricate and validate a prototype. Demonstrate the prototype's ability to meet the requirements in the Description. Evaluate the results of the demonstration and refine the design as necessary. Conduct on-vehicle testing in a relevant environment. Evaluate and compare the results to Marine Corps requirements. Prepare a Phase III development plan to transition the technology for Marine Corps use. Delivered a prototype at the end of Phase II.

PHASE III DUAL USE APPLICATIONS: On vehicle testing across different variants and refinement as a result of testing will be required. Production planning and partnerships should be created if necessary for production.

Other military applications potentially include use in combat vehicles used by other services and other countries. The developed technology could also potentially be used in commercial markets such as heavy construction and agricultural equipment, and possibly in the Recreational Vehicle (RV) market.

REFERENCES:

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KEYWORDS: Amphibious Combat Vehicle; ACV; Noise; Sound; Reduction; Heating, Ventilation and Cooling; HVAC; Climate; Maintainability

N251-004 TITLE: Kill Web Conceptual Modeling for Wargaming

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

OBJECTIVE: Develop C4ISRT (Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance, and Targeting) Network and Kill Web models for wargaming that are sufficient to withstand review board scrutiny to support model verification, validation, and accreditation, as required. The focus is on developing and implementing the models referenced herein, not on the underlying mechanics of the PM WGC (Program Manager Wargaming Capability) materiel solution simulation framework.

DESCRIPTION: This SBIR topic addresses several parametrics of interest related to C4ISRT Networks and Kill Web models for future inclusion in the General Robert B. Neller Center for Wargaming and Analysis, formerly the Marine Corps Wargaming and Analysis Center (MCWAC). The parametrics address the procedural and physical information and decision flow through the C4ISRT networks to effectively model the coordination between the various warfighting functions to achieve effects on targets. The relevant processes include aspects of planning, directing, tasking, collecting, processing, producing, and disseminating information, including network transmission. Network transmission modeling should account for node locations and links, information size, data/error rates, bandwidth, and latency. Network nodes can be fixed sites or mobile and should be susceptible to damage states and degraded performance.

Previous efforts within the Neller Center simulation system development focused primarily on physics-based models of communication transmission. In typical kinetic-focused wargaming, the kill web sense-decide-effect process constraints and realities are not always highlighted. This effort involves a novel approach for including rigorous kill web considerations within wargames alongside the other types of typically employed models.

In the table linked below, the major parametrics considered are listed, along with a description of the parametric and the pertinent specific conceptual model requirements for each parametric topic.

https://navysbir.com/n25_1/N251-004-Kill_Web_Conceptual_Modeling.pdf

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and MCSC in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop concepts for an improved representation of C4ISRT Networks/Kill Webs in wargaming Modeling and Simulation (M&S) that meet the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs. Establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by evaluation of the plan of attack for the development effort including data availability. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Based on the results of Phase I concepts and the Phase II development plan, the small business will develop prototype conceptual models. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for C4ISRT Network/Kill Web M&S. System performance will be demonstrated through prototype evaluation over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use.

It is anticipated that the Phase II prototype development may require the gathering, storing, and processing of classified data at the SECRET level or higher (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Integrate C4ISRT Network/Kill Web conceptual models into the Neller Center wargaming software to demonstrate their effectiveness in an operationally relevant environment within the Neller Center. Support the Marine Corps for M&S Verification, Validation, and Accreditation (VV&A) to certify and qualify the system for Marine Corps use.

The conceptual models described herein are not only a high priority within the Marine Corps [Refs 1,3], but are equally applicable across the Services, to support not only wargaming, but also analysis, training, and experimentation. Successfully developed conceptual models would likely be of great interest across these communities. DoD components and prime contractors are in need of accurate C4ISRT Network/Kill Web simulation representation to support gap analysis and solution assessment. Commercial game developers for DoD use cases would benefit from augmenting their software offerings with these kill web models, adding to the realism and real-world complexity afforded the wargame participants.

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KEYWORDS: General Robert B. Neller Wargaming and Analysis Center; Marine Corps Wargaming and Analysis Center; MCWAC; United States Marine Corps; USMC; M&S; Modeling and Simulation; conceptual model; analysis; Neller Center; wargaming; Force Design; kill chain; kill web

N251-005 TITLE: Day/Night Crew Served Weapon Sight System

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

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

OBJECTIVE: Develop a day and night capable target acquisition and engagement sight system for crew-served small arms weapon systems.

DESCRIPTION: This SBIR effort is to develop a day/night crew-served weapon sight system that combines the functionality of multiple legacy sight systems while providing additional performance and capabilities. Marines require a replacement for technologically obsolete thermal weapon sights procured for medium (7.62mm) and heavy (12.7mm and 40mm) machine guns. These single-function devices do not provide fire control capabilities, such as target range determination with dynamically corrected aimpoints, nor do they provide the clarity and range of dedicated visible light sight systems utilized during daylight. The Marine Corps is also investigating capabilities to provide the range performance of heavy machine guns in form factors comparable to medium machine guns, with associated mobility advantages for dismounted Marines. Such a capability would require an associated day/night sight system and fire control to efficiently utilize the limited amount of ammunition carried by machine gun teams. Technical approaches may include modular or fully integrated capabilities (see technical parameters in Phase II) but should emphasize light weight for dismounted applications. Multiple approaches may be assessed in Phase I, but a prototype hardware solution (or multiple solutions) must be achievable within the time and funding scope of the base Phase II effort. In all phases of the effort, the proposer shall provide target and environmental modeling assumptions and sensor/optical parameters.

It is recommended that proposers utilize the U.S. Army Night Vision Integrated Performance Model (NVIPM) for sensor range predictions. A copy of NVIPM software can be provided as Government Furnished Information upon contract award, however proposers are expected to have prior proficiency in use as training will not be provided by the Government. Phase I proposals shall include, but are not limited to, discussion of the performer's experience and knowledge of relevant technologies and their application to optical systems for small arms; the proposer's ability to model the size, weight, power, cost, and range performance of optical systems for small arms applications; and the proposer's capabilities for rapid prototyping and relevant prior examples. Supplementary material should include recent examples of the performer's ability to develop, refine, and qualify relevant systems for use in military operational environments and produce systems in significant quantities, utilizing either internal resources or via teaming or licensing agreements. Phase I proposals may include preliminary concepts that demonstrate understanding of the relevant trade spaces.

The prototype system is not expected to be optimized for power consumption, nor to meet gunfire shock and full military operational environment requirements; however, it shall be suitably robust for use outdoors in temperate climates. The prototype shall include an external power capability to operate on

120VAC power via an adapter and any internal batteries shall be removable by the operator, allowing use on external power only.

The prototype system shall provide the operator a 70% probability of recognizing personnel targets at no less than 2,400 meters in overcast starlight conditions (~100 microlux), without the use of active illumination sources, through bright sunlight conditions (~100 kilolux) and under 7 kilometer clear air equivalent visibility. The prototype system shall include a color visible light capability (powered digital imager or unpowered direct view optic) for bright sunlight to civil twilight (3-400 lux) use, in clear air, at the stated distance. Solutions incorporating digital day imagers shall have dynamic range sufficient for observing objects in shadows across the stated ambient light levels. Viewable scene and/or symbology brightness shall be adjustable to minimize detectable emissions at night and bright enough to permit observation during daylight without the use of a light sealing eyecup. The prototype system shall be capable of performing the stated task in dirty battlefield and adverse weather conditions at no less than one-third the clear air range. Recognition shall be evaluated by the ability of the operator to detect and correctly count the number of upright personnel within a group with no more than 50% line of sight positional overlap between individuals presenting a frontal aspect.

For NVIPM modeling, the recommended relevant parameters are: 0.75 meter target characteristic dimension, V50 (recognition) = 2.2 cycles, 2 Kelvin target contrast for thermal band imaging, and 25% target contrast for reflectance band imaging.

The prototype system shall have a fire control capability with sufficient ranging and corrected aimpoint accuracy to permit first-round engagement of targets at the maximum effective range of the associated small arms system.

The prototype system shall have sufficient field of view to observe projectile impacts on target, rapidly search for and detect targets, and maintain situational awareness of friendly forces approaching perpendicularly to the target area before they enter the cone of fire. Specialized mounting solutions, including superelevation capabilities, are permissible for different weapons. Relevant USMC weapons include the M240B 7.62mm Medium Machine Gun, M2A1 12.7mm Heavy Machine Gun, and Mk19 40mm Heavy Machine Gun.

The prototype system should demonstrate the ability to receive target handoff from a secondary observer, such as a nearby machine gun team leader or a distant small unit leader (Objective).

The performer shall provide a plan for both low and full rate production, describing proposed fabrication capabilities and teaming or licensing agreements, if applicable. The performer shall provide a cost estimate for non-recurring initial resources and facilities as well as production of sight systems based on step ladder pricing.

PHASE I: Define and develop a concept for a day/night crew-served weapon sight system. Establish the feasibility of the concept. Prepare a Phase II plan.

PHASE II: Develop and deliver at least one hardware system prototype suitable for demonstrating the range performance, operator employment, and approximate size and weight of the preferred concept on relevant small arms systems. Prepare a Phase III commercialization/transition plan.

PHASE III DUAL USE APPLICATIONS: Further refine the sight system for optimization of size, weight, power, and manufacturing cost and for survivability in the conditions associated with weapon firing shock and the military operational environment. Deliver sufficient representative sight systems to allow qualification and Marine user evaluation for refinement prior to full rate production. Dual use applications include law enforcement precision marksman and civilian hunting applications, subject to ITAR and local government restrictions. Related applications may include machine vision systems for remote inspection and autonomous vehicle long distance hazard/pedestrian avoidance.

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KEYWORDS: Sensors; Optics; Fire Control; Sights; Small Arms; Weapons; Targeting

N251-006 TITLE: Diagnostics, Prognostics, and Health Management for Non-Steady State, Rapid Acceleration/Deceleration, High-Load Bearings

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials;Integrated Sensing and Cyber;Sustainment

OBJECTIVE: Develop and demonstrate an empirically developed system for failure risk prediction, diagnostics, prognostics, and health management of rapid acceleration/deceleration, high-load bearings to increase operational availability (Ao) of carrier-based recovery systems.

DESCRIPTION: Arresting gear on aircraft carriers quickly decelerate aircraft over a short distance (hundreds of feet or meters) and time (2–3 s). Nimitz-class carriers utilize the MK-7 arresting engine, while the Ford-class utilizes the MK-15, Advanced Arresting Gear (AAG). In both instances, an aircraft tailhook engages the cross-deck pendant (CDP). The CDP attaches to the purchase cable (PC), which transfers energy to the arresting engines. Below deck, sheaves (i.e., pulleys) are used to change PC direction and wrap the cable around shock/energy absorbers. Due to the nature of the application, the sheave bearings on the MK-7 and the spherical roller thrust bearings on the MK-15 AAG experience high-loading, and rapid acceleration followed by rapid deceleration. This cycle repeats as aircraft are continuously arrested during flight operations. Arrestments are followed by retracts, which have a lower load and acceleration, where the cable is retracted back to its pre-arrestment position.

Bearing specifications differ between MK-7 and MK-15 (AAG); they also differ within MK-7 depending on location and use. The max RPM of the MK-7 bearings is in the range of 1000–1400 RPM; the max-RPM range of the MK-15 is between 600–900 RPM, with a few follower-bearings going up to 1,400 RPM. The bearings accelerate to and decelerate from this speed over a matter of 2–3 seconds. Load ratings vary depending on where the bearing is used. On the MK-7, the maximum load ratings range from approximately 335,000 lb–360,000 lb (151.95–163.29 MT) static (with one outlier rated for 560,000 lb [254.01 MT] static.) and 190,000 lb–268,800 lb (86.18–121.93 MT) dynamic. In operation, the max operating loads are 105,000 lb (47.63 MT) cable tension, 210,000 lb (95.25 MT) resultant load. However, there can be overload scenarios that load sheaves to an approximate theoretical load of 350,000 lb (158.76 MT). Thrust loads are minimal (a few hundred pounds) for the majority of the sheave bearings. One sheave bearing type is rated at 2,100 lb (.95 MT) of thrust. Examples of the MK-7 inner diameters, outer diameters, and widths include: 7.9 in (20.07 cm) ID x 12.6 in (32.004 cm) OD x 3.5 in (8.89 cm) W, 12.6 in (32.004 cm) ID x 19.7 in (50.034 cm) OD x 2.5 in (6.35 cm) W, 18.7 in (47.5 cm) ID x 24.3 in (61.72 cm) OD x 2.7 in (6.86 cm) W. The MK-15 uses 300 mm (Timken / SKF bearing model number 29360) and 360 mm (Timken / SKF bearing model number 29372) inner diameter spherical roller thrust bearings under high-dynamic loads, as well as a few follower bearings (both pillow-block and thrust bearings) that go up to 1,400 RPM; the long-term effects of thousands of arrestments on the risk of bearing failure has yet to be determined.

When selecting a roller bearing, a common practice is to estimate the bearing’s "L10" life, defined as the number of revolutions (sometimes listed as a time at a constant speed) before there is a 10 % chance of bearing failure. A bearing can have one of many different types of failure mechanisms, including a lubricant failure causing the bearings to seize; as well as a failure in fatigue, causing rollers to crack and potentially jam the bearing. These empirical equations are based on prior tests (mostly around the 1940s) of roller bearings being continually spun until failure. These tests predominantly used continuous speed tests, and these empirical equations assume a continuously spun bearing. When a roller bearing’s speed is varied, the only available approach to estimating the bearing’s L10 life is to extrapolate from a summation of continuous speed calculations; this is at best an educated guess, and one does not truly know the probability of a bearing failure for bearing applications with significant variability in speed. It is clear, however, that a rapid change in speed will impart more fatigue and alter the lubricant properties, and thus the true long-term risk of failure from hundreds of thousands of arrestments has yet to be truly determined.

In addition, maintenance practices, failure risk, and the life of steady state bearings are better defined, and diagnostics/prognostics technologies are more mature. The rapid acceleration and deceleration of bearings in arresting gear applications is atypical; there is significant variability when quantifying the risk of a bearing failure, and this unknown risk from this unique use case leads to potentially conservative maintenance practices. This includes high-frequency greasing of the sheaves on MK-7 (every 20 arrestments) and routine teardown for inspection. The inspections include taking apart the sheaves, wiping off grease, and visually inspecting the bearing. Repeated disassembly and reassembly of the sheaves increase the maintenance, and the frequent disassembly for inspection inherently increases the risk of damage. A reduction in maintenance requirements can reduce Operations and Support (O&S) costs by (a) decreasing hours spent on inspection, and (b) preventing excessive teardown from increasing the failure rate of the sheaves. Sheave inspections take anywhere from 6–14 hours of work (per sheave) depending on the type of sheave. A method of reducing the inspections and maintenance of the bearings that preserves safety and reliability would increase Operational Availability.

Mobil Mobilith SHC 460 grease is used on the MK-7 sheave bearings, and none of the bearings are sealed. Phenolic and steel spacers act as grease retainers, but grease still escapes from small gaps between the spacers and the housings. For the majority of sheaves, the grease ports are stationary and grease is fed through grooves in the spacers. One sheave type is greased from the inner diameter of the sheave shafts. On the MK-15 AAG, Mobil Mobilith SHC 629 and 634 bearing oil is used in the spherical roller thrust bearings; seals hold the liquid oil within the bearing cavity.

The Navy is seeking an innovative solution to setting up an apparatus to subject roller bearings under a high load (relative to the bearings' dynamic load limit). The apparatus will cyclically ramp up the bearings from stationary to a high speed (relative to the bearings' rated speed), and then immediately and rapidly decelerate the bearings to stationary; each cyclic event should last less than 5 seconds. This cyclic acceleration and deceleration would need to continue indefinitely until the bearings have failed. Undoubtedly, this process can take a long time, but it would be essential for such an apparatus to be scaled and/or replicated in such a way such that a trend of estimated failure rates versus the number of cycles can be determined with a reasonable statistical confidence.

From this experimental apparatus, the Navy is seeking an empirically derived solution to predict the risk of a bearing failure and to track the bearing health over time. This will involve the development of diagnostics/prognostics algorithms. Insight into appropriate greasing, inspection, and maintenance intervals is required to decrease maintenance hours, extend bearing life, and alert Sailors to required maintenance prior to bearing failure. It is expected that a fixed, scheduled greasing interval will remain. Research and data are required to determine if the current 20-arrestment interval is reasonable or too conservative. In regard to diagnostics and prognostics of the bearings, real-time health monitoring is preferred, but periodic, automated inspections are also acceptable, so long as they do not increase the maintenance burden on the Fleet and enable a move towards a condition-based maintenance (CBM) approach.

Approaches may include, but are not limited to, a combination of modeling and simulation (M&S), instrumentation, sensor fusion, prognostics and health management, and/or other methodologies for data collection and data analytics, based on the empirical data. From a software perspective, advances in artificial intelligence and machine learning, or other related innovations associated with prognostics and health management may be leveraged to achieve the goals as outlined. Prior research and literature surrounding reliability, availability, and maintainability, including associated failure distributions (e.g., normal, Weibull, etc.) and other probabilistic/statistical methods are also relevant. From a hardware perspective, existing sensors, such as accelerometers, temperature sensors, thermal imaging, torque sensors, nondestructive inspection equipment, and so forth, may be appropriate; however, proposers are in no way limited to these technologies or methodologies and may offer alternative means to monitor health. Designs must be minimally intrusive, and capacity/space for additional, bulky sensing equipment is limited.

PHASE I: Demonstrate feasibility of high-load, non-steady state bearing predictions and health monitoring. Design and develop a solution that utilizes hardware to collect data at representative bearings and utilizes software to accept data for evaluation via M&S, data analytics, AI/ML algorithms, or other methods. Awardee may develop a physical, subscale bearing test bed during Phase I; however, it is not a requirement if the awardee can achieve similar results by generating realistic datasets using computer resources. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design and build a full-scale prototype based on Phase I work. Demonstrate the technology in a lab environment using a bearing test bed that models the loading and acceleration profiles of the Navy's bearings. Consideration should also be given to cyclic operations (i.e., high-sortie rate testing), as this is expected to lead to the highest temperatures, wear, and potentially bearing failure.
Validate and verify that the approach meets needs and requirements of the application by showing that diagnostics/prognostics algorithm(s) can identify (a) a proper greasing interval, (b) current bearing health state, (c) when to visually inspect and/or perform maintenance, and (d) remaining useful life or mean time between failures (MTBF) as applicable.

Assuming iterative design is used, and a more capable solution is developed gradually throughout this phase, consideration will be given to packaging to meet military specifications, data storage/processing, the health monitoring user interface, and integration with existing equipment and infrastructure.

PHASE III DUAL USE APPLICATIONS: Use any algorithms, sensor systems, bearing monitoring systems, and life-cycle prediction tools developed during Phase II to both accurately predict the expected number of arrestments a set of bearings can handle prior to an expectation of failure, as well as predict when anomalies in the bearing performance (e.g., vibrations, increase in torque) is indicative of a developing problem. Transition the monitoring systems to the ships to alert the crew when anomalies are detected, or maintenance is needed.

There are countless examples of commercial applications, which use bearings that accelerate and decelerate rapidly, and that can benefit from this technology. Some examples likely include bearings with large braking requirements, such as landing gear on aircrafts, and brakes on trains.

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KEYWORDS: Bearings; Tribology; Lubricants; Failures; Monitoring; L10

N251-007 TITLE: Alternative Wireless Technologies for the Aircraft Carrier Flight Deck

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

OBJECTIVE: Develop a wireless communication method that functions inside shipboard radio frequency (RF) limited environments to accommodate data links between mobile devices and computer systems.

DESCRIPTION: The aircraft carrier flight deck is not only a physically hazardous environment, but a highly contested electromagnetic environment. Allowing wireless communication between computers and mobile devices on a flight deck is a challenging problem. Various systems such as radar interfere with bands in the electromagnetic spectrum, ruling out technologies such as commercial Wi-Fi as a solution. The importance of managing Electromagnetic Interference (EMI) is especially important in the presence of ordnance where technologies must be tested under Hazard of Electromagnetic Radiation to Ordnance (HERO). Most importantly, there are RF restrictions due to Emissions Control (EMCON) during operations. Wireless communication on the flight deck is an enabler to many key technologies. This includes mobile devices used for providing naval aviation information to flight deck Sailors, audio communication devices, and autonomous systems relying on wireless links. Creating a flight deck compatible wireless solution would improve many aspects of Sailors' jobs during operations.

There have been many advancements in wireless links using technologies outside of the RF spectrum. Technologies based on free space optics use both the visible and nonvisible spectrum to transfer data. For example, Light Fidelity (LiFi) technologies have been created to provide a WiFi alternative in indoor environments. Ceiling mounted lights can be used to transfer data to receivers on laptop computers. Long distance data transfer has also been demonstrated to be able to send data in outdoor environments when directionality and power are adjusted. However, there are disadvantages in the light spectrum due to the need for direct line of sight and loss of effectiveness in degraded weather conditions. Alternatively, the sound spectrum outside of human audible frequencies can be used as a medium but has disadvantages in range and interference. There are difficulties in both mediums when implementing within a wireless network with multiple devices.

The U.S. Navy is seeking a solution to prototype a wireless communication network that is capable of being used in RF limited environments. It must provide bi-directional connectivity between mobile devices across the entirety of the aircraft carrier flight deck. While examples were given above with solutions outside of the RF spectrum, methods that make use of RF with low probability of intercept and detection is also acceptable. The proposed solution should include hardware designs for networking devices such as access points and peripherals to enable mobile device connectivity. A plan on how to implement connectivity across an area as large as a carrier flight deck should be included. The solution should accommodate data throughput of at least 100 kbit/s from device to device on a single channel to accommodate voice and intermittent data transfer. Technologies will be judged based on reliability, compatibility with shipboard emissions requirements, and anticipated data rates.

PHASE I: Define and develop a concept for wireless connectivity within an air capable shipboard environment that eliminates or reduces radio frequency emissions. Perform an initial assessment of the technology through modeling and simulation or in a lab setting where data is sent between a minimum of two devices using the wireless medium. Provide a plan to expand the technology to a local area network. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype wireless network of devices using a wireless medium that eliminates or reduces radio frequency emissions. Produce prototype network hardware such as transceivers and access points. Demonstrate the technology in an outdoor environment at ranges experienced on aircraft carriers.

Provide an assessment of probability of detection, as well as test results for latency, data rates, and reliability. Provide documentation on hardware architecture and device drivers.

PHASE III DUAL USE APPLICATIONS: Integrate the wireless network developed in Phase II into an air capable ship flight deck and validate system functionality. Test its compatibility within the environment (EMI and HERO requirements) and determine if the system has a low probability of detection.

The project has significant implications to the telecommunications industry. Wireless transmission outside of commonly used RF bands are vital to future generations of wireless networks (i.e., 6G) to use in conjunction with RF. It increases overall bandwidth by offloading data sent through RF bandwidth to other mediums. The technology can be used indoors within local area networks and outdoors through cell phone towers.

Technology developed in this effort can be implemented in locations where traditional RF or WiFi cannot be used. It has implications within areas where there is equipment sensitive to RF such as medical devices. It can be used in undersea communications systems where traditional WiFi will not work.

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KEYWORDS: Wireless Network; Radio Frequency; WiFi; Optical Communication; Local Area Network; Emissions Control

N251-008 TITLE: Autostereoscopic Flight Simulator Display System for Improved Depth Perception

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

OBJECTIVE: Develop a novel flight simulator display system, which improves user depth and velocity perception greater than those, which can be perceived via traditional two-dimensional visual display systems.

DESCRIPTION: Current display systems for Navy flight simulators traditionally project two-dimensional (2D) imagery of a three-dimensional (3D) environment onto a display medium, but user depth perception is greatly decreased due to a loss of visual information about the 3D environment. The human vision system relies on stereoscopic views of the real world in order to accurately gauge depth, object location in space, and velocity. This information is interpreted by the visual system from the combined effects of monocular and binocular cues. Naval aircrews must reliably perform tasks in 3D space (e.g., AAR, formation flights, air-to-air engagement, and landing on aircraft carriers). Therefore, the goal of this SBIR topic is to develop a display system capable of providing stereoscopic views of a computer generated 3D environment specifically for flight simulator usage.

It is expected that this effort will produce an autostereoscopic display system capable of replacing current flight simulator display systems without the use/requirement of stereoscopic eyewear. The visual acuity and performance of the system will be equivalent to or better than current flight simulator display systems regarding resolution (i.e., minimum 20/20, objective 20/10), refresh rate (i.e., minimum 120 Hz, objective > 140 Hz), luminance (i.e., maximum 1,500 cd/m2 and minimum 0.00 cd/m2), and integration into high fidelity naval aircraft training systems. The display system will also allow a user to accurately gauge depth at least between 5–100 ft (1.52 m–30.48 m) to an equivalent stereoacuity between 40 to 20 arcsec (objective 20 arcsec). Any impacts on human performance will need to be minimized and/or eliminated and evaluated to prevent negatively impacting the pilot's normal flight operations and learning (e.g., strabismus, vergence-accommodation conflict, visual distortions, operator feedback, lateral/vertical head movements, etc.). Users should not have a significantly limited “head box” to maintain stereoscopic vision. Formal pilot evaluations and human factors studies should be developed with assistance from the TPOC’s and NAVAIR’s Human Research Protection Official.

Note: NAVAIR will provide Phase I awardees 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: Design an autostereoscopic display system that does not require the use of eyewear/glasses/headwear, which is able to meet or exceed the requirements outlined in the Description. Determine technical feasibility through experiments that address extended use from a human factors point of view. The Phase I effort will include prototype plans to be developed under Phase II. Prototype plans shall include methods for incorporation with high fidelity cockpit simulator systems currently in use by the Navy (e.g., tactical operational flight trainer “tub”). While the initial targeted simulation environment is for fighter jet platforms, integration should not be limited to fighter jet platforms as rotary-wing and large fixed-wing platforms also require stereoscopic simulation.

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE II: Develop and demonstrate a functional prototype of the system. Perform pilot evaluations of the system's performance and capabilities, human factors analysis, and psychological assessment for simulator sickness and human performance. Determine if the display system can be used as a replacement to current flight simulator display systems. Identify, address, and document deficiencies and areas for improvement.

Note: Please refer to the statement in the Description above regarding human research protocol for Phase II.

PHASE III DUAL USE APPLICATIONS: Use pilot evaluations, human factors studies, and/or lessons learned from the Navy simulator integration (Phase II) to improve on the autostereoscopic display system design and transition from prototype to producible solution.

Autostereoscopic display technology is a new and growing field, which is getting a significant amount of attention inside and outside of the DoD. Testing this system as a simulation tool, and addressing human factors such as comfort for extended use, would allow this system to enter the market as a proven display system ready to be utilized in training systems. These training systems could extend beyond aircraft and military applications (e.g., gaming, entertainment, private sector training, etc.).

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KEYWORDS: Autostereoscopic; Stereoscopic; Display; Depth Perception; Simulator; Training

N251-009 TITLE: Network Enabled Weapons Settings Verification

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;Human-Machine Interfaces;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: Possible rewrite: Develop and demonstrate the ability to verify the compatibility of cryptologic key material and radio initialization settings among weapons, sensors, and shooters and to permit required data exchanges.

DESCRIPTION: The U.S. Navy has, and continues to develop, a category of air-launched smart munitions known as Network Enabled Weapons (NEW). These weapons require target location updates during the weapon time of flight to ensure that the target is within the weapon's seeker field-of-view at weapon endgame. Remote sensor platforms transmit this updated target information via Weapon Data Link (WDL) radios. The WDL is currently Link-16 (L16) Line of Sight (LOS) datalink. Additional LOS and Beyond Line of Sight (BLOS) datalinks are currently in development for use in software programmable radios. These datalink radios require NSA-produced Black (encrypted) cryptologic key material (KEYMAT) and myriad specific initialization parameters to enable data exchange between the weapons, the launch aircraft, and the remote sensor platforms. The KEYMAT and initialization parameters are provided via entry into aviation mission planning systems by trained Naval Aviators and Naval Flight Officers, for subsequent digital transfer to the platforms and weapons. Current Fleet employment procedures generally have the launch aircraft provide the target updates, though they can also come from other targeting platforms. However, the Air Wing of the Future (AWOTF) will train and fight in a distributed environment, whereby NEW will regularly need to communicate with other nodes within the kill web besides the launch aircraft, to include other aircraft in the air wing and other Navy, Joint, and Coalition platforms. Assured communications is a critical enabler for this distributed environment.

The objective is to develop and demonstrate the ability to verify the compatibility of cryptologic key material and radio initialization settings among weapons, sensors, and shooters and to permit required data exchanges. End article must be ready for production, meet all requirements and specifications for National Security Agency (NSA) certification for handling of cryptographic key material, and supportable by current and future Fleet logistics.

The Fleet is struggling to improve the success rate of NEW employment in training and exercises due to the intolerance of any faults, errors, or omissions in the data entry and transfer process. To reduce the operational burden on aviators and to significantly raise the success rate of NEW employment, the Fleet requires a mission data verification capability to verify the aircraft and weapon dataloads are compatible and will result in successful data exchange after the weapon is launched. This verification must occur while aircrew are still near the mission planning system, to allow timely correction of errors. Waiting to verify correct initialization until the aircrew are in the aircraft with engines and systems online delays flight events and breaks aircraft carrier emissions control (EMCON) conditions required in wartime. In addition, not all NEW are capable of radio initialization verification before launch.

The flight test community at Naval Air Warfare Center Weapons Division, China Lake, CA, has developed a device that meets some of the Fleet requirements. However, it uses NSA Type 1 certified flight-worthy radios, has a user interface built for engineers instead of aircrew, and is of a size and weight unsuitable for deployed use aboard aircraft carriers and at remote operating locations ashore. This solution also requires a separate instantiation for each model of WDL radio currently in use.

The Fleet requires a solution that addresses the shortcomings of the device in use by the flight test community. A fieldable, sustainable, and usable solution must have a small footprint, easily stowable and transportable by aircrew and squadrons. In this regard, a software-only solution that can run on a laptop would be preferred, but not to the detriment of other requirements. It must be producible at a per-unit price below that of flight-worthy hardware, if possible. The solution must be capable of using the actual datalink initialization files from mission planning, including operational KEYMAT. The solution sought must work for every type of L16 terminal currently fielded in naval aircraft and weapons and must be architected to be easily and quickly updateable to work with new radios and new datalinks as they are fielded. Success is the ability to use NSA sourced Key Encryption Keys (KEKs) to decrypt Key Management Infrastructure (KMI) wrapped Traffic Encryption Keys (TEKs) in support of Navy missions. Key formats follow the NSA Cryptomodernized Key Specifications for L16 and vendor specific key splits that enable the radio operation. It must not produce any electronic emissions. It must be simple to use by trained aircrew and must take minimal time to produce a result. If the solution determines that the dataloads are not compatible, it should be able to inform the aircrew of exactly which parameter or data is causing the incompatibility. However, this feature is not required for fielding.

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: Identify and design a concept that, with minimal to no aircrew action (besides providing access to the dataload from the mission planning system), ingests the planned L16 radio KEYMAT and initialization parameters for multiple aircraft within the carrier air wing (CVW), multiple weapon types (all current deployed NEW), and multiple weapons (i.e., a single weapon type carried by multiple aircraft to be employed as a salvo), tests whether the combination of KEYMAT and radio initialization will allow the required data exchanges, and provide aircrew an indication of success or failure. Emphasis should be on currently fielded aircraft, weapons, and radios. Phase I deliverables include a detailed description of the proposed solution, a detailed plan for development of a proof-of-concept capability, and a proposed cost and schedule for Phase II. The plan should include a draft NSA certification plan (if required by the proposed solution). The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design, develop, and deliver a proof-of-concept solution as described in the Phase I deliverables. Produce an NSA reviewed certification plan and tailored Information Assurance Requirements (as required). Expand the design to accommodate emerging waveforms and WDLs. Assess

and report the utility/feasibility of adding BLOS radios. Provide cost and schedule estimate for transition to production and production of IOC quantities, as well as sparing and support plan.
Work in Phase II may become classified. Please see note in the Description section.

PHASE III DUAL USE APPLICATIONS: Obtain final approved NSA certification (as required). Partner as necessary for transition to production and sustainment. Produce IOC quantities (approximately 10–32 units). These units will be deployed aboard U.S. Navy aircraft carriers and to Master Jet Bases for use by strike fighter squadrons for NEW training.

The capability will have dual-use/commercial application benefits supporting commercial sales of UAV/drones requiring data link mission systems software uploading in either a classified or non-classified environment. Having a key validation tool will provide the quality checks and balances required to assure mission success.

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KEYWORDS: Network Enabled Weapons; Link-16; Initialization Parameters; Assured Communications; Mission Data Verification; NSA Type 1 Encryption

N251-010 TITLE: Conformal Antennas for Unmanned Aerial Vehicles (UAV)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials;Integrated Sensing and Cyber;Microelectronics

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

OBJECTIVE: Originate an additive manufacturing-based technology suitable for use in creating conformal antennas that also function as structural skins/air flow surfaces for airborne pods and wing-based Unmanned Aerial Vehicles (UAV). Also desired is the development of related techniques, which can be used for ground vehicles and drones.

DESCRIPTION: Conformal antennas became popular during the conflict in Afghanistan when their lack of visual signatures provided an operational stealth advantage. Since then, the increased maturity of electromagnetic simulation codes has allowed the impact of multiple feed points on nonplanar surfaces on the frequency dependence of antenna patterns to be controlled in the design process. The same codes now allow the frequency span of periodically spaced resonant element arrays to increase from 4:1 to as much as 50:1 by implementing electrical interconnections between actual phase centers for radiation. Conformal antennas lack the need to modify the design of antenna fins. Such changes impact air flow and hence flight performance and require expensive design verification costs for both pods and UAV. Ultra-wideband antennas are also inherently more attractive than narrow band ones since many techniques exist to reconfigure wideband systems into multiple narrow band ones for cases where frequency scanning or limited operation adaptation are acceptable. Moreover, functional specific antenna fins limit the maximum production volume of a given transceiver's realization, raising per unit acquisition and logistics costs and increasing the likelihood of manufacturing delay. Thus, it is desired for wideband, conformal antennas to develop as generic packaging commodities. It is notable that additive manufacturing techniques have been used to construct complex periodic arrays, though the range may still be limited by structural and electrical properties of the "inks".

It is known that the addition of carbon nanotubes to various polymers change their electrical properties from insulating to conductive, though how close to high purity copper in electrical properties can be achieved is unclear, especially in a material strong enough to be used as thin shells with good structural properties. Thus, it is unknown if conformal antennas for unmanned platforms, such as pods and UAV, should be constructed as single layers with local control of the electrical conductivity or multilayered prints and using standard additive conductor structures at each feed point or slot antenna concepts. 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: Develop a design for a 4:1, > 90° field of view (FOV) antenna for 6 to 24 GHz on a cylindrical volume 10 in. (25.4 cm) in outer diameter and having minimal internal stiffening structure, 5 ft (1.52 m) long and with two pairs of wings that can be realized using the simulation code and manufacturing process identified in the Description. During the base, both complete the design in simulation and produce prototype planar array coupons having more than four elements. Experimentally document the electrical and structural properties of the printed materials and the functionality of these coupons as directional emitters. Identify all the roadblocks to realizing the performance objective defined in the original proposal. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Work with the naval sponsors to refine the design into a target platform of specific operational class and functional requirements. Deliver a scaled first prototype in the Base period. An iteration thereof that addresses sponsor concerns should be completed in the Option period. This iteration is then to be flight tested during the Phase II Option with the internal volume occupied only by onboard signal emitters and any required batteries. This work is expected to be export controlled and could become classified secret.

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

PHASE III DUAL USE APPLICATIONS: Focus on integration of the design concept into a particular functional system. Work with program office staff to produce further improvements to shells loaded with more realistic internal transceivers and document their functionality under fielded conditions. These shells become a generic part wherein the RF antenna characteristics are determined by connections and hardware inside the volume.

Commercial applications could include hour to day-long deployments as reconfigurable extra/temporary replacement relay stations for wireless systems. Also, car collision avoidance systems use sparsely arrayed antennas on increasingly nonmetallic surfaces as active radars, while driver entertainment and assistance systems require multiple communications network capacity.

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KEYWORDS: Distributed Antenna Arrays; Slot Antennas; Carbon Nanotubes; Additive Manufacturing; Wideband Antennas; Reconfigurable Antennas

N251-011 TITLE: Extreme High Speed Laser Application (EHLA) for Titanium Cylinders Bores

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

OBJECTIVE: Develop Extreme High Speed Laser Cladding technology for the inner bore of titanium cylinders.

DESCRIPTION: Internal bore diameters of hydraulic cylinders and dampers experience excessive wear in extreme conditions and require replacement at high cost. Current titanium coating applications introduce a high heat-affected zone into titanium housings causing, delamination, reduced fatigue life, distortion, and surface cracking. Coating technologies available today are limited to select processes as to not affect the base titanium material but the processes still ultimately result in early failure of the component due to heat-affected zone penetration. Additionally, coating blind bores is not common in industry. This is due to fixturing and tooling available as discussed in the third paragraph.

Coating the bore of the cylinder with a hard, wear-resistant, and corrosion-resistant coating is desirable to extend the life of the component. The Extreme High Speed Laser Application (EHLA) technology is unique in that it melts the powder before it hits the substrate, which causes a very little heat-affected zone, by orders of magnitude less than common coating applications. For comparison purposes, EHLA may create heat-affected zone of ~0.001 in.–0.003 in. (0.025–0.076 mm), whereas traditional laser clad creates a heat-affected zone of 0.03 in. (0.076 mm), or more. With EHLA, the coating is metallurgical bonded via the fusion process to the base layers, so it does not chip, peel, or delaminate.

The EHLA process has mainly been used for line-of-sight applications, but the technology has progressed, and non-line-of-sight (NLOS) equipment is now available for use within the past year. The benefit of NLOS is that it allows the coating to get into smaller diameter bores, radii, and difficult transition areas of a part. A German company named the Fraunhofer-Gesellschaft originally developed this technology. China has heavily invested in this technology. The Fraunhofer-Gesellschaft is currently the only company in the world that has vast experience in extreme high-speed laser application technology. They have used this technology to coat external components. Small Internal bore application has been developed within the last year, which can now be applied down to 3.5 in. (8.89 cm) diameters. Successfully coating titanium bores with this technology will help future programs and future Original Equipment Manufacturers (OEMs) be less averse to selecting titanium as an actuator or cylinder material. By choosing titanium they can adhere weight savings on the aircraft because they get the added benefit of this novel wear coating's performance. This technology is not restricted to titanium cylinders, but the process can be adapted to coat aluminum and steel cylinders easily and have the same beneficial results. EHLA is cost-effective due to few required pre/post processing treatments, high repeatability and precisely controllable, and it can easily be removed and reapplied without the need of building another asset.

PHASE I: Identify potential wear coatings and application for use on Titanium cylinder substrates with NLOS applications using EHLA technology. Determine a coating material that can be applied to beta-STOA Ti-6Al-4V (Current supplier: Consolidated Industries) that has a high-Rockwell Hardness C (HRC) rating and high-wear resistance with small ductility in order to prevent wear and internal debris. Identify methods to ensure the surface has adequate texture for oil retention and lubricity. Determine and define the correct laser head and powder feeding rate to properly apply the coating onto the titanium cylinder that keeps the temperature at or below 350 °F (176.66 °C) with as little heat-affected zone as possible. Provide evidence of feasibility for developing the coating process in Phase II. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Prototype the EHLA NLOS process for application of wear coatings for Titanium cylinder substrates with minimum bore inside diameter of 3.5 in. (8.89 cm) and minimum length of 12 in. (30.48 cm) based on Phase I results. Develop and implement the coating method to ensure surface has adequate texture for oil retention. Complete necessary testing to validate the integrity of the substrate and the coating: metallurgical analysis, bond testing, wear testing, corrosion testing, and fatigue. Provide a report that outlines the prototype process, equipment, methodology and testing completed to verify integrity. Develop a plan to mature the technology in Phase III.

PHASE III DUAL USE APPLICATIONS: Using the matured EHLA NLOS process, coat a full-scale 53K titanium damper housing and complete a full-scale 1700 hr endurance test to demonstrate that the EHLA process provides minimal wear and corrosion resistance. Once complete, this technology can begin to integrate into the 53K fleet and become a route for OEMs to design hydraulic cylinders out of titanium to provide weight savings.

OEMs and the private sector will benefit from this technology by having the capability to coat titanium cylinders instead of typically going with steel in order to provide weight savings. Along with the added benefit of reducing internal wear, higher quality adhesion to the cylinder housing, and superior oil retention for a sliding seal. EHLA is available for use in multiple cylinder applications including aluminum and steel.

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KEYWORDS: Coatings; Titanium; Extreme High Speed Laser Cladding; Wear Resistant; Actuators; Dampers

N251-012 TITLE: Resource Manager Enhancements for Automated Maritime Mission Prosecution

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

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

OBJECTIVE: Develop decision making tools and processing techniques to dramatically reduce the time required to achieve maritime situational awareness in very dense contact environments.

DESCRIPTION: Distributed maritime operations in dense surface contact littoral environments is challenging and requires automated mission prosecution. The construction of surface picture heavily relies on the use of a sensor resource manager controlling a surveillance radar augmented by electro-optical/infra-red (EO/IR) and electronic support measures (ESM). The sensor resource manager enhancements would ideally demonstrate improved classification of dark surface contacts not transmitting automatic information systems (AIS). Surface contact physical attributes (e.g., length), behavioral characteristics, and in-theater location should be contributors to the automated decision processes. The aggregation and exploitation of historical information could utilize artificial intelligence/machine learning (AI/ML) methods as appropriate to facilitate in-mission decision processes.

In dense maritime environments typical of many areas of the western Pacific, an airborne surveillance platform with a capable radar, ESM and AIS may have several thousand or more vessels under track. Making sense of what is going on is extremely challenging. The automatic association of information from these independent sensors is certainly beneficial in gaining maritime situational awareness. However, in many instances AIS messages contain false coordinates, incorrect field entries or missing entries. In other cases, vessels stop transmitting AIS or AIS reception is jammed. Furthermore, during times of heightened tension or conflict many radio frequency transmissions from surface vessels are expected to curtail dramatically. Achieving a comprehensive wide-area maritime situational awareness in these dense environments is very challenging in the best of circumstances, but is more challenging when the role of AIS and ESM degrades. From a radar perspective, maritime situational awareness involves developing a surface track picture, and then using an inverse synthetic aperture radar (ISAR) mode to image individual vessels in order to classify them. Inverse synthetic-aperture radar (ISAR) dwells may last 15–30 s each, meaning it is impossible to image all vessels under track.

In order to address this sensor timeline issue, the Navy needs to gather more classification information from very short duration ISAR sessions. These short sessions or ISAR snap shots (ISARSS) would take approximately 1 s rather than the 15–30 s for a traditional ISAR. The construction of surface picture relies heavily on the use of a sensor resource manager controlling the radar's operation. In this SBIR topic, the Navy seeks to develop the means to maximize the vessel classification information from an ISARSS with sensor resource management control. Minimally, the vessel's length overall and the general topside profile is expected to be derived. This information may be sufficient to identify a vessel as a possible combatant. In order to make ISARSS truly valuable, much more classification information is required. Providing fine naval class-level identification using ISARSS, leveraging compressive sensing techniques would fundamentally change the time and resources needed to achieve wide-area maritime situational awareness.

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: Develop an architecture for the automatic aggregation of this information into an exhaustive set of filtering discriminants that can be subsequently used to enhance sensor resource manager decision processes during mission prosecution. Complete an initial analysis of how ISARSS might support fine naval class-level identification with tight coupling between the ISARSS classification information and the sensor resource manager. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Mature the coupled resource management and ISARSS exploitation approach for a specific radar system identified by the Navy sponsor. The ISARSS exploitation approach will be matured using collected field data supplied by the Navy sponsor. Assess the performance of the ISARSS exploitation as a function of range, dwell time and illumination geometry. Assess the performance of the combined system in a high-fidelity mission level simulation. Prepare an integration plan for the integration on a platform identified by the Navy sponsor.

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

PHASE III DUAL USE APPLICATIONS: Complete the automated control approach and ISARSS exploitation and integrate into a Navy mission system.
The automated control and imaging exploitation capabilities could be utilized by agencies like the Coast Guard.

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KEYWORDS: Sensor Resource Management; Inverse Synthetic Aperture Radar; Automatic Target Recognition; Maritime Situational Awareness; Radar; Automation

N251-013 TITLE: Passive Cooling/Heating System for Thermal Regulation in Clothing

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

OBJECTIVE: Develop a novel a passive cooling capability that provides thermal regulation when operating in the aircraft and/or insulation during inwater survival with a minimal impact on bulk and weight.

DESCRIPTION: For Navy and Marine Corps aircrew, the need to wear an anti-exposure coverall is determined by the operational environment air and water temperatures in which they will be operating. Anti-exposure coveralls are required when flying over water temperatures of 60 °F (15.6 °C) or lower and the outside air temperature is 32 °F (0 °C) or below (when corrected for wind chill). Temperatures in the cockpit and aircraft at takeoff and during flight can be much higher as the aircraft departs from a warm environment and operate over cold water that requires wearing an anti-exposure coverall. Current Navy constant wear exposure suits, the CWU-86/P for men and CWU-87/P for women, are required to be worn by aircrew in rotary-wing, tilt-rotor, and ejection seat aircraft when operating in these environmental conditions. The CWU-86/P and CWU-87/P are dry suits and designed to prevent water intrusion into the suit, keeping the layers underneath dry in order to provide the insulation required for survival. The CWU-86/P and CWU-87/P were designed for a 2 hr inwater exposure time and 3–4 hr of wear time. The increasingly common practice of mid-air refueling extends the duration of wear time in flight and extends the potential inwater exposure due to a longer time before rescue. The design does not afford any thermal regulation for comfort during normal flight conditions, which leads to overheating and sweating, and which is distracting and can lead to dehydration and fatigue.

The Naval Air Warfare Center Aircraft Division (NAWCAD) is seeking novel solutions to improve personal thermal management in flight and maintain or improve inwater thermal protection from hypothermia. The solutions must provide aircrew the capability to actively regulate body temperature in flight without degrading in water survival. Increases in body temperature during flight and decreases in temperature during in water survival can impact strength, endurance, cognitive function, and mission effectiveness decrease [Refs 1-3].

More specifically the solution and technology must meet the following requirements. The requirements address both inflight and inwater scenarios. A solution that addresses one, but not both scenarios will be considered, as well as solutions that address both scenarios.

1. The solution must maintain or improve thermal regulation of aircrew when wearing the current inwater configuration of the CWU-86/P or CWU-87/P worn with two layers of long underwear (layer 1: mid-weight, layer 2: heavy weight).
2. This solution must manage moisture build up inside of the exposure suit to reduce the potential of hyperthermia.
3. The solution must insulate the body to reduce heat loss during inwater immersion and survival for 4 hr (threshold) 24 hr (objective).
4. Aircrew must be able to wear the solution for 12 hr, without interfering with operation of the aircraft or mission tasks.
5. The solution must be compatible with aircrew life-support equipment worn over the top of an anti-exposure coverall. For rotary-wing and tilt-rotor aircrew the configuration will include a survival vest with LPU-36/P or LPU-21E/P life preserver, HGU-56/P helmet, gloves, and boots. For fixed-wing, ejection seat aircrew the configuration will include the CSU-15/P anti-g garment, the PCU-58P parachute/restraint harness, the LPU-37/P or LPU-23/P life preserver, the HGU-68 helmet, gloves, and boots.
6. The body core temperature from body heat build-up during operational performance of aircraft must not exceed 101.3 °F (38.5 °C).

7. The body core temperature must fall no lower than 95 °F (35 °C).
8. The hand and foot skin temperature must be no lower than 60 °F (15.6 °C) when immersed in 45 °F (7.2 °C) water for a minimum of 2 hr, and 60 °F (15.6 °C) when immersed in 32 °F (0 °C) water environment for a minimum of 4 hr.
9. The garment must not interfere with bladder relief systems worn with the anti-exposure suit.
10. The solution, when worn as part of the anti-exposure suit configuration must not cause body burn greater than 25%.
11. The solution must follow MIL-STD-1472H (5.8.3.2). For systems and equipment that are life-critical (e.g., accessibility of safety interlocks, clearances for ejection seats, fit of gas masks), the design for all physical factors (size, shape, weight, reach, strength, and endurance) must accommodate the multivariate central 99 % of suitably clothed and equipped males of the target user population and the multivariate central 99 % of suitably clothed and equipped females of the target user population using dimensions applicable to the tasks.
12. The solutions must not require power (objective) and will utilize a portable power source (threshold) when used in the aircraft. Power is not preferred when in water.
13. The solution must not obstruct emergency egress from the aircraft.
14. If applicable, the solution must continue to function as designed after 25 launderings.
15. The solution must maintain functionality for a minimum of 1 deployment (9 months) with minimal maintenance support.
16. The solution must be easily donned by the individual without requiring additional help.
17. The solution must not cause hot spots or rash if in contact with the skin.
18. The solution must meet airworthiness standards (i.e., MIL-HDBK-516).

PHASE I: Design and develop a solution concept of a thermal regulation system for use with a constant wear anti-exposure coverall. Demonstrate technical feasibility of the solution through analysis and limited laboratory demonstrations. Provide cost and reliability estimates. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop, demonstrate, and validate a working prototype for testing based upon the design concept created during Phase I. Conduct laboratory testing and demonstrate thermal regulation capability in a laboratory environment. Demonstration will be conducted in a simulated environmental environment with personnel representing the central 5th to 95th percentile male and female aircrew.

PHASE III DUAL USE APPLICATIONS: Perform final design updates based upon prototype testing in Phase II. Produce systems for flight testing and develop production capability for commercialization. Provide updated engineering drawings, detail specifications, cost and life cycle analysis, maintenance and repair procedures.

The technology developed under this effort can apply to commercial aircrew flying in helicopters over water, commercial fishing industry, commercial applications in which workers are wearing garments to protect from liquid contaminants.

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KEYWORDS: Exposure Suit; Heating; Cooling; Passive; Clothing; Thermal Regulation

N251-014 TITLE: Enhanced Submarine Mast Detection and Discrimination

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

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

OBJECTIVE: Exploit the radar backscattering return from the wake produced by a submarine mast to enhance detection and discrimination beyond what is possible when relying solely on the return from the mast.

DESCRIPTION: The U.S. Navy requires an operational capability to detect submarine mast wakes from high altitudes using coherent radar waveforms that also reliably reject sea clutter detections. Submarine mast detection has always been one of the most challenging radar problems. Submarines deploy a variety of sensor masts including optical and electro-optical periscopes, electronic support, radio frequency direction finding, and radar. Maritime wide area surface search radars traditionally operate at low altitudes with non-coherent waveforms. At high and grazing angles coherent processing can add Doppler spectrum as a radar observable. If the Doppler spectrum of a mast's return can be adequately separated from that of the sea, then improved detection performance is possible. However, the radar cross section of the mast itself may be very small. Therefore, if the wake generated by the mast can also be exploited, additional performance is possible.

Measurements of backscatter from real submarine masts is generally classified, although some measurements of masts have been published in the open literature [Refs 1 and 2]. Those measurements show that the backscatter is composed of the return from the mast, the wake generated by the mast moving through the water, and the clutter return from the surrounding ocean surface within the radar's antenna beam. Analysis of those measurements show the return from the mast, in this case with a Doppler shift placing outside the clutter spectrum, and a significant return from a wake. The sea clutter spectrum is also visible. It appears that the Doppler spectrum for the wake extends over about –3 m/s to 3 m/s, equivalent to a Doppler spread of about 400 Hz in X-band. The clutter extends over about –0.5 m/s to 1.5 m/s, or about 125 Hz in X-band. The target has a narrow spectrum, mainly confined to a single Doppler bin having a resolution of about 0.1 m/s. The total power in the wake appears to be comparable to the power from the mast alone. These results are a function of the test conditions and in some other cases the mast may have the same Doppler shift as the sea clutter returns and a clear separation in Doppler space cannot always be relied upon.

In this SBIR topic, the Navy seeks to better understand the wake signature from the moving mast. More complex detection schemes might be considered; for example, those involving micro-Doppler signatures from the wake. An understanding of the wake magnitude and Doppler spread over the range of mast configurations, sea states, submarine speed, direction of movement relative to the prevailing seas and radar viewing geometry is needed to gain a comprehensive understanding of the feasibility of such schemes.

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: Complete comprehensive analytical and numerical assessments of how the wake generated by a moving submarine mast will supplement the hard body return for detection and discrimination performance improvements. Assume the grazing angle ranges from 5 to 20 degrees over a representative range of conditions. Consider probability of detection and false alarm rate as compared to those for the mast alone. Develop the basis for the discrimination approach which complements the hard body technique. Prepare an overall system architecture concept. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Work with the Navy to test and refine the approach developed in Phase I using experimental data provided by the Navy. Tune the approach to the data's specific conditions. The supplemental detection and discrimination approach should be sufficiently mature at the conclusion of Phase II that it could be integrated into a radar's submarine mast detection and discrimination system.
Work in Phase II may become classified. Please see note in the Description section.

PHASE III DUAL USE APPLICATIONS: Complete the automated processing capability for enhanced submarine mast detection and discrimination and integrate with a Navy maritime surveillance radar system.

The techniques could be applied to a variety of small target detection capabilities in a maritime environment such as those needed by the Coast Guard.

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KEYWORDS: Submarine Masts and Periscopes; Wake Characterization; Electromagnetic Scattering; Doppler Processing; Radar; Maritime Surveillance

N251-015 TITLE: Predictive Lifing Tool for Coupled Corrosion, Pitting, and Fatigue Degradation

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

OBJECTIVE: Develop and demonstrate predictive modeling and lifing capability for coupled corrosion, pitting, fracture, and fatigue mechanisms of naval aero-engine propulsion materials.

DESCRIPTION: Critical propulsion components are carefully lifed to uphold system safety and reliability in support of the warfighter's mission. Lifing analysis relies on an understanding of the fracture and fatigue mechanics of component materials to establish inspection, maintenance, and removal intervals throughout the life of the weapons system. Often, component lifing is based on empirically derived material properties, S-N curves, and Weibull analyses of inspection and failure events. However, the roles of the austere naval operational environment and environmental degradation of material properties are difficult to evaluate, and it becomes even more complicated to predict the resulting impact on fatigue and service life.

In naval aviation, the warfighter must operate within maritime atmospheric environments, and critical propulsion components are exposed to harsh cycles of high humidity, temperature, and salt exposure, which contribute to corrosion degradation and pitting. In recent years, there has been significant research into coupled corrosion, pitting, fracture, and fatigue mechanisms. This research has uncovered numerous contributing mechanisms, such as galvanic coupling, high temperature oxidation, saltwater corrosion, cyclic environmental corrosion, hydrogen embrittlement, coupled erosion/corrosion or impact/corrosion, among others. This interconnection of mechanisms has made the development of predictive corrosion modeling very difficult and very complex.

However, there is an ever-growing need for predictive lifing capabilities. The material, maintenance, and manpower costs of repairing or replacing components due to corrosion has become a significant hindrance to the affordability, availability, and safety of the warfighter. Currently, the U.S. Navy spends between $3 to 4 billion per year to combat corrosion. Part of this cost is driven by the undetermined effect corrosion degradation has on component life; out of an abundance of caution, components are repaired or replaced prematurely when there may be additional, safe operational life still available. Notably, this need exists not only across naval aviation but also across surface and undersea naval material applications, so predictive corrosion fatigue lifing capabilities may be disseminated across the Department of the Navy. Thus, the U.S. Navy seeks the development of a predictive modeling and lifing tool for coupled corrosion, fracture, and fatigue of naval aero-engine propulsion materials to support more accurate, reliable, and safe lifing of warfighter components. This lifing tool should address as many of the specific capabilities listed here as feasible. The proposed solution may be a self-contained tool encapsulating all the capabilities listed. It may be an add-on tool compatible with a commercial-off-the-shelf predictive model, such that the combination addresses the target capabilities. It may also be a series of independent tools that each address the different capability needs. The intent of this Description is to outline the desired capabilities of the final lifing tool but to allow the proposer flexibility for how to achieve and package these capabilities.

The tool should address the following capabilities:

1. Develop a Material Model with Customizable Loading Conditions. Any predictive lifing tool should be capable of reflecting realistic or structurally relevant loading conditions. For example, airworthiness considerations may require conventional tension and tension fatigue testing, steady and cyclic applied loading, flexural loading, and uniform and non-uniform loading conditions. Solutions are sought that are capable of modeling different mechanical loading scenarios and can be validated with common tensile, flexural, or other experimental method. Upon award, the Navy

technical point of contact (TPOC) can help identify the most crucial mechanical loading configurations to model.

1. Many different alloys, coatings, greases, and other materials are used in the U.S. Navy fleet. The material model should be developed and demonstrated with the material properties of (a) a representative aluminum alloy, and (b) a representative stainless steel. Upon award, the Navy TPOC can assist the team to identify the most appropriate material systems based on the required data inputs per the strategy described above and available property data. Common aluminum alloys used in the fleet are F357, AA 2024, and AA 7076, and common stainless steels are 17-4PH, A286, and M152.
2. Simplify Material Corrosion Degradation. Corrosion mechanisms are highly complex and interdependent. Thus, truly predictive modeling of those mechanisms is very challenging, likely involving coupled chemical and environmentally-driven reaction kinetics and likely beyond the scope of a single project. Solutions are sought, which propose a reasonable and achievable simplification of naval aero-engine corrosion mechanisms within the material model. For example, it may be reasonable to apply some environment-dependent scaling coefficient or stress riser to the stress intensity factor driving crack growth. It may also be possible to model material degradation due to corrosion by reducing the material to an effective, load-bearing geometry or by imposing a pre-existing defect, like a pit or crack, to the material model. Furthermore, aero-engine corrosion is highly cyclic, so models that incorporate some cyclic progression of corrosion degradation will be prioritized. Continuing from the previous examples, this cyclic degradation may take the form of periodic reduction of the load-bearing geometry or of pre-existing surface defects of the material model. These are just examples of simplifications and are not meant to constrain proposed corrosion degradation modeling. Upon project award, the Navy TPOC can provide experimental data on observed corrosion rates, pitting, and pre-existing defect features as well as some operational data, which may describe the frequency and magnitude of environmental cycles.
3. Correlate Impacts to Fatigue Life. Once a strategy to model the corrosion degradation is identified, that strategy should be implemented within the material model with customizable loading configurations to form the predictive lifing tool. This lifing tool should be capable of quantifying a predicted fatigue strength over a range of loading conditions in the form of an S-N curve. S-N curves are common graphical depictions of the load fatigue strength relationships of a material or component and provide an easy, visual means of comparing the strength properties of different materials. The key output of this predictive lifing tool should be the S-N curves of one representative aluminum alloy and one representative stainless-steel alloy across a realistic range of loads and cyclic content. Upon project award, the Navy TPOC can provide guidance about engine loading and cyclic content.
4. Predict the Fatigue Life Impacts of Pre-existing, Surface and Near-Surface Cracks and Pits. The predictive lifing tool should be capable of representing the effect of pre-existing, surface and near-surface cracks and pits. Many degradation mechanisms begin with the generation of surface and near-surface cracks and pits, and the predictive capability to model the fracture and fatigue performance of a material will inform allowable limits on pre-existing pits, cracks, and porosity within an as-manufactured material. The tool should be capable of modeling the impact of crack or pit size, depth, and density within the material. The resulting fatigue performance should be represented in S-N curves.
5. Validate the Fundamental Fatigue Life Predictions. The predictions of the corrosion fatigue lifing tool should be validated for both the representative aluminum alloy and the representative stainless-steel alloy in at least two disparate loading configurations (e.g., two different tensile loads, one tensile load and one torsion load, etc.). Tool predictions should be made for each material in an ideal, uncorroded state; a minor-to-moderately corroded state; and a moderate-to-heavily corroded state. The nature of the modeled corrosion state may depend on the proposed strategy to model corrosion degradation. Upon award, the Navy TPOC may help to identify the

appropriate model prediction and validation conditions, but these conditions should be producible in a laboratory environment. The proposer should identify the test facility capable of performing the validation experiments, mimicking the test conditions in the tool prediction to enable a direct comparison of results.

6. Package the Predictive Lifing Tool into a Testbed. The predictive corrosion fatigue lifing tool should be packaged into a testbed deliverable, integrating the required capabilities previously described. This testbed may take the form or forms most appropriate to deliver these capabilities to NAWCAD engineering personnel. For example, the testbed may consist of a single, standalone software package or model, or it may consist of a series of add-on packages for existing commercial software. If awarded funding, teams should work with the Navy TPOC early in the tool development to identify the form of the testbed deliverable to comply with any Navy software or computational tool restrictions. In addition to providing key benefits to the Navy, the lifing tool is anticipated to extend corrosion fatigue lifing capabilities to other ground, surface, and aerial commercial and military vehicles operating in highly corrosive environments, so the proposer should outline a commercialization pathway for the lifing tool.
7. Provide Workforce Training for the Tool. To facilitate the delivery of the testbed lifing tool, the proposer should plan for and conduct either an on-site or virtual training for NAWCAD engineering personnel. The objective of the training should be to provide NAWCAD personnel an understanding of the tool's function with respect to the required capabilities listed above, of how to use the tool, and of the application of the tool to other material and environmental conditions (including identifying necessary user inputs for such applications).

PHASE I: Demonstrate the feasibility and probability of success via the initial development of a tool framework.

1. Technical Challenges Assessment. Perform a review of the technical challenges facing a proposed solution and assess these challenges. Consider the availability of environmental and material data, the proposed strategy for corrosion modeling simplification, the difficulty and time required for the tool development, among other obstacles. This assessment should inform the Solution Feasibility Assessment, which capabilities will be addressed, and to what extent they will be addressed.
2. Strategic Work Plan. Based on the Technical Challenges Assessment, develop a strategic work plan for the development of a corrosion fatigue lifing tool to address the listed capabilities and to clearly identify the scope of work and tasking associated with development of each capability. This work plan should carefully consider and identify the assumptions, advantages, and limitations of the proposed strategy to model corrosion degradation described in the section "Simplify Material Corrosion Degradation." However, this work plan should also address the other capabilities, validation, testbed delivery, and training. The work plan should lay out a schedule of tasking and activities for Phase I and subsequent phases of work if awarded. Outline specific tasks, objectives, milestones, and go/no-go decision points to track the progress and feasibility of the proposed solution in context with the Technical Challenges Assessment and Risk Assessment.
3. Risk Assessment. Evaluate the Strategic Work Plan and Technical Challenges and identify potential sources of risk. Develop a risk mitigation plan that outlines specific strategies and/or go/no-go decision points in the outlined work plan.
4. Preliminary Feasibility Assessment. Begin execution of the Strategic Work Plan to demonstrate the initial feasibility and likelihood of success of the proposed solution. Phase I progress will be evaluated based on accomplishments made against the Strategic Work Plan and towards Capabilities 1, 2, 3, and 4.

The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Fully execute the Strategic Work Plan developed in Phase I and demonstrate a predictive corrosion fatigue lifing tool.

1. Testbed Development. The Strategic Work Plan should be fully executed to deliver a predictive corrosion lifing tool satisfying the listed capabilities.
2. Testbed Validation. Validation of the testbed should be completed as described in Capability 5.
3. Updated Risk Assessment. Upon completion of the testbed, the Risk Assessment from Phase I should be revisited and updated to reflect resolved or new risks, and to identify appropriate mitigation to sustain use of the lifing tool. Future risks or opportunities for future development should also be identified, which may bring added capability.

PHASE III DUAL USE APPLICATIONS: Complete delivery of the testbed corrosion fatigue lifing tool.

1. Testbed Delivery and Training. Delivery and training of the testbed with NAWCAD engineering personnel should be completed as described by Capabilities 6 and 7. A commercialization pathway beyond the Navy should also be identified.
2. Technical Challenges Re-Assessment. Perform a re-assessment of the technical challenges identified in Phase I. These challenges would have informed the proposed strategy for corrosion modeling simplification, such as for example the simplification to the effective load-bearing geometry. This re-assessment should consider how the lifing tool may require future development to meet the specific needs of commercial and military end users and how corrosion model simplifications may or may not be appropriate for different users. Identify a pathway to re-address those challenges and to feasibly avoid model simplifications. Continuing with the previous example, if the model was simplified to a load-bearing geometry, describe the future tasking required to introduce the reaction kinetics that may instead inform a more representative depiction of the material degradation. Identify what information or knowledge gaps need to be resolved to avoid such simplifications, what testing or analysis is needed to address those gaps, and assess how feasible it would be to incorporate updates to the lifing tool.

The solution is expected to be highly applicable to both military and commercial aviation propulsion systems and materials. Military operations, by their nature, are more strenuous than commercial, and involve operations in the harshest environments, which contribute to accelerated corrosion. However, commercial aviation is also experiencing significant degradation due to corrosion, particularly commercial operators who fly in and out of coastal and subtropical regions. As such, this corrosion fatigue lifing tool may benefit commercial operators to predict how that degradation will affect component lifecycles and to use the tool to provide informed engineering judgement for component maintenance and sustainment activities. While the tool targets naval aviation applications, the basic function of the tool may also be extended to ground and surface vehicles operating in highly corrosive environments. Air-breathing propulsion systems, like gas turbines, are used for power generation in surface vehicles and use equivalent designs and materials to aviation systems. Lightweight and structural materials (i.e., stainless steels and aluminums), are also common across ground, surface, and aerial vehicles, meaning that material-customizable configurations of the tool may be readily transferred among applications.

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KEYWORDS: Naval Aviation Propulsion; Corrosion; Fatigue; Cyclic Environment; Corrosion Fatigue Modeling; Lifing Tool

N251-016 TITLE: Expendable Sonobuoy-Launched Unmanned Aerial Vehicle for ASW Cued Search, Detection, Tracking, and Classification

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 an expendable Tier 1 Sonobuoy Launched Unmanned Aerial Vehicle (SL UAV) that can be launched from a P-8A's sonobuoy launcher system from high altitude, with a sensitive magnetometer, and capable of deploying an in-water passive acoustic sensor(s) for Anti-Submarine Warfare (ASW) target cued search, detection, localization, tracking, and classification.

DESCRIPTION: The metrics of this development are:
Overall Sonobuoy Launched UAV for ASW Re-Acquire, Tracking, and Classification System Objectives:

1. Packaging: LAU-126A Sonobuoy Launch Container (SLC) or equivalent,
2. SLUAV Weight: Max 39 lb (17.7 kg) (bare, not including the SLC),
3. SLUAV Stowed Dimensions: 4.875 in. (12.38 cm) diameter x 36 in. (91.44 cm) length,
4. Storage: 9 years shelf life,
5. Launch Envelope: Full Sonobuoy production specification,
6. Speed: 70 kts Cruise Air Speed (Threshold),
7. Endurance: 70 min (Threshold),
8. Operational Altitude: 500–2,000 ft (15.24 m–609.6 m),
9. Range: 20 nm LOS (extending to 50 nm),
10. Payload Volume: Greater than 94.4 in.^{3} (1546.94 cm^3),
11. Environment:
    a. Temperature – must be able to operate in -20 °C–50 °C,
    b. Light Rain such that visibility is greater than 1 nm,
12. Autonomy: Threshold: Fly pre-programmed waypoint tracks and orbits, Objective: Transition to autonomous target tracking as cued by MAD system,
13. On board Processing:
    a. AI performance: Not less than 275 TOPS (INT8),
    b. Max GPU frequency: Not less than 1.3 GHz,
    c. Number of GPU cores: Not less than 2048 CUDA cores and 64 Tensor cores,
    d. Number of CPU cores: Not less than 12,
    e. CPU frequency: 2.2 GHz,
    f. Memory (RAM): Not less than 64 GB.
14. Command and control:
    a. Phase I and II: Any,
    b. Phase III: UAS Control Segment (UCS) Architecture, and
15. Cost: In final form, < $10,000 in quantities of 100.

Magnetic Anomaly Detection (MAD) System Specific Objectives:
The SL UAV must support MAD with the requirement that the inherent platform motion coupled with the SL UAV & acoustic sensor payload magnetic signature shall not prevent the following performance:

1. Platform magnetic field components will exhibit an amplitude noise spectral density of less than 1 pT/rtHz from DC to 100 Hz.
2. Magnetometer should work in real-world conditions including a dynamic range of +/- 100 µT on each axis, no dead zones, and an accuracy of 1 nT over the temperature range of -0 °C–50 °C.
3. MAD in-air noise level: Threshold: 20 pT/rtHz in 0.01–100 Hz with a raw heading error of

In-Water Passive Acoustic Sensor Specific Objectives:
1. Operating Life: Threshold 60 min; Objective 70 min,
2. Max Operating Depth: Threshold 200 ft (60.96 m); Objective 400 ft (121.92 m),
3. Deployment time: Threshold 120 s; Objective 60 s,
4. Scuttle: Threshold: Automatic based battery life remaining; Objective: Automatic and on-command,
5. Sensor DI: Threshold: omni; Objective: higher gain and/or direction-finding capability,
6. Sensor(s) Frequency Coverage: Threshold: 0.01 Hz–2.5 kHz; Objective: 0.001Hz–25 kHz,
7. Sensor Noise Equivalent: dependent on proposed topology; intent would be to extend contact time (detection range) commensurate with DI and ambient conditions,
8. Data shaping: whitened to environment for reduced uplink bandwidth,
9. Sensor Calibration Accuracy: Threshold: +/-2dB; Objective: +/-1dB,
10. Range: 20 nm LOS (extending to 50 nm).

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: Develop a concept for an expendable SL UAV supplied with an Area of Uncertainty (AOU) conduct a cued search, detection, localization and classification using MAD and an in-water passive acoustic sensing capability to meet the above requirements. Explicitly state, theoretical, physical, numerical and computational methods employed. Approach for aircraft design and MAD/acoustic operation should be back up with simulated results and proved experimentally on a laboratory environment before proceeding to Phase II. If developing a new aircraft, compare to performance of similar SL UAVS previously developed. Clearly label artificial intelligence/machine learning (AI/ML) methods employed on SL UAV computer. Compare performance with non-linear correlation methods often employed on weak ML neural-networks. MAD detection and classification methods should not be limited to dipole models and must include, but not limited to, harmonic fields. Computational methods should be able to implement data fusion algorithms incorporating different sensor types. Encryption methods for data transmission should also be addressed.

A prototype of the aircraft should be completed by Phase I. This includes structural analysis and flight clearances. Magnetic characterization at magnetometer location should also be completed at different engine speeds. Failure to meet the magnetic noise threshold at the magnetometer location will result on a rejection for a Phase II.

A successful Phase I will be defined on meeting the threshold on the above-mentioned parameters in the structural analysis, simulation, and laboratory testing. Results from the previous should be confirmed by the TPOC, and more analysis/test may be requested by the TPOC as needed. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Based upon the Phase I effort, construct SLUAV MAD + Acoustic ASW System and demonstrate the feasibility of meeting the above requirements on a relevant and operation environment. A successful Phase II effort will culminate with a full-system demonstration of the combined MAD and acoustic capabilities on multiple SL UAVs. The SL UAVs, during this demonstration, should be air launched from a surrogate platform to demonstrate they can unfold, transition into stable flight and communicate. Additionally, the SL UAVs should be subjected to shock loads prior to air launch, these shock loads should replicate the loads the prototype would see from a Cartridge Activated Device (CAD) launcher or pneumatic sono-launcher as close as possible.

A successful Phase II will also measure the ability of the SL UAVs to operate in Swarm, classify and localize targets, and meet the in-flight thresholds defined on the Description.
Work in Phase II may become classified. Please see note in the Description section.

PHASE III DUAL USE APPLICATIONS: Based upon the Phase II effort, on a relevant environment, conduct a Swarm search with SL UAV's, which includes relevant targets. Effort should detect, track, and classify targets using a combination of both magnetic sensors and acoustic sensors. The SL UAV's should be air launched from a relevant platform, which satisfy sponsors' demands.

SL UAV technology, combined with data fusion and processing capabilities, would improve product innovation in the deliverable of products meeting reckoning and detection demand while airborne both in the sea and earth landscape.

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KEYWORDS: Unmanned; Air Vehicle; UAV; UAS; Magnetic; MAD; Acoustic; Infrasound; Machine Learning; Artificial Intelligence

N251-017 TITLE: Small Type-1 Encryption for Aircraft, Littoral, and Terrestrial Higher-than-Secret (STEALTH) Applications

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

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

OBJECTIVE: Develop very small modular NSA Type-1 High Assurance Internet Protocol Encryptor (HAIPE) Internet Protocol Security (IPSEC) encryption modules that support multi-frequency, carrier-hopping, spread spectrum features with removable crypto modules.

DESCRIPTION: Type-1 Encryption “device” for Aircraft, Littoral, and Terrestrial Higher-than-Secret (STEALTH) requires physically separated Red and Black dual processors as part of the architecture. STEALTH must have provisions for a modular Radio Frequency (RF) System on Chip (SoC) to support L and S Band Transmission Security (TRANSEC) Waveform (WF) Encryption. STEALTH will support Multi-Frequency, Carrier-Hopping, Spread Spectrum features in modern WFs. Target applications are for smaller embedded systems, such as 3U VPX, SOSA VPX, and other systems requiring removable plug-and-play crypto. Encryption data rates need to be able to support low to medium encrypted transmissions. The system is intended for tactical-relevant aircraft, ships, vehicles, dismounted users, SIPR, and JWICS government users that need removable crypto modules and that can be easily removed and stored in secure spaces (i.e., safes, etc.), or removed from military platforms to facilitate Secret and Top Secret handling procedures.

The Navy requires very small modular NSA Type-1 High Assurance Internet Protocol Encryptor (HAIPE) Internet Protocol Security (IPSEC) encryption modules along with physically separated Red & Black dedicated, processors, memory, and storage that can be easily removed from computers, radios, electronic warfare systems, and can also be embedded into antennas that have Software Defined Radios (SDRs) integrated into the antennas. Current crypto solutions are entire stand-alone large avionics boxes and cannot be easily integrated into emergent Software Defined Radios (SDRs) or mission computers requiring greater Size, Weight, Power, and cooling (SWAPc) and higher integration costs. The DoD requires a crypto solution that allows the users to easily remove these crypto units without having to de-install the crypto system from an aircraft, ship, ground control station, or secure classified facility. The lack of carriage/sled docking architectures or socket type connector design architecture is a contributing factor to the current constrained architecture. Multi-domain platforms and Sensitive, Compartmented, Information Facilities (SCIFs) require a removable “credit card”—sized crypto card (rough dimensions) that can operate with the following requirements:

1. Data Rate: 10 Mbps (threshold) up to 100 Mbps (objective) for Secret and TS/SCI when operating Type-1 NSA encryption algorithms.
2. Size: .75 in. X 3 in. X .25 in. (1.905 cm X 7.62 cm X 63.5 cm) thick (Thumb Drive Sized) that can plug-and-play in tactical embedded systems or through external connection devices (removable architecture approach without disassembly or deinstallation of the system).
3. Ability to code and zeroize over a USB and PCI-E minibus.
4. Processing: 4-Core (3 GHz, 8 x Peripheral Component Interconnect express (PCIe) Lane (Threshold), 16 x PCIe Lane (Objective)) per enclave.

5. Memory: 32 GB of RAM (Double Data Rate (DDR) 4, 3200 MHz data speed (or higher)) per enclave.
6. Storage: Persistent storage capability of 2 TB per enclave.
7. Telecommunication Electronics Material Protected from Emanating Spurious Transmissions (TEMPEST).
8. Embedded Cryptological Unit (ECU) shall support the Joint Communication Architecture for Unmanned Systems (JCAUS).
9. Power: Host power provided by 5VDC Bus.
10. Cooling: Convection cooled (No external fan).
11. Thermal: Operate 50–80 °Celsius.
12. Security level: Secret, TSI, NATO – (Guidance: See CUI NSA PICO Brief).
13. Open Standards: Configuration 1: 2X (RED & Black) multi-lane, mini-PCI interface with USB, Thunderbolt 4 (Embedded daughter card or stand alone for MOSA, SOSA, FACE, etc.).
    Note: Enclave is defined as separate Red and Black sub-systems.

Work produced in Phase II will 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. § 2004.2 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: Develop and demonstrate the feasibility of a conceptual design/architecture that will support a STEALTH plug-and-play NSA Type-1 crypto module approach. Present a Red and Black cypher text core isolation approach that shows how the architecture meets TEMPEST requirements for data bus and power layout, memory and processing architecture, and compliance with NSA design standards (to be provided after contract award). The design should also show the mounting options for various applications and the plug-and-play approach to accommodate multiple SDRs, computer processors, and small device applications. The design approach should address the incorporation of a modular Radio Frequency (RF) System on Chip (SoC) that has Red and Black separation, supports L and S Band, TRANSEC Waveform (WF) Encryption. Embedded Cryptological Unit (ECU) shall support the Joint Communication Architecture for Unmanned Systems (JCAUS). Additionally, a high-level unclassified Anti-Tamper (AT) design approach should be addressed in Phase I. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: A lab-based proof of concept brass board design and Red and Black (Physically separated) RF SoC (L and S Band) that will be submitted to NSA for consideration and approval that can be removed without disassembly/de-install of the host system. Demonstrate full encryption using NSA algorithms with RED and BLACK rule sets applied to parsing classified (secret data) and unclassified data in a controlled lab environment.

The work under this effort will be classified at SECRET under Phase II (see the Description section for details).

PHASE III DUAL USE APPLICATIONS: Transition to PMA/PMW-101 Program of Record (PoR) for Multi-Information Distribution System (MIDS) Program Office (MPO). Full Qualification and Test (FQT) to include TEMPEST and Authority to Operate (ATO).

Continue the development of the STEALTH Type-1 encryption devices while developing an NSA approval path to operate at SECRET, TS/SCI, Special Access Programs (SAP), to support Federal and Foreign Governments, Five Eyes (FVEY), and for NATO secret.

Small removable HAIPE devices have commercial transition applications for protecting bank information, company proprietary information, as well as, for government classified operations developed during Phase II. Open Standards compliant (i.e., SOSA, JCAUS, etc.) for integration with other commercial products (i.e., SDRs, Servers, Desktop Computers, etc.).

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KEYWORDS: System on Chip; SoC; High Assurance Internet Protocol Encryptor; HAIPE; ECU; Joint Communication Architecture for Unmanned Systems; JCAUS; National Security Agency; NSA; Telecommunication Electronics Material Protected from Emanating Spurious Transmissions; TEMPEST; Small Type-1 Encryption for Aircraft, Littoral, and Terrestrial Higher-than-Secret; STEALTH

N251-018 TITLE: Compact Electric Fuel Pump for Extreme Viscosity Fuels and Slurries

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: Design and demonstrate an electric metering fuel pump capable of pumping highly viscous liquid and slurry fuels with SWaP sufficient for a flight vehicle.

DESCRIPTION: Fuels with higher energy density than JP-10 are being explored to improve system range. Unfortunately, many of these candidates (including metal particle slurries) are significantly more viscous than standard jet fuel. Enabling the use of the more viscous fuels would offer new platforms increased range potential over conventional fuels. Based on Navy defined parameters (viscosity, particle size, run time, flowrate, power draw, etc.) the proposer should design and demonstrate an electric pump minimizing total pump weight/volume/power draw. Metrics of success include fluid metering accuracy and repeatability of throttle authority.
Pump requirements:

1. Capable of moving neat liquids of 1.5 St or greater,
2. Capable of moving slurry fuels that use a hydrocarbon liquid fuel as a base and:
   i – contain maximum of 50 wt. % of solids,
   ii – where the particles are between 50 nm and 60 μ in diameter, and
   iii –the particles are 9. 0 Mohs or harder
3. Maximum controllable flowrate of at least 5 gallons/min (18.9 L/min),
4. Minimum controllable flowrate of no more than 0.3 gallons/min (1.14 L/min),
5. Repeatable flowrate control of +/- 0.1 gallons/min (+/- 0.38 L/min),
6. Sustained pumping of viscous and slurry simulants for minimum 45 min at minimum 90% flowrate without failure,
7. Capable of starting and continuous operation from -40 °C to 50 °C,
8. Weigh no more than 15 lb (6.8 kg), and
9. Take up no more than 130 in.^3 volume.

PHASE I: Design and simulation of electric fuel pump meeting or exceeding Navy defined requirements. Pump design must incorporate high-accuracy metering capability and throttle authority with high-viscosity fluids and slurries. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Production and testing of middle-weight pump. Pump does not have to be at final flight-weight or compact packaging, but must have clear pathway towards being so. Testing of the pump will include endurance runs using simulant fluids and slurries. Metering accuracy and throttle authority of the design to be evaluated.

PHASE III DUAL USE APPLICATIONS: Refine design of pump using Phase II test results. Produce and evaluate a flight-weight and compact pump capable of meeting Navy defined specifications with representative working fluid.

Technology developed for a compact, high-viscosity pump can be used as upgrades to larger industrial pumps to extend life and/or capabilities.

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KEYWORDS: Pump; Fuel; Compact; Slurry; Viscosity; Metering;

N251-019 TITLE: Neuro-Symbolic Artificial Intelligence (AI) Agents for Cybersecurity Authority To Operate (ATO) Development

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

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

OBJECTIVE: Research, design, and develop an innovative automated software toolset to assist the Cybersecurity workforce personnel in developing and maintaining Authority to Operate (ATO) packages under the Risk Management Framework (RMF) process.

DESCRIPTION: The DoD leverages the RMF to guide cybersecurity processes and requirements [Refs 3, 5, 7, and 9]. Further, program offices have experienced a dramatic increase in the man-hours required to produce a cybersecurity ATO package and maintain that package throughout the lifecycle of the system or systems supported. This increase has put a strain on budgets and increased schedules.

One outcome from Deep Neural Network (DNN) experiments into what are called large language models (LLMs; e.g., GPT3 or Lambda) is the ability for analysis of large data sets and the capability of system composed documents based on user requests [Refs 1 and 2]. For example, one might say, “Write me a paper about ‘Logistics issues in Africa’”, and the system can then automatically produce a document that may sound reasonable. It has classified or categorized information about both logistics and Africa. It may even have found areas of overlap. The system is trained to understand, identify, and replicate patterns of what a paper should look like, how it might be organized, and the structure of paragraphs and sentences. There is a chance, therefore, that the paper actually conveys real information. There is, however, a significant chance that the paper is utter nonsense (i.e., a pattern borne out of mimicry rather than substance). The use of the LLM approach may be less viable as one moves towards novelty. That is, if a paper that describes a new concept, device, method, process, or strategy is desired, LLMs are unable to provide much help. In one sense they are merely sophisticated search algorithms that can find existing patterns and sometimes combine those patterns to useful effect.

An ATO is by its very nature a novel problem. So, one might argue that the LLMs are not going to add much value. This, however, is only true if they are used in isolation. This SBIR topic seeks a technical approach that leverages one or more technology type, such as LLMs, and capabilities offered by Artificial Intelligence (AI) and/or Machine Learning (ML) [Refs 4 and 8]. For example, approaching this challenge as an applied engineering discipline, focusing on applying a myriad of AI Techniques such as DNN to identified AI reasoning tasks with an understanding that most expertise is found in the heads of subject matter experts (SMEs) rather than in large data repositories, is expected to maximize the efficiency and effectiveness of the capability and maximize return on investment. The desired outcome of this SBIR topic is to develop technology and a methodology to work with SMEs to capture their expertise and mental models on the RMF and ATO process. From here, the technical approach should leverage these mental models to generate bias DNN classifiers and provide a way to represent an organization’s specific expertise and content.

Expected outcomes include:

- Efficiency Gains: Significant reduction in time and manpower required for ATO drafting.
- Consistency and Compliance: Standardized ATOs that adhere to Department of Defense (DoD) Cybersecurity regulations and policies.
- Scalability: Potential application across various DoD acquisition entities, enhancing overall efficiency of the Cybersecurity workforce.

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: Design and develop a system that captures and organizes cybersecurity hardware/software configuration information and can automatically write an ATO for a given system leveraging that information. Develop a hybrid solution that integrates the capabilities of large language models, leveraging the mental models of experts and past ATOs into the ATO creation process. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop, test, and validate prototype software toolset proof of concept. Recognizing that initial generated ATOs will lack quality, develop and engage in an iterative test cycle, design and development software refinement, and document proposed concept of operations for employing technology. The goal is to capture and adapt knowledge over time, which incrementally improves the process through feedback from experts.

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

PHASE III DUAL USE APPLICATIONS: Mature technology and seek approvals for deployment on DoD systems. Extend capability to more advanced capabilities for higher level security documentation. Investigate solutions to automated sustainment of underlying knowledge models. Consider additional modular capabilities to extend utility and use throughout the ATO process.
Cybersecurity is an issue for commercial sector organizations beyond DoD such as banking, medical, and civil infrastructure (e.g., power, water, GPS, and internet). As technology use has continued to increase, individual considerations for protections increase as well. The commercial sector will likely benefit from similar technology within these industries, as well as means for commercial products used within households to increase certification/guarantees to consumers.

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KEYWORDS: Automated Software; Cybersecurity; Authority to Operate (ATO); Risk Management Framework (RMF); Deep Neural Network (DNN); Generative Artificial Intelligence

N251-020 TITLE: Computational Tools for the Prediction of Galvanic and Crevice Corrosion of Advanced Materials Relevant to Sea-Based Aviation

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

OBJECTIVE: Develop computational tools that can be used for aerospace design, to minimize galvanic corrosion risk of mixed-material couples for component geometries with occluded areas exposed to atmospheric conditions relevant to sea-based aviation.

DESCRIPTION: The recent revision of MIL-STD-889D provides a starting point for comprehensive galvanic compatibility comparison of aerospace-relevant materials in immersion conditions. However, galvanic corrosion is known to be dependent on specific atmospheric factors associated with the usage environment. Due to the interactions of electrochemical processes and atmospheric conditions, the rank ordering of galvanic compatibility in immersion may not be fully representative of the degradation rates and damage distribution experienced in service. Furthermore, significant progress has been made in modeling galvanic couples openly exposed to aggressive atmospheres, but model development is needed to capture the influence of concentration polarization and mixed materials within crevices that occur at fasteners and faying surface of structural joints. Crevice corrosion at fasteners and joints presents the greatest corrosion risk for the structural integrity of airframes.

Determining a high-level approximation of relative galvanic compatibility risk under different environments on exposed surfaces and within crevices through a user-friendly computational tool for rapid analysis would enable increased accessibility and transferability of corrosion performance information between corrosion experts, aircraft designers, and engineers. If acceptable levels of galvanic compatibility are exceeded, military standards/handbooks and technical manuals/orders for corrosion prevention and mitigation strategies could be updated to aid the Cognizant Engineering Authority and computational tool user to address these issues early in the design and deployment phases.

To account for complex geometries, galvanic corrosion rate prediction across a 3D and/or 2D geometry can provide spatial resolution of relative corrosion risk, helping to inform corrosion mitigation through both design and long-term maintenance planning (inspection guidance) of aerospace structures. Corrosion prediction across a 3D and/or 2D geometry can be difficult, due to both substructure and superstructure contributions (i.e., inner and outer mold-line material combinations), creviced geometries (fastener assemblies, lap joints, etc.), and dynamic atmospheric environments. Incorporating systematic iterations of these factors to characterize their relative contribution to the galvanic corrosion risk assessment (both in magnitude and spatial distribution) through computational tools will help inform future design efforts and sustainment programs. Identifying component-level predictions of corrosion “hot spots” under specific conditions would inform specification of corrosion protection systems and determine areas of particular importance for inspection as part of an aircraft maintenance program.

PHASE I: Design and develop an approach and initial demonstration for rapidly assessing galvanic compatibility of multiple aerospace-relevant materials and three-dimensional geometries in atmospheric conditions. Develop a computational tool framework to provide a rapid and user-friendly assessment of the galvanic compatibility in atmospheric conditions, and detail methods to address atmospheric conditions relative to assumptions and inputs based on immersion testing. Describe the formal structure for all relevant metadata and assumptions used to achieve an approach suitable of naval aircraft and operating environments. Draft an approach to couple corrosion prevention and mitigation strategies with galvanic compatibility risk from existing military standards/handbooks and technical manuals/orders. Develop a computational prediction model to assess galvanic corrosion rate prediction across a 3D and/or 2D geometry, including occluded geometries, with a subset of geometries and materials, incorporating both thin-film atmospheric and crevice corrosion conditions. Demonstrate the feasibility of the model through a limited set of tests articles using galvanic couples to obtain both current responses and physical damage distribution. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Increase the assessment of material combinations, relevant geometries, and atmospheric environments in the galvanic compatibility testing for the purposes of optimization, validation, and verification. Establish the tiered computational tool framework, with modular open system architecture, and populate it with necessary property measurements, geometric models, and environment inputs to demonstrate functionality. Provide large-scale parameter-space corrosion rate prediction across a 3D and/or 2D geometry can, highlighting conditions with the most risk (highest galvanic corrosion) or most variability (change in galvanic compatibility). Clearly identify all requirements, limitations, and assumptions of the framework and computational tools. Demonstrate the capability and user-friendly accessibility through beta-testing with naval aviation stakeholders. Conduct an operational assessment for atmospheric corrosion using test articles designed to simulate structural component exposed at a marine test site. Draft methods for implementing new materials, assessing environments, and adding new geometries for use within the tiered framework. Develop the implementation plan for delivery of capabilities to the Navy and other DoD components through U.S. Government enterprise systems and assess commercialization viability for dual-use applications.

PHASE III DUAL USE APPLICATIONS: Incorporate beta-testing results from Phase II testing to address user needs. Finalize software design and make an initial software package available for purchase to the DoD.

All marine-based industries (ships, oil and natural gas platforms, and aviation) have common risks stemming from galvanic and crevice corrosion. By developing these models, engineers in these fields can develop more resilient and safer systems more quickly to accomplish the industry specific goals.

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KEYWORDS: Crevice Corrosion; Galvanic Corrosion; Corrosion Modeling; MIL-STD-889D; Digital Engineering; Environmental Severity

N251-021 TITLE: Open Architecture Solution for Data Transfer on Naval Aviation Platforms

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;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 hardware, firmware, and software enhancements to existing legacy Mission Computers and associated data busses allowing rapid integration of modern software capabilities within in service aircraft (e.g. F/A-18, E-2D, SH-60, M/V-22) and their native data sources (e.g. MIL-STD-1553).

DESCRIPTION: Despite significant investments by the Department of Defense in the next generation of open architecture for military aircraft platforms; the truth remains that the bulk of the U.S. military aircraft fleet is still heavily reliant on proprietary, prime vendor supplied mission computers, and tactical data bus technologies. This reliance results in exorbitant costs imposed by the original equipment manufacturer (OEM) for any maintenance or upgrades of existing platforms; dramatically slowing NAVAIR's ability to introduce capability into a highly dynamic battle space. Further, by maintaining a tight grip on mission computer, flight program, and data bus access prime vendors effectively box out any competition that could otherwise add significant value to these aircraft.

In order to maximize combat effectiveness and maintain U.S. technological superiority amongst global threats, there exists a need to develop airborne system architectures, hardware, and software solutions capable of securely exposing aircraft and mission data to third party hardware and software applications. These new capabilities must successfully interact with legacy mission computers and data busses without adversely impacting existing platform DO-254 and DO-178C certifications. Once in place, these capabilities will provide the necessary connectivity to in-service platforms allowing for rapid introduction of new capability without incurring the high cost of prime vendor-based integration and deployment. Solutions should identify critical components for interfacing with NAE platforms such as F/A-18, E-2D, SH-60 and M/V-22. Perform feasibility analysis of hardware and software options for implementing the selected approach, including the Tactical Mobility Integrated Project Team (TacMo IPT)/PMA-272-developed Multiple Obstructed Brokered Hub (MOB Hub) embedded computer.

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: Design and develop an approach to sense, synthesize, and provide aircraft unique data to a modern software application suite. Solutions should identify critical components for interfacing with Naval Aviation Enterprise (NAE) platforms such as F/A-18, E-2D, SH-60, and M/V-22. Perform feasibility analysis of hardware and software options for implementing the selected approach, including the TacMo IPT/PMA-272-developed MOB Hub-embedded computer. Finally, identify an approach to disseminate the collected data to third party hardware and software components without impacting the existing aircraft certifications. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype system using the results found in Phase I and evaluate against a representative test system using Government furnished simulation/stimulation equipment. Utilize MOB Hub Circuit Card Assembly (CCA) and/or Jet in a Box hardware to validate prototype with real or representative aircraft data. Potentially use a MOB Hub CCA as an embedded computer to evaluate prototype.

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

PHASE III DUAL USE APPLICATIONS: Further refine the system developed in Phase II and integrate into a designated aircraft. Demonstrate the system's ability to disseminate aircraft unique data to third party hardware and software components without impacting the existing aircraft certifications or assist with aircraft certification process.

Commercially this technology could be used for any legacy hardware/software platform where replacing legacy equipment is cost prohibitive. Commercial satellites, civilian aircraft, and older automotive platforms could all implement this technology to introduce modern computing capabilities without impacting the existing hardware/software suites while enhancing cyber security and extending future capability.

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KEYWORDS: Cyber Security; Open Architecture; Embedded Computers; Human Machine Interface; Naval Aviation Platforms; Data Busses

N251-022 TITLE: High Energy Density Synthetic Fuel Development

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

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

OBJECTIVE: Synthesize a novel liquid hydrocarbon fuel or generate a synthetic fuel blend with a higher volumetric energy density than JP-10, which maintains a flashpoint above 60 °C and viscosity below 200cSt at -40 °C.

DESCRIPTION: There is a mission critical need for increased range in gas turbine powered cruise missiles. The proposer should develop a scalable process for high energy density fuel synthesis and provide a cost analysis for commercial scale production. The fuel properties must be characterized to demonstrate net heat of combustion exceeding that of JP-10. High energy density fuel will improve the range of current and future airbreathing propulsion systems.

To minimize environmental impact, renewable solutions are highly encouraged and potential toxicology issues should be considered for maritime use.

PHASE I: Design and develop a proof of concept, production, and delivery of 250 mL of fuel to Navy lab. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Produce and deliver of 100 gallons (378.54 L) of fuel to a Navy lab. Perform a cost analysis of fuel production at designated production levels.

PHASE III DUAL USE APPLICATIONS: Design and cost a large-scale production facility capable of meeting yearly Department of Defense needs.

Fuels developed through this SBIR topic may have utility for rocket propulsion. Chemical byproducts may have utility as lubricants and polymer precursors.

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KEYWORDS: High Density Fuels; Synthesis; Propulsion; JP-10; Hydrocarbons; Jet Fuel

N251-023 TITLE: Live, Virtual, Constructive (LVC) Afloat: Automated Scenario Generation

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

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

OBJECTIVE: Develop the capability to automate the creation of training scenarios for aviation platforms underway using the Next Generation Threat System (NGTS). This capability should include a framework and accompanying architecture in which specific performance parameters can be varied based on Machine Learning (ML) algorithms and Artificial Intelligence (AI).

DESCRIPTION: As the Navy prepares the carrier airwing of the future (AWOTF) for the high-end fight, the training paradigm will shift to almost exclusively Live, Virtual, Constructive (LVC) environments due to expanded range capabilities of the peer threat competitors and Operational Security (OPSEC) considerations. As a result, warfighters will be able to train as they fight with higher fidelity scenarios that more accurately represent red kill chains. This high-fidelity, data-rich environment provides unique opportunities for instructional strategies to better support end-to-end training and improve readiness. Specifically, LVC environments increase the amount of—and access to—data that can support improved scenario generation, performance assessment, and debrief when utilized appropriately. However, LVC training is not without its challenges. These challenges include resource requirements to develop these high-fidelity scenarios as they can be cumbersome and labor intensive. Moreover, scenarios that do not contain significant variations may lose utility very quickly as operators can begin to anticipate scenario outcomes after a few exposures. Consequently, a need exists for rapid generation of real-time, adaptive, high-fidelity scenarios.

Additional challenges lie in the assessment of performance. The carrier airwing of the future will rely on integrated tactics that require a level of coordination and information exchange across platforms that have not been required in past tactics. The complexity of coordination associated with integrated tactics necessitates a significant amount of voice communications across the different platforms to provide Situation Awareness (SA) and elicit decision-making. While communication is critical to cross platform coordination and overall tactical execution, it remains one of the most challenging training objectives to meet during Air Defense events.

As such, the present effort seeks to alleviate identified challenges with scenario generation and performance assessment through the investigation of generative AI (e.g., DALL-E and ChatGPT) or other forms of AI to support scenario generation and communications assessment. This SBIR effort shall focus on utilizing AI to learn from pilot-in-the-loop red threat behavior to rapidly generate constructive threat presentations that adapt to trainee behavior in a tactically feasible manner. Additionally, AI shall be applied to further the state-of-the-science in communications analysis [Ref 5]. Specifically, AI shall support analysis of blue recorded communications and provide an initial assessment in terms of accuracy of the words said (relative to ground truth) and speed at which they are said. This will include digesting communication recordings, assessing quality of communications-based accuracy and speed, then providing these results via automated debrief.

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

This effort will specifically look at Air Defense training scenarios within LVC environments to increase speed at which high-fidelity, adaptive scenarios can be generated and assessed to enhance operator performance. This capability will be developed with the intention of a transition path to the NGTS. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Design and develop a development plan for a proof-of-concept solution to rapidly automate the creation of training scenarios for aviation platforms at sea. This will include identifying the most appropriate methodology for developing the scenario generation framework and architecture, enhancing red threat presentation, and developing a graphical user interface (GUI) for instructors that align with current NGTS GUI. An unclassified sample dataset will be provided to help support this investigation. The Phase I development plan will be used to demonstrate feasibility of application into the larger, integrated training system. The plan shall detail integration into NGTS to allow for transition into an operational LVC environment. Additionally, the plan shall include a Subject Matter Expert (SME) evaluation of capabilities and how to conduct an Analysis of Alternatives to identify best practice method moving forward for training delivery. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Research, develop, design, and deliver a proof-of-concept scenario generation capability and intelligent mechanism for modifying threat models based on evolving threat presentations and test in NGTS through execution of the integration plan developed in Phase I. During Phase II, the sample data provided will be more tactically and operationally relevant and classified at the SECRET level. Awardees can expect the scenarios to be more tactically complex. Design and tool development shall include tactically appropriate presentation of evolving red threats utilizing the NGTS behavior structure, usability documentation, and technology evaluation. Demonstration of the tool, along with documentation of usability of the training software is critical. Risk Management Framework guidelines should be considered and adhered to during the development to support information assurance compliance. Work in Phase II may become classified. Please see note in the Description section.

PHASE III DUAL USE APPLICATIONS: Introduce additional data from NGTS, as well as other live and virtual entities within the scenario. Scenario generation shall be enhanced to include external (live and/or virtual) entities. Integration testing and demonstration of capabilities will be conducted in a distributed simulation via Distributed Interactive Simulation (DIS) protocol at the SECRET level. Software shall be integrated with NGTS to facilitate transition into operational LVC environment. Documentation and any supporting materials shall be delivered to NGTS team for maintenance and future enhancements.

The scenario generation tool can be leveraged in the private sector as an aviation training aid in environments with limited network access. Tailorable aviation scenarios can be used for commercial or private pilot training devices to expose trainees to a wider variety of simulated high-risk events.

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KEYWORDS: Scenario Generation; Live, Virtual, Constructive; Training Underway; Artificial Intelligence (AI); Tailorable Scenarios; Next Generation Threat Systems (NGTS); Adaptive Threat Models

N251-024 TITLE: Self-Hosted Certificate-Key Management Server

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;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: Provide a Self-Hosted Certificate-Key Management Server (CKMS) hosted on Gigabit Ethernet Data Multiplex System (GEDMS) to allow for individual systems to communicate over encrypted channels.

DESCRIPTION: A CKMS is a specialized server or system designed for the management of digital certificates and cryptographic keys in a secure and organized manner. Digital certificates are used in public key infrastructure (PKI) systems to verify the identity of entities and secure communications over the internet. A CKMS focuses on the management of cryptographic keys that are associated with these certificates, ensuring they are generated, stored, and distributed securely. The Self-Hosted CKMS will provide a secure and (de)centralized way to manage certificates and keys for devices within a closed network. The CKMS will be designed to be scalable, extensible, and easy to use and administer. CKMS is especially important in environments where digital certificates are widely used for authentication and data encryption, such as securing web communications with Secure Sockets Layer and Transport Layer Security (SSL/TLS), code signing, secure email, and many other applications. It ensures that the cryptographic keys and certificates are managed in a way that maintains their security and reliability.

Device certificates are digital certificates that enable mutual authentication and secure connections between two devices (i.e., machine-to-machine [M2M] communications) and is achieved using PKI. A device certificate is typically issued by an organization’s internal certificate authority, known as a private CA. The private CA will be internal to the organization (meaning, an organization issues its own certificates for use on its network).

GEDMS is a mission-critical system that provides IP-based network transport and the collection, processing and distribution of data across DDG 51 class destroyers. GEDMS is designed to provide high-speed data communication and networking capabilities to support a wide range of shipboard systems and applications, including command and control, radar, navigation, weapons systems, communications, damage control, and other mission-critical functions. It allows for the efficient and secure exchange of data among various shipboard systems and subsystems.

Key features and characteristics of GEDMS in a Navy context may include:

- High Data Rates: GEDMS operates at gigabit Ethernet speeds, providing fast and reliable data transmission for shipboard systems.
- Redundancy: GEDMS often incorporates redundancy and fault tolerance to ensure the reliability of data communication even in the presence of hardware failures or battle damage.

- Security: Given the sensitive nature of Navy operations, GEDMS includes security measures to protect data and network integrity.
- Scalability: The system can accommodate various types of shipboard equipment and systems, making it adaptable for different classes of Navy vessels.
- Interoperability: GEDMS ensures that various shipboard systems can communicate and exchange data effectively, improving overall operational efficiency.
- Maintenance and Support: The Navy conducts regular maintenance and updates to ensure GEDMS remains operational and secure.

GEDMS is an integral part of DDG 51 class destroyers, helping to ensure the efficient operation and coordination of various Platforms and Enclaves on board. It plays a crucial role in supporting the Navy's mission and enhancing its capabilities in a network-centric warfare environment.
Given the critical nature, and the crucial role GEDMS provides in supporting the Navy's mission, it's imperative to ensure the integrity, confidentiality, and availability of the data transmitted across the network. The lack of secure device communication can provide attack vectors that make the GEDMS environment susceptible to Man-In-The-Middle (MITM) attacks, spoofed commands, and status message spoofing.

The Navy seeks a closed-network CKMS to provide a secure and centralized way to manage certificates and keys for devices within the closed network. The CKMS shall run on a single board computer with the following minimum specifications, Quad-Core X86 1.5Ghz CPU, 16GB RAM, 256GB internal storage, and two (2) network interfaces supporting the following types: 10/100/1000BASE-TX, 1000BaseLX, and 100BaseFX. The single board computer shall support Linux and Win10 Operating systems. The CKMS will be responsible for generating, distributing, renewing, and revoking certificates and keys, as well as auditing and logging all activity. To enhance security, mitigate vulnerabilities and protect the confidentiality and integrity of the GEDMS environment, the following steps should be considered to build, configure, and implement the CKMS solution:

To establish a secure and well-maintained CKMS for a closed network, it is imperative to systematically address various aspects.

Navy needs a Key Management server that is superior to what is commercially available, is able to operate in a self-contained environment, and is decentralized, so combat damage to the server will not disable ship network access. Currently, we are not aware of any Key Management Servers that meet these requirements. PMS 400D investigated this in the past and rejected the available candidates because they presented a single point of failure that is unacceptable in combat. Innovation will be needed to produce a robust cybersecurity solution.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for an improved device for a Self-Hosted CKMS that meets the requirements above. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be developed into a useful product for the Navy. Feasibility will be established via computer modeling or other means deemed appropriate. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop a CKMS prototype, to include designing the CKMS architecture, database schema, user interface, APIs, and other software. The prototype will be tested to demonstrate its core functionality, such as certificate and key generation, distribution, renewal, and revocation. Additionally, the prototype will be tested at a Land Based Test Facility to ensure its suitability to shipboard use. The results of these tests will be used to refine the prototype into a design that will meet Navy requirements. Prepare a Phase III manufacturing and development plan to transition the CKMS to Navy use.

Begin by clearly defining the network's specific needs, encompassing device types, security levels, compliance standards, and scalability requirements. Select robust cryptographic algorithms that adhere to industry best practices for key generation and certificate signing. Establish a Certificate Authority (CA) responsible for validating device identities and signing certificates. Implement secure key storage mechanisms, such as Hardware Security Modules (HSMs), to safeguard cryptographic keys from unauthorized access. Enforce a robust access control mechanism, preferably Role-Based Access Control (RBAC), to restrict key and certificate management to authorized personnel. Develop functionality for the entire certificate lifecycle, including automated processes for generation, distribution, renewal, and revocation. Implement comprehensive logging and auditing features to ensure accountability and security in CKMS activities. Secure communication by encrypting data in transit using protocols like TLS. Employ monitoring tools and alerts to promptly identify and respond to suspicious activities. Establish regular backup procedures and a disaster recovery plan for quick restoration in case of failures or data loss. Ensure compliance with relevant industry standards and regulations such as X.509, PCI DSS, or HIPAA. Maintain comprehensive documentation for the CKMS, covering configuration details and guidelines for ongoing maintenance and troubleshooting. Conduct thorough testing in a controlled environment, encompassing functional, security, and performance aspects before deploying in the production environment. Keep the CKMS software and underlying systems up to date with the latest security patches to address emerging threats. Finally, provide training to administrators and users on proper key and certificate management practices to prevent inadvertent security issues. This holistic approach ensures the CKMS aligns with the specific requirements and compliance standards of the closed network, fostering a robust and secure key management infrastructure.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the CKMS to Navy use. Commercial uses may be limited due to the security posture inherent in these types of Navy systems. Other military applications would include use on any network that requires an added level of security between the systems communications and interfaces with minimal disruption to the design of existing user.

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KEYWORDS: Control System Network; Multimedia Communication; Digital Key Management; Cryptographic keys; Access Control; Key Management Server

N251-025 TITLE: Automated Writing of Problem Reports

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

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

OBJECTIVE: Develop a software solution that utilizes artificial intelligence (AI) and machine learning (ML) to automate the generation of accurate and consistent problem reports for surface navy platforms.

DESCRIPTION: The Navy's Aegis Combat System (ACS) currently relies on manually generated problem reports using testing, analysis, and operator feedback. These problem reports are currently populated by personnel with varying degrees of experience. Information is provided by personnel attempting to identify issues that may or may not agree with the written performance specifications for their systems. This produces a lack of details needed to reproduce the issues. The process is time consuming, prone to human error, and lacks consistency across platforms and personnel. The Navy seeks an innovative software solution that is capable of automatically generating accurate and reliable problem reports for surface navy platforms, replacing manual processes used in the current ACS. This can be accomplished either through merging, removing, or automatically generating problem reports to reduce operator workload and improve efficiency. Added capability would provide more accurate problem reports written against specifications for human understanding and improvement of human system integration (HSI). Currently there are no commercially available remedies found to solve this situation. The observation of anomalous behaviors or unexpected testing and analysis results will drive generation of problem reports. The software solution needs to provide a system that can perceive, recognize, learn, decide, and act on their own. The solution will need to consolidate and interpret data. The software solution will utilize ML systems with the ability to explain their rationale, characterize their strengths and weaknesses, and convey understanding of how they will behave in the future. The software application will also need to be capable of analyzing existing reports to understand format and content requirements. It will need to accept input from the test community and operators, automatically generate problem reports that are accurate and reliable based on various data sources, including sensor data, test observations, and operational experiences, and integrate seamlessly with all elements of the ACS. Because of the planned implementation for both operational and testing environments, the software application should permit realistic testing of evolving threat types and configurations in a dynamic test environment. This will enable the proficiency of testing and certification problem reporting timelines for new Aegis program timelines. This will also help in maintaining or improving product quality through the early detection of deficiencies in the product. The speed and accuracy of the solution must exceed existing ACS performance attributes by 10% or better.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for a problem report solution that demonstrates it can feasibly meet the parameters in the Description. Feasibility will be demonstrated through modeling and simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype problem report solution based on the results of Phase I that meets the parameters described in the Description. Demonstration will take place at a government provided facility. The government subject matter expert will evaluate the prototype to ensure it improves situational visualization and situational understanding within a varied problem reporting context.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Government use within the Aegis Weapon System (AWS in Advanced Capability Build (ACB) 20 or higher) as part of an Integrated AWS database. Refine the prototype for integration into the current AWS operational planning tools. Test and refine the prototype design for the appropriate interfaces with other Navy systems and to comply with information security requirements.

The developed technology should be broadly applicable to live testing of manned and unmanned systems and simulations in which users need Course of Action (COA) planning and updates to the plan as time progresses. Dual use applications are numerous, almost any analyst seeking to combine spatial and temporal data in a single display could use this technology including the Federal Aviation Administration or civilian air controllers.

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KEYWORDS: Anomalous Behaviors; unexpected testing and analysis results; automatically generate problem reports; Machine Learning to automate; testing and certification problem reporting timelines; consistency across platforms

N251-026 TITLE: Passive Position Sensing and Navigation for Small Crafts and Unmanned Surface Vehicles (USVs) in Global Positioning System (GPS) Denied Environments

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

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

OBJECTIVE: Develop a passive device or system that allows a Small Unmanned Surface Vehicle (sUSV) or other small craft to develop and maintain awareness of its location on the earth's surface in a Global Positioning System (GPS)-degraded or -denied maritime environment.

DESCRIPTION: Current naval navigation systems are heavily reliant on GPS, which is a highly accurate all-weather source of positioning, navigation, and timing (PNT). However, GPS utilizes weak radio frequency (RF) signals from distant satellites that may be subjected to intentional and unintentional interference. GPS signals may not be available or reliable in a degraded/Anti-Access/Area Denial (A2/AD) environment. In recent years, the ability to compromise GPS has been demonstrated by adversaries using jamming techniques that interfere with military mission execution. Additionally, RF transmissions, including use of a surface search or navigation radar, can disclose a vessel's location, as can use of a fathometer or depth finder. To mitigate these challenges, the Navy is seeking affordable passive navigation technologies for improved PNT on sUSVs or small craft when GPS is degraded and/or unavailable.

Inertial navigation systems (INS) and precision clocks may extend the PNT solution for short periods, but both are subject to drift errors. An alternative real-time PNT solution—utilizing complimentary PNT sensor data and networks—is required to maintain an accurate and reliable navigation solution by bounding the drift errors without GPS dependency.

The proposed system footprint should be no larger than 4 inches by 4 inches and no taller than 4 inches. The system should weigh less than 10 lbs. and total system power consumption should be less than 100W. Objective performance requirements are a positioning accuracy requirement of less than 10 meters, less than 3 meters/second velocity error, and better than 20 nanosecond time transfer. With respect to affordability, each system should cost less than $125,000.

Older electronic navigation systems such as Long-Range Navigation (LORAN) and Omega have been retired, and other satellite-based systems such as Russia's Global Navigation Satellite System (GLONASS) and the European Union's Galileo have the same disadvantages as GPS. This SBIR topic does not seek optical line-of-sight algorithms (e.g., visual positioning systems [or camera-based positioning solutions] or sextant-based solutions). Optical line-of-sight algorithms can be utilized to assist in bounding the solution from other PNT sensor solutions. The PNT sensor solution should be an "all-weather solution" not dependent upon cloud cover. This topic seeks a novel system, an improvement over existing methods, and/or a combination of methods to achieve the stated accuracy goals. Systems may use visual, gravity, magnetic, bathymetric, relative navigation, signal of opportunity, and/or other technological applications. Use of a fathometer is discouraged but not prohibited. The final product should be a fully integrated system that interfaces with the sUSV's autonomy or craft's electronic display panel by passing a stream of latitude, longitude, time, and confidence fields. The final product should be able to take an input from an onboard inertial navigation system that provides a "dead reckoning" solution to previous fixes and in turn, provides heading information to the ship.

This system will meet critical Navy needs by allowing sUSVs and other small craft to safely navigate without revealing their locations to adversary forces. The product will be validated and tested ashore for compliance with the Navy-provided Interface Control Document (ICD). Once validated ashore by the Navy, it will be qualified and certified during Navy Sea trials in at least three different geographical locations, e.g., Atlantic Ocean, Gulf of Mexico, and Pacific Ocean, and in a variety of conditions. These conditions will include near-shore and all open ocean conditions, daytime and nighttime, and all-weather conditions including clear visibility and foggy. Depending on the technology used, tests will be selected that provide results from a diversity of conditions having an impact on the solution.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a conceptual design for a Passive Position Sensing and Navigation system that meets the requirements in the Description. The concept design must define a system that can consistently operate within the established navigational rules, and include any modeling and simulation, studies, or prototypes in support of concept risk reduction. Demonstrate the feasibility of the proposed concept through modeling, simulation data analysis, and concept demonstrations.

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

PHASE II: Develop and deliver a prototype system based on the requirements in the Description. The prototype systems will be evaluated at sea in both near-shore, and open-ocean and all-weather conditions to verify and validate the performance regarding position and navigation accuracy.
Participate in a Critical Design Review (CDR) during which the system's necessary interfaces, dependencies, and risks are identified and presented. After a successful CDR, refine and build a prototype system. prototypes will be integrated into Navy-provided systems ashore as described in the Navy-specified ICD. After integration, the prototype will be tested ashore in a laboratory environment to verify that it meets the ICD requirements.

Final Testing and certification of the prototype system will consist of performance Verification and Validation (V&V) tests for both ashore and at-sea tests on a vessel of opportunity. The overall performance V&V tests of the system will also include hardware-in-the-loop testing on a vessel of opportunity provided by the Navy. Prepare a Phase III commercialization/transition plan.
It is probable that the work under this effort will be classified under Phase II (see the Description for details).

PHASE III DUAL USE APPLICATIONS: Long-term accuracy has been a challenge for all Navigation sensors and technologies due to bias instability (going from hours to days). The final product from this effort will be a Navigation system, for use at all open sea and weather conditions, which provides an accurate position with minimal bias drift when GPS is degraded or denied during operation. Ultimately, it will be validated, tested, qualified, and certified for Navy use.

Support the Navy in transitioning the technology to Navy sUSVs or other small craft in order to maintain awareness of their locations on the earth's surface. The technology can also be transitioned for use in commercial small craft or boats.

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KEYWORDS: Global Positioning System (GPS); Small Unmanned Surface Vessel (sUSV); Small Craft; Navigation Sensor; Position, Navigation and Time (PNT), Bias Drift

N251-027 TITLE: Acoustically Transparent Underwater Curing Adhesive

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

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

OBJECTIVE: Development of an underwater applicable, curable, and acoustically transparent adhesive for the mitigation of defects in submarine sonar conformal flow surfaces.

DESCRIPTION: Current and developing sonar technologies rely on conformal structures that serve dual purpose as a fastening component and as an acoustically enhancing material. These structures may suffer damage and degradation over time and decrease acoustic performance of the sensors due to flow obstructions which may cause unwanted noise. Current repair methods require the submarine to be dry-docked, with high time and cost expenditures. This SBIR topic seeks to repair these flaws using a material with properties which allow it to be applied, cured, and used underwater and make it acoustically compatible with array sensing capabilities.

Existing consumer gap fill material is used for bonding to metals for pipe repairs, ceramics, and some rigid plastics. In the naval environment, currently approved materials per S0600-AA-PRO-200 include HYCOTE 461 and HYCOTE 151, which are an underwater curing epoxy and paint, respectively. These materials are used mostly on metal surfaces, with their focus on functioning as an anti-corrosion coating and contouring smooth surfaces after repair work has been performed. Another material in use has been PR-944F, which is a two-part, elastomeric, chemically curing adhesive for metals, plastics, woods, and ceramic surfaces. This adhesive has been shown to be used underwater as a seam filling material when performing sonar structure repairs.

Sonar sensors embedded in conformal polymeric materials (NGD-09) are being incorporated in existing and future submarine hulls. These structures interact with incoming sound waves to assist in detection. Current adhesives and fill epoxies do not contain the full set of properties that would allow them to effectively function as an underwater repair solution for emerging structural imperfections in acoustic embedding material. A product with the strength properties of existing adhesives, underwater curability, and acoustic transmissibility under system working frequencies which is compatible with the undersea environment would simplify efforts to maintain conformal sonar systems without affecting their acoustic performance. A non-toxic compound would be desirable.

To produce such a material, several research requirements must be addressed:

- Material must be able to be applied, cured, and faired underwater under expected pier side working environments.
- Material will also be evaluated based on ease of application and use by working personnel in typical shipyard conditions.
- Once set, material must demonstrate acoustic transparency and produce no altering or detrimental effects on the acoustic performance of the sensors under broadband frequencies under use conditions.

- Once set, the material must maintain its adhesive strength to bonded material (i.e., metals, urethane, glass-reinforced plastic (GRP), NGD-09, and rubber) under expected environmental conditions experienced throughout the submarine's lifetime (i.e., salinity, pressure, and temperature fluctuations).
- Mechanical properties must be compatible with and equivalent to those of existing conformal acoustic material.
- Material should not have toxic effects on the environment or user during application, curing, and use.
- Anti-fouling capabilities must be equivalent to or improve upon that of current array coatings.
- Material must be able to be applied on a sufficiently large flaw area determined by an analysis of current and expected flaw sizes.

Additional uses exist which fall outside the requirement of acoustic transmissibility for underwater curing adhesives. An adhesive could effectively function to repair, fill, or seal any non-acoustic structure that would benefit from underwater repair. A specific application is repair of damage to the surface of polymer-based fairing structures that surround the main sonar system to ensure they effectively contour the hull, and no turbulent flow develops which can hinder sonar performance.
Contending material solutions will be evaluated against standards for applicability in repairs, and physical, chemical, and mechanical properties similar to those used on PR-944F and existing sensor conformal material. As for acoustic transmissibility, the standards to be used will fall within those of sensor conformal material.

The development of this technology can provide the Navy with an alternative to perform repairs which would remove the labor, cost, and time associated with the dry-docking process. This technology will have use in existing and future hulls due to the increasing amount of sonar systems which rely on conformal sensor embedding structures. Advanced developments in future materials may eventually produce a product that is incompatible with this technology, however this is unlikely during the short-term due to the current state of conformal structures as being newly introduced into the fleet.
Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Define and develop a concept for an underwater acoustically transparent adhesive that can meet the performance constraints listed in the Description. Feasibility for the material is expected to be theoretically demonstrated, however any further preliminary physical artifacts may be produced to support its validation (e.g., any preliminary lab samples that demonstrate fulfillment of the previously stated capabilities). Outline an approach to validate the proposed solution. Describe a production and test plan geared toward generating a prototype for Phase II.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II. Verify contending solutions for feasibility and fulfillment with the main requirements and capabilities stated under the identified problem in the Description.

PHASE II: Determine if the solution can meet Navy requirements. Due to the physical nature of an underwater adhesive, these developments will take the form of a prototype material to be applied in a series of simulated environments and conditions. Perform a series of prototype evaluations. Develop a plan to transition the technology into a system that can be acquired by the Navy. A prototype should be delivered at the end of the Phase II.

Conduct tests that involve a facet for non-acoustic, physical material performance and another for testing of acoustic transmissibility. The setup to simulate the working environment will likely contain sensors embedded in conformal material as well as other structures to which the adhesive may want to be tested on. This mockup will also have manufactured or induced flaws on the surface of the conformal material for repair. These evaluations specific to the prototype will be performed to determine if the adhesive material at a minimum meet the performance constraints stated under the identified problem in the Description.

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

PHASE III DUAL USE APPLICATIONS: A successful demonstration of the prototype in Phase II will concretize the process of transitioning the solution into a technology for Navy use. This process is expected to be supported by the Phase III awardee. Building on test results and further discussions on final performance requirements, develop a production plan to meet the needs of the specific application. This plan will consider the compatibility of the solution for use on legacy, existing, and future platforms. It will also consider the manufacturability of the product given current and future resources and lifecycle requirements. Support will be expected for the transition of the technology into use on Navy submarines under existing schemes for maintenance and repair processes. Further validation of the product for Navy use will take place using identified material property and performance standards as a guide to any further testing and qualification processes that must take place. Depending on the material developed, it may need to be presented to the Navy non-metallic Technical Warrant Holder for the military standard it would be evaluated against and approval.

The final adhesive material will be used in platforms which contain conformal acoustic structures. Given the final performance of the adhesive underwater, it may be used to repair non-conformal structures whose underwater repair would bring cost and schedule reductions to the Navy. These are most of the submarine platforms under the VA and OHIO programs, as well as the upcoming CLB class sonar systems. This technology will meet needs for allowing a continuous performance across a wide range of submarine sonar systems with a reduction on the cost and schedule to perform repairs. Outside of the Navy, and dependent on potential classification of material properties, this product may be streamlined to commercial and recreational boating applications which would require underwater repair of the hull.

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KEYWORDS: Underwater Curing Adhesive; Acoustically Transparent Material; Flow Surface Repair; In Water Repair; Anti-fouling; Sonar Material Repair.

N251-028 TITLE: Alternative Means of Deploying Shot Line

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

OBJECTIVE: Develop an accurate, reliable methodology of deploying shot line between two ships for underway replenishment (UNREP) operations.

DESCRIPTION: The U.S. Navy's DDG-51 Class Destroyers are typically at sea for extended periods. To sustain the ships, they are frequently resupplied at sea via UNREP. During UNREPs, shot lines are deployed to start the process of deploying a service line to pull the fuel hose to the receiving ship. The current method for deploying shot line has changed little since the Age of Sail. The shot line is a lightweight line attached to a projectile that is fired from a rifle powered by chemical propellant. Once the shot line is received on the other ship, it is hand-pulled by two to three sailors to bring a larger rope across and eventually the span line wire rope. Since the shot line is manually fired, it is an inaccurate process that sometimes requires multiple attempts before the connection can be established. If the shot line connection does not occur, the ship's UNREP evolution may be at risk. The current process of deploying shot line is time consuming, inaccurate, and presents a potential hazard to personnel on the receiving ship. Shot line is deployed to the receiving ship via a manually fired gun. The equipment used has been improved over time, but still has the basic drawbacks of using a shoulder fired gun. Manually aiming shot line is difficult, particularly at high sea states, and prone to error. The development of an alternative means of deploying shot line to meet Navy needs must overcome several technical challenges. First, the ships are approximately 200 feet apart. The line must be shot from one moving platform to another moving platform, relying on the proficiency of the gunner's mate in sometimes challenging environmental conditions. Next, the device must be able to function during conditions up to Sea State 5 on the Beaufort scale. Environmental conditions include such hazards as rain, sea spray, and fog, all of which affect visibility and thus the ability to accurately deploy the shot line. While the legacy process has been safe under optimal conditions, it still has some risk.

Recent technological advancements in smart targeting systems have potential to improve the deployment of shot line. However, such systems have not been adequately demonstrated in the commercial sector to meet Navy requirements. Especially since the system must be compact, but also able to operate in rough weather. R&D is needed to improve and innovate these technologies, so they are fit for Navy use.
An alternative means of deploying shot line must be inherently safe under all conditions that underway ships would attempt UNREP. Any device utilized in a developed methodology should be man-portable and compact for storage and transport.

PHASE I: Develop a concept for an improved method for deploying shot line that meets the requirements above. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be developed into a useful product for the Navy. Feasibility will be established via computer modeling or other means deemed appropriate. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype shot line deployment system. The prototype will be evaluated to determine capability in meeting the performance goals defined in the Phase II Statement of Work. Product performance will be demonstrated through evaluation, modeling, and demonstration over the required range of parameters. An extended test in a maritime environment will be used to refine the prototype into a design that meets Navy requirements. Prepare a Phase III manufacturing and development plan to transition the alternative means of deploying shot line to Navy use.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the alternative method of deploying shot line to Navy use. Develop installation, maintenance, and operations manuals for shot line deployment to support the transition to the fleet. There are many potential commercial applications for an alternate means of deploying shot line in inimical conditions. Notable examples include such varied fields as bridge construction, rapid deployment of bear bags, and, launching rescue lines for people in the water. The service industry supporting off shore platforms will benefit from developments under this topics.

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KEYWORDS: Shot Line; Span Line Deployment; Underway Replenishment; UNREP; Projectile Deployment; Service Line

N251-029 TITLE: Dual Band, Color Visible (VIS) and Short-Wave Infrared (SWIR) Camera

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

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 single sensor/camera that captures visible (VIS) color and short-wave infrared (SWIR) bands in daylight, haze, and low light conditions with real time video output.

DESCRIPTION: Future submarine periscopes or future submarine off board systems will employ multiple imaging sensors with different imaging modalities and bands. The size of new masts will be similar in size to existing traditional submarine periscopes or smaller and similar for off board systems. The need to add additional capabilities drives the design toward reducing the size, weight, and power (SWaP) of sensors and internal components. Imaging sensors are needed for situational awareness and navigation. Visible band sensors are employed to differentiate navigation lights to quickly determine a ship's aspect at night and identify navigation markers and buoys.

Short wave infrared cameras are a low-cost alternative to costly thermal sensors for low light leveling situational awareness and navigation. To reduce SWaP while maintaining the benefits of both imaging bands, the Navy desires the development of a single sensor to capture imagery in the VIS color and SWIR bands. Combining both imaging bands into one compact sensor while maintaining the performance of each is challenging. Silicon based complementary metal-oxide semiconductors (CMOS) are the most available visible band focal plan arrays photodetectors, while indium gallium arsenide (InGaAs), Germanium (Ge), and more recently colloidal quantum dot (CQD) are common for SWIR focal plane array photodetectors. Two focal plane array approaches have been explored utilizing a beam splitter along with the deposition of CQDs onto silicon for simultaneous imaging of visible and SWIR light. Existing visible to SWIR dual band imagers are commercially available but are monochromatic and fail to provide the user the required situational awareness provided by a color screen. Development is needed to achieve a VIS color to SWIR solution. The final single sensor should also provide three outputs: visible, SWIR, and a fused visible-SWIR image. The fused image can be implemented separately from the sensor via post processing.

The following capabilities are desired for the dual band color VIS and SWIR sensor:

- Pixel pitch: VIS 5 microns, SWIR 12 microns
- Pixel Density: VIS 1920x1080, SWIR 1920x1080
- Frames per seconds: 30-60
- Spectral Range: VIS 0.4-0.7 microns, SWIR 0.9-1.7 microns
- Noise Equivalent Illumination/Irradiance: VIS 0.144m Lux·s, SWIR 2x10^9 photons/cm^2·s
- Bad pixels: SWIR dark or light response better than +/- 25% of array response
- Read noise: SWIR 60e
- Dark Current: SWIR 5nA/cm2 at 25°C
- Quantum Efficiency: VIS 80%, SWIR 60%
- Spatial Alignment: VIS-SWIR co-bore sighted
- Temporal Alignment: Within one or two frames

The Navy requires the technology to enable the insertion of a dual band VIS-SWIR sensor into submarine mast systems to reduce space requirements where a mast must be smaller.

To modernize key capabilities for advance naval operations, from the perspective of sensing and navigation, the Navy must manage the operational environment, as well as develop advance capabilities that exploit novel principles to bring new and affordable capabilities to the warfighter. The technology identified in this SBIR topic will enable faster situational awareness; enhance enemy, friendly, and neutral ship detection and classification; and improve safety of ship navigation.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Define and develop a conceptual design for an extended range or dual band color VIS/SWIR sensor/camera that meets the requirements described above. Demonstrate the feasibility of achieving daylight through low light color imagery and show that the concepts can be feasibly developed into a useful product for the Navy. Material testing and analytical modeling will be analyzed to establish design feasibility. The Phase I Option, if exercised, will include a design layout and capabilities for the Phase II prototype.

PHASE II: Develop an extended range or dual band color VIS/SWIR sensor/camera prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II Statement of Work (SOW) and the Navy requirements for nighttime navigation. System performance will be demonstrated through prototype evaluation and modeling over the required range of environmental parameters including lighting conditions and maritime navigational cues. Evaluation results will be used to refine the prototype into an initial design that meets Navy requirements and will be delivered at the end of Phase II. Prepare a Phase III development plan to transition the technology for Navy use.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use for the Submarine Electromagnetic Systems program. Develop an extended range color VIS/SWIR sensor for evaluation to determine its effectiveness in an operationally relevant environment. Support integration and testing aboard operational platforms.

Commercial use of this technology includes surveillance systems, commercial navigation systems, and imaging for search-and-rescue. These are examples of a few systems that must operate in a variety of lighting and sometimes hazy conditions, and which may also require distinction between specific colors.

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KEYWORDS: Low light; color imager; high dynamic range; Short-Wave Infrared; SWIR; dual band; maritime navigation; Electro-Optical/Infrared; EO/IR

N251-030 TITLE: Artificial Intelligence (AI)-Generated Domain Specific Model and Ontology

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

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

OBJECTIVE: Develop a concept for a comprehensive assessment methodology to automatically generate a surface Domain Specific Model (DSM) and a model of concepts and their relationships (i.e., ontology) from domain-related technical documentation and generate machine readable interface documentation (e.g., JSON, XML).

DESCRIPTION: The Integrated Combat System (ICS) operates independently and as part of a netted integrated force with shared sensors, Command and Control (C2), weapons, and communications. A surface ship can have over forty (40) system elements that have unique data models. This data must be normalized through a common ontology to ensure a common understanding that is useable for machine processing (e.g., Artificial Intelligence and Machine Learning [AI/ML]). Manual generation of this DSM is a daunting task that has yet to be successfully accomplished. Once a DSM is established, new sensors, weapons, and communications elements can be integrated with little to no changes to the integration software, thus reducing time and required acquisition funding.

In contemporary military operations, the synergy and interoperability of diverse combat systems are critical for mission success. However, achieving seamless integration remains a formidable challenge due to the disparate data formats and structures employed by various platforms. This SBIR topic proposes harnessing the power of AI to devise a unified common data model (CDM) tailored specifically for combat systems (i.e., DSM). By employing advanced ML algorithms, natural language processing (NLP) techniques, and ontological analysis, the Navy seeks a capability to automatically extract, analyze, and harmonize data schemas from multiple sources. The envisioned AI-driven CDM will serve as a foundational framework for standardizing data representation, facilitating real-time data exchange, and enhancing decision-making processes across heterogeneous combat environments. There is no commercial technology that can generate a combat system CDM from Navy technical documentation sources.

The solution will employ a comprehensive assessment methodology comprised of simulation-based testing, real-world data integration trials, and user feedback analysis to evaluate the effectiveness, efficiency, AI trustworthiness, and usability of the proposed AI-driven CDM in enhancing combat system interoperability. The results of this assessment will provide valuable insights into the practical implications and potential limitations of implementing AI technologies for combat system integration, thereby informing future research directions and operational strategies in military contexts.
Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow

contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for the AI-based DSM that meets the parameters of the Description. Demonstrate the feasibility of the concept in meeting the Navy's need by a combination of analysis, modeling, and simulation. The Phase I Option, if exercised, will include initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype AI-based DSM based upon the results of Phase I. Demonstrate the prototype's functionality through ingesting of data from various representative simulated combat system sensor, weapon, and/or communication elements provided by the government. Demonstrate the ability to modify resource settings and send controls.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The final product will be a set of containerized applications that transform sensor, weapon, and communications data into the DSM and back into element unique interface specifications to send element unique settings and controls. Provide necessary product-level objective quality evidence to support product certification for use. It is anticipated that DSM can become a standard for future element developments, thus minimizing future data transformations.

Automated generation of a DSM using AI has application beyond military systems. Any industry where there are differences in terminology can use this technology to achieve commonality.

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KEYWORDS: Power of Artificial Intelligence; Diverse Combat System; Unique Interfaces; Domain Specific Model; DSM; Combat Management System; Natural Language Processing; Integrated Combat System; ICS

N251-031 TITLE: Advanced Beam Control and Wave Slap Mitigation

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE);Microelectronics

OBJECTIVE: Develop an advanced beam control system on a mast mounted single 12-inch aperture beam director that mitigates wave slap and controls laser emissions, by accurately pointing to and tracking targets.

DESCRIPTION: The Navy is seeking an advanced beam control system for free space optical (FSO) communication, light (laser) detection and ranging (LIDAR), laser systems, and imaging, while maintaining a stable line-of-sight with passive and active compensation of optical beam and imaging jitters. A beam control system must also mitigate environmental effects such as wave slap on the beam director and safely control the firing of laser beam when encountering wave slaps in a timely manner. Currently, there is no government or commercial beam control system for detecting incoming rogue wave and safely controlling the emission of the laser while reliably maintaining a beam control loop for accurate imaging, tracking, or pointing of a laser beam on targets. Typical disturbance sources contributing to optical jitter include platform vibration, structural flexibility, dynamic loading, and acoustics. The beam control system should be designed to minimize and compensate for optical jitter from those various disturbance sources. A well-designed optical jitter control system not only increases the effectiveness of the laser pointing system on targets, but also enhances the imaging and tracking capabilities that will share the same optical path. In order to have a very accurate beam control system, the conventional alignment, which is based on mechanical system alignment between beam director and target line of sight, needs to be very accurate under mechanical jitter, atmospheric turbulence, target motion, etc. However, this method is relatively low speed and requires a very stable platform. To avoid such problems, in this SBIR topic the Navy seeks an innovative high speed and high precision beam steering technology to compensate for any of the above disturbances from mechanical jitters, atmospheric turbulence, phase correction errors, etc.

Detailed requirements for the beam control system:

- Laser Power: > 100 kW average
- Elevation Range: -10 degrees to +85 degrees
- Azimuth Range: 360 degrees
- Target Acquisition Course Field of View (FOV): Wide (50 degree), Medium (8 degree FOV), Narrow (2 degree FOV)
- Target Acquisition Fine: < 1 degree FOV (with zooming capability)
- Target Acquisition Sensors: Visible (VIS), Short Wavelength Infrared (SWIR) and Medium Wavelength Infrared (MWIR) sensors with common FOV
- Target Feedback Control System with Target/Track Illumination Laser (TIL): As a probe laser and BIL (beacon illumination laser)
- Target Tracking: Demonstrate accurate and stable target tracking with positive feedback target lock-in, short acquisition time, and multiple target selection
- Wave Slap: Detection and mitigation within 10 milli seconds or less and closed loop with fire control
- Pointing Accuracy: 1 microradian (relative to inertial reference) closed loop using pulse probe laser
- Shock Tolerance: Structures and components must remain operable through 20G shock acceleration
- Beam Control System Housing: Pressurized 1 atm N2 gas for reduced condensation along the beam control optical path
- Beam Control System: Shall have Athermalization of the optical system

• Beam Director/Periscope Housing: Withstand fluid pressure of greater than 500 psi without leakage; and isolate components at maritime environment
• Volume: Compatible with existing/future Navy platform mast configurations (17” x 17” x 45”)
• Target illumination pulse laser with Deformable Mirror (DM): Include in design for adaptive wave-front, phase correction of laser beam due to atmospheric turbulence; Polarized pulse laser (as probe laser, LIDAR, TIL) can be used for the advanced beam control target detection and laser beam control on target of interest.
• Co-bore sighting: shared by imaging, TIL and laser
• Fast Steering Mirror: Include in design for correction of jitter from on-board vibrations and base motion compensation.
• LIDAR: Target ranging to provide information to beam control system for FOV and target tracking for beam delivery onto target.
• Imaging band: Vis, SWIR and MWIR; Use of Artificial Intelligence technique and multiband imaging for improving target detection, tracking, and pointing of the laser beam under different atmospheric condition is recommended.
• Optical path beam scattering detection system: to monitor beam path inside the beam control system in real time with laser fire control for safety.

Many technical challenges need to be solved before a laser system can be integrated onto a platform mast configuration. One of these issues involves building and demonstrating a compact and agile beam control system. Beam Control systems developed so far for land-based or airborne use are too large for to integrate them for Navy platform mast configuration use and are not submersible. Adapting beam control system designs for the Navy platform mast configurations requires greatly reduced space, weight, and volume while the overall system continues to maintain extremely accurate movement of the optical elements so that the laser intensity is maintained on target for the application of free space optical communication, imaging and tracking, LIDAR, and other laser system. Furthermore, system affordability must be addressed upfront as a major design consideration.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept and demonstrate the feasibility of the advanced beam control system and identify the risk associated for mast mounted configuration to include integration of both TIL and laser beams. Modeling and simulation shall be used to determine feasibility and to assist with providing an initial assessment of performance under marine environment. Parameters that will demonstrate feasibility are identified in the Description section. The Phase I Option, if exercised, would include the initial layout and design to build the prototype in Phase II.

PHASE II: Develop and deliver the full-scale prototype beam control system with wave slap detection closed loop with beam fire control, target acquisition, target detection, stable optical communication, and power delivery on target with high precision based on the requirements outlined in the Description. If the

Phase II Base is successful and is able to meet all initial objectives as outlined, the Phase II Option I and Option II will be exercised for the full mast mounted beam control system delivered to NAVY for test and evaluation.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the advanced beam control system into submarine laser and imaging programs for target tracking, and laser beam delivery on target. Validate, test, qualify, and certify the system for Navy use at the Navy facility.

Free-space optical (FSO) communications is an area of dual use for this technology.

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KEYWORDS: Beam control system; Wave slap detection; Free Space Optical; FSO; Adaptive optics; imaging and periscope system; target illumination laser (TIL)

N251-032 TITLE: Autonomous Unmanned Surface Vehicle Fueling at Sea

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

OBJECTIVE: Develop a capability that will enable Large Unmanned Surface Vehicles (LUSVs) to conduct astern refueling operations from an auxiliary ship or platform while underway.

DESCRIPTION: LUSVs are intended to operate autonomously, including fueling at sea operations. Currently there is no technology, military or commercial, to facilitate autonomous FAS operations with Unmanned Surface Vehicles (USVs) . Manned astern FAS operations involve the refueling ship trailing a hose in the water that the receiving ship retrieves from the water and connects to a fuel riser on the bow of the vessel. This operation requires personnel to hook the hose in the water, operate a gypsy winch to pull the hose up on the deck of the vessel, and finally connect/disconnect the hose to the fuel riser. The Navy seeks to automate this process to eliminate the requirement for personnel aboard the receive ship.
The proposed solution should deploy from the bow of the LUSV and be capable of autonomously identifying, locating, and connecting to a 6 inch astern refueling hose in the water. Solutions could include a simple adapter to the standard hose interface on the refueling platform. The Navy values a solution that minimizes the equipment that needs to be developed. Proposed solutions should incorporate the entire process and must not include temporary manning of the LUSV.

The autonomous FAS system shall conduct and complete refueling evolutions while underway in sea state condition three from a logistics support platform without requiring any onboard/manned support on the receiving vessel. The system shall have emergency break-away capability to facilitate rapid and/or unplanned disconnection of the fuel line without any fuel spillage in the event of potential equipment malfunction, potential vessel collision, or other unanticipated emergency. The system must also prevent fuel contamination.

The FAS system shall be designed to optimize maintenance requirements and enhance safety, including ensuring access to equipment to facilitate safe and effective performance of maintenance actions. Safety considerations include human (human/system interface), toxic/hazardous materials and substances, production/manufacturing, and testing.

Proposers should develop a solution that is Mobile Open Systems Approach (MOSA) compliant to allow for compatibility with future USVs. To ensure interoperability with planned and future USVs, solutions must also comply with PMS 406's Unmanned Maritime Autonomy Architecture (UMAA). UMAA establishes a standard for common interfaces and software reuse among the mission autonomy and the various vehicle controllers, payloads, and Command and Control (C2) services in the PMS 406 portfolio of unmanned system (UxS) vehicles. The UMAA common standard for Interface Control Documents (ICDs) mitigates the risk of unique autonomy solutions applicable to just a few vehicles allowing flexibility to incorporate vendor improvements as they are identified; affects cross-domain interoperability of UxS vehicles; and allows for open architecture (OA) modularity of autonomy solutions, control systems, C2, and payloads. UMAA standards and additional ICDs will be provided during the Phase I effort.

PHASE I: Develop a concept design for an autonomous LUSV FAS system that meets the requirements in the Description. The concept design must define a system that can consistently operate within the established constraints and include any modeling and simulation, studies, or prototypes in support of concept risk reduction. Demonstrate the feasibility of the proposed concept through modeling, analysis, and concept demonstrations.

The Phase I Option, if exercised, will deliver a preliminary design of the concept, identifying the baseline design (hardware, software, support systems) and underlying architectures to ensure that the concept has a reasonable expectation of satisfying the requirements.

PHASE II: Develop and deliver a prototype system based on the requirements in the Description. The prototype systems will be evaluated at sea in both near-shore and open-ocean conditions.

Identify the necessary interfaces, dependencies, and risks. After a successful Critical Design Review (CDR), the company will develop a prototype system. Testing and certification of the system will consist of simulation with a vessel of opportunity. The testing and certification of the overall performance of the system will consist of hardware-in-the-loop testing on a vessel of opportunity provided by the government.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. Successful FAS systems will transition to the LUSV program and will be evaluated for transition to the Medium Unmanned Surface Vessel (MUSV) program and other USV programs. Technology developed for Autonomous Fueling at Sea may also have applicability to other allied nations and commercial users.

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KEYWORDS: Fueling at Sea; FAS; Autonomous FAS System; Medium Unmanned Surface Vehicle; MUSV; Large Unmanned Surface Vehicle; LUSV; Underway Replenishment; UNREP; autonomy; unmanned operations

N251-033 TITLE: Mixed Reality Point Cloud Manipulation

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

OBJECTIVE: Develop a capability to visualize and modify 3-D point cloud models generated by Light Detection and Ranging (LiDAR) and photogrammetry with mixed reality hardware to improve the ability for engineers and technicians to perform virtual ship checks to support design, installation, and modernization to deliver ships on time at lower costs.

DESCRIPTION: Program Executive Offices (PEOs), shipyards, Original Equipment Manufacturers (OEMs), Alteration Installation Teams (AITs), Regional Maintenance Centers (RMCs), and others perform countless ship checks and inspections throughout a ship's lifecycle. Investments are currently being made into creating dimensional digital twins with LiDAR, photogrammetry, and other 3-D scanning technologies. These technologies have proven invaluable for generating 3-D models that aid in various maintenance and sustainment functions throughout an asset's lifecycle, but the Navy does not have an effective environment for visualizing and collaborating in the review of ship models.
3-D model generators and consumers visit ships, submarines, or other physical objects of interest, 3-D scan the physical asset leveraging LiDAR or Photogrammetry technologies, generate a 3-D data model with point cloud software, and then view the 3-D model in a 2-D environment (typically a computer monitor) to support future 3-D work (example: installation and modernization). This approach limits user performance and fidelity relative to what fully 3-D models offer, and results in lower effectiveness in the use of this technology.

Immersive 3-D native environments such as augmented reality (AR), virtual reality (VR), or holographic displays provide the opportunity to experience 3-D models in their native dimensions by allowing users to explore and visualize structures and components with every aspect of the model in a familiar and lifelike environment. This will allow naval architects, engineers, technicians, logisticians, shipyard workers, and others across the NAVSEA enterprise to gain significantly more value out of 3-D models with the ability to collaborate in real-time as if physically visiting the ship as a team.

While specific use cases differ in application, the general improvements to visualization are of scale, proportions, special relationships, interferences, and overlays of technical data and annotations from previous inspection and work crews. All these factors will be invaluable to maintenance planning and coordination. Direct return on investments will be seen by improved detection and resolution of physical interferences, design flaws or conflicts, physical damage to equipment or platforms, or other issues with material condition over traditional 2-D renderings on computer screens. Finally, mixed reality will offer the ability for collaborative touring, viewing, diagnosis, and resolution if the aforementioned issues to help diverse teams resolve challenges significantly faster, but currently these tools are not yet mature enough for wide adoption.

To improve the application, execution, and use of 3-D scanning technologies for shipyard applications, NAVSEA would greatly benefit from research, development, and transitioning of software tools that allow the exploration of models in full 3-D views. This concept of employment would be directly applicable to two primary user communities for design purposes:

A) Ship-level inspections, issue documentation, and tagging which occurs on the deck plates of ships and are reviewed by both local and distributed engineering teams. Teams specifically inspect equipment for work and maintenance discrepancies (paint issues, corrosion, loose nuts, bolts, fittings, et al), which should be annotated, documented, and reported via Navy IT systems. In a 3-D environment those annotations can be made directly in a 3-D model environment to better correlate issue status with the specific physical location and piece of equipment of concern, and then models can be shared across multiple teams to maintain a single maintenance operations and maintenance picture.

B) Long-term (multi-year) and short term (single year) modernization planning design work which occurs at the shipyard, at contractor offices, or at distributed engineering Navy laboratories. Engineers, architects, and technicians will take existing 3-D models and drawings, import CAD models for future installations and redesign, and look for interferences, poor condition of existing structures and materials, and will annotate corrections that need to be performed by other teams. A collaborative environment where these models can be viewed and toured by diverse teams to collaborate and rapidly resolve issues is critical, as is the ability to compare as-designed drawings to as-built and current condition models and take measurements inside of those models.

PHASE I: Provide detailed workflows for ingesting 3-D point clouds into vendor software and hardware. Demonstrate similar capability using contractor provided data to assess feasibility. To support this, the government will provide detailed requirements for interaction functionality, data specifications and standards for government models (provided at contract award). The Phase I Option, if exercised, will include the initial design specifications, capabilities description, a preliminary timetable, and a budget to build a scaled prototype solution in Phase II.

PHASE II: Demonstrate the ability to ingest, manipulate, and mark up 3D models of Navy-representative ships generated by the government, with annotations that can be shared across team-mates. Develop a full-scale prototype and complete a successful demonstration of the prototype's capabilities.

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning this technology in the form of a fully operational system (premised on the Phase II prototype) to government use initially on DDG 51 class ships. The final product delivered at the end of Phase III will be an integrated hardware and software solution that can be used by any industry, academia, or government engineering or operations teams that can benefit from collaboration in 3-D space. This includes operations planning, construction and construction management, surveying, and any other use case with similar requirements.

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KEYWORDS: LiDAR; Photogrammetry; Point-Cloud; Mixed-Reality; Annotation; Virtual Ship Check

N251-034 TITLE: Maritime Expeditionary Response Crawler

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

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

OBJECTIVE: Develop a small, multi-mission capable, minefield suitable undersea crawler platform to operate in complex seabed environments.

DESCRIPTION: The Navy seeks an expeditionary-sized bottom crawler system to detect, acquire, and neutralize or render safe threat objects in the seabed environment. Currently there is no commercial capability available. The expeditionary-size bottom crawler system shall be a remotely operated platform that must be capable of conducting operations in water depths over 600 meters while also capable of transit on the ocean surface for a distance of at least two nautical miles to a georeferenced point where it can autonomously submerge to the seabed. The crawler platform should not exceed 150 lbs. (not including payloads) and must be designed to accommodate the addition of alternative, end-effector specialized payloads including disruptors, short-range diagnostic sensors, and manipulators. The crawler system must be capable of integration with alternative specialized payloads in the field, which range from neutrally buoyant up to 100 pounds, including additional power adequate for both the baseline platform and payloads without degrading crawler stability and mobility on the seabed. The system must be capable of at least 6 hours of continuous operation including power required for platform, navigation, sensors, and communications.

The system must incorporate navigation, camera, and high frequency sonar sensors and a tethered buoy subsystem with active tether management for Radio Frequency (RF) communications. When submerged, the system shall release the tethered buoy to enable RF command and control by operators at a safe standoff distance. The tethered buoy subsystem shall provide operators supervisory control and situational awareness for detection, reacquisition, and render safe or neutralization tasks to enable clearance of naval mines and other underwater explosive-laden threats. It shall also be capable of allowing operators to take full manual control of the platform when necessary. Supervisory autonomy to reduce cognitive burden to the operator is desired. The system's tether shall be capable of very low latency, reliable communications at varying depths and standoff ranges to enable precision operations.

The system must be capable of effectively conducting operations in different sediment and seabed types (e.g., rocky, flat sand, silt, etc.) and must be stable on the seabed in dynamic sea states and currents. Additionally, it must be designed to achieve, maintain, and/or restore itself to the proper orientation for maneuver to and from the target, and for employment of payloads when at or near the target.
It is desired that the system be designed for operations in close proximity to influence actuated threat mines and have a magnetic signature of three times non-contact specification at a range of 3-4 feet from the closest point of the platform and appendages as specified in MIL-DTL-19595.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for a Maritime Expeditionary Response Crawler System that meets the requirements described above. Demonstrate through modeling and simulation, benchtop tests or other supporting documentation the efficacy of the proposed system design for satisfying prototype system requirements. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II, and plans to assist the Navy in refining system level requirements for transition to operational systems as a component of the Maritime Expeditionary Standoff Response (MESR) Family of Systems.

PHASE II: Develop and deliver a prototype for evaluation to determine its capability in meeting the performance goals defined in the Phase II SOW and the Navy requirements as stated above and to incorporate a diagnostic sensor payload. (Information on the payload will be provided as government furnished information (GFI) during the Phase I Option period). Demonstrate the prototype's performance in a relevant undersea environment against Government-furnished threat representative surrogate targets. Prepare a Phase III development plan to transition the technology to Navy use.

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

PHASE III DUAL USE APPLICATIONS: Provide technical and transition support for the incorporation of the solution into Navy program(s). Provide support for additional testing depending on the particular program (if needed). Explore the potential to transfer the system or technology to other military and commercial systems, including the scientific community. For example, implementation in the US Navy, United States Marine Corps (USMC) and Army Explosive Ordinance Disposal (EOD) Workspace for littoral ordnance neutralization activities in the surf zone. In addition, this technology can provide support within other federal agencies (e.g., Federal Bureau of Investigation (FBI), Department of Homeland Security (DHS)) and civilian first responders and law enforcement agencies to provide a broad range of EOD related support services.

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KEYWORDS: small unmanned surface vessel; sUSV; bottom crawler; mine countermeasures; MCM; Navy expeditionary; underwater improvised explosive device; unexploded explosive ordnance

N251-035 TITLE: Integrated Air & Missile Defense (IAMD) Adaptive Trainer (IAT)

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 an Artificial Intelligence (AI) and Machine Learning (ML) (AI/ML) based immersive adaptive training approach that continuously improves an operator's performance in evolving threat landscapes including Integrated Air & Missile Defense (IAMD).

DESCRIPTION: The Navy's IAMD systems are crucial for protecting ships and assets from air and missile threats. However, the rapidly evolving nature of these threats necessitates continuous improvement in training methods to ensure personnel are prepared for the latest challenges. Traditional methods like classroom lectures and simulations often present predefined scenarios that may not reflect the ever-changing tactics and capabilities of adversaries. This repetitive nature can lead to complacency and hinder the development of critical thinking and adaptation skills needed in real-world situations. By addressing the limitations of traditional methods, improved training can equip Navy personnel with the adaptable skills and knowledge needed to counter sophisticated and evolving threats. Immersive adaptive training (IAT) can lead to significant cost savings through reduced training time, improved resource utilization, and increased operational efficiency.

The Navy seeks a next-generation, AI/ML based IAT system that can adapt to individual trainee needs, incorporate real-time data and feedback, provide immersive and engaging training experiences, and measure and track training effectiveness. There are currently no known commercial solutions to meet this technology need.

The technology should leverage AI/ML to assess individual trainee strengths and weaknesses, and tailor training content and exercises accordingly. This personalized approach can significantly improve learning outcomes compared to the one-size-fits-all methods currently being utilized.
It should integrate real-time data from simulations, exercises, and operational deployments to continuously update training scenarios and challenges. This approach ensures trainees are exposed to the most relevant and up-to-date threats.

It should utilize Virtual Reality (VR), Augmented Reality (AR), or other immersive technologies to create realistic and engaging training environments that enhance learning and retention. The technology should incorporate comprehensive performance metrics and feedback mechanisms to track individual and group progress, identify areas for improvement, and demonstrate the effectiveness of the adaptive training, improving an IAMD course of action (COA) by at least 10 percent.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able

to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for an AI/ML-based IAT system for IAMD systems that meets the objectives stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy's need through a combination of analysis, modeling, and simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and demonstrate a prototype AI/ML-based IAT system for IAMD based on the results of Phase I. Demonstrate the prototype's functionality based on pilot testing with representative groups of IAMD personnel to evaluate the system's effectiveness, usability, and impact on training outcomes. Develop a comprehensive training plan and supporting materials for the AI/ML-based adaptive training system.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The final product will be an effective AI/ML-based IAT system for IAMD systems. Continued development will occur through testing with representative groups of IAMD personnel to evaluate the system's effectiveness, usability, and impact on training outcomes. Final system use will be analyzed by the Navy to determine effectiveness and utilization in IAMD systems. This system will provide state of the art training for IAMD by giving personalized, adaptable, and immersive learning experiences that significantly improve personnel readiness and combat effectiveness.

This technology could be utilized to support operator training in other mission areas. The AI/ML could additionally benefit commercial applications within the Federal Aviation Administration applications utilizing intensive motion to improve personnel experience benefiting proficiency.

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KEYWORDS: Artificial Intelligence for training; Machine Learning for training; Adaptive Training; Integrated Air and Missile Defense; engaging training environments; Next-Generation Training; VR/AR

N251-036 TITLE: Unmanned Aircraft Systems (UAS) Advanced Networking Interoperability

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: Develop software tools that seamlessly integrate Unmanned Aircraft Systems (UAS) platforms with AEGIS Combat System (ACS) to optimize mission effectiveness and situational awareness.

DESCRIPTION: The ACS currently does not fully take advantage of recent upgrades in technical advancements and lacks full utilization of UAS capabilities, due to a lack of integrated routing protocols, controllers, and security. Resulting inefficiencies in speed and quality of information limit fast and accurate understanding of the battlespace from the “unmanned” perspective. Providing speed and quality information is necessary for modern surface Navy operations.

The Navy is seeking an innovative software tool to improve the “unmanned” battlespace and provide the needed integration and interoperability improvements to align existing UAS communication platforms within the broader ACS. This will also provide improved cost benefits to the Navy through improved maintenance and reduced manning. A commercial solution does not currently exist for these improvements.

Potential gaps with interoperability and integration of UAS platforms into the ACS that may be specifically targeted for improvement include adherence to communication standards, sensor fusion and data integration, and command and control interfaces. Development of software-defined networking (SDN) solutions, unified communication gateways, and secure protocol translators tailored specifically to UAS communications are needed to facilitate seamless communication and coordination between UAS and other components within the ACS. Through dynamic configuration and flexible routing capabilities, SDN controllers and agents will optimize network resources based on mission requirements (i.e. real-time situational awareness, mission flexibility, interoperability with Allied Forces, etc.) and operational conditions (i.e. electromagnetic interference, harsh weather conditions, mission-critical data security, etc.), providing real-time adaptability and scalability within complex combat environments. The optimized network will efficiently allocate and manage network resources, such as bandwidth, latency, and routing paths, to meet mission requirements and adapt to operational conditions effectively and can also involve dynamically adjusting network configurations in real-time to maximize performance, reliability, and scalability. The creation of unified communication gateways that serve as centralized hubs for integrating diverse UAS communication protocols with standard combat system interfaces will also be needed. These gateways will bridge the gap between UAS-specific protocols (i.e. MAVLink, STANAG 4586, etc.) and legacy communication standards (i.e. Link-16, Cooperative Engagement Capability, Link 11/22, etc.), facilitating seamless interoperability and data exchange across the entire combat system architecture. The development of secure protocol translators and adapters must ensure the integrity and confidentiality of data transmitted between UAS and combat system nodes. By implementing encryption, authentication, and access control mechanisms, these modules will mitigate potential security vulnerabilities and safeguard sensitive information in transit. Interoperability and integration performance improvements of 10% or higher should be targeted.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for a software tool that meets the Description requirements. Demonstrate feasibility through comparative evaluation and integration capability into the ACS. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype in Phase II.

PHASE II: Develop and deliver a prototype software tool based on the results of Phase I. Demonstrate the prototype meets the requirements in the Description. The prototype will be tested by government Subject Matter Experts in a government environment.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the prototype application to ACS use in the baseline testing modernization process. Integrate the prototype into a baseline definition, incorporate the baselines' existing and new sensor capabilities, conduct validation testing, and obtain combat system certification.

In the commercial world, this technology can be utilized to enhance the coordination and connectivity of autonomous vehicles within smart transportation systems, improving traffic management and safety. This technology can be applied by professionals specializing in transportation engineering or autonomous vehicle development, particularly in roles focused on software development, system integration, and traffic optimization.

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KEYWORDS: Unmanned Aircraft Systems; UAS; AEGIS Combat System; ACS; Software-defined networking; Unified communication gateways; Secure protocol translators; communication standards; UAS communications

N251-037 TITLE: Underwater Launch and Recovery of Unmanned Underwater Vehicles (UUV's)

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

OBJECTIVE: Improve Unmanned Underwater Vehicle (UUV) launch and recovery capabilities across the fleet by developing a universal approach that can be readily adapted to the existing T-AGS 67 Moon Pool Launch and Recovery System (MLARS) being installed for use by the U.S. Navy.

DESCRIPTION: The Navy seeks to develop a system to recover submerged UUVs so they can be brought aboard using an existing T-AGS 67 MLARS. System development will initially focus on PMS 325 craft, starting with Naval Oceanographic (NAVO) Survey Ship (T-AGS) vessels. Locating and connecting to unmanned vessels below the surface is challenging due to the environmental conditions at depth such as temperature, pressure, visibility, and currents as well as very different surface zone challenges.

The Navy seeks improvement of its UUV recovery capability across the fleet by implementing technology that is deployable from a variety of handling configurations, including ships cranes. Additionally, this SBIR topic aims to reduce the proliferation of specialized UUV recovery systems. A new approach is intended to reduce the need for multiple specialized UUV launch and recovery systems. The proposed system should enable UUV recovery at or below the water's surface, up to 200 feet below the surface. The technology developed under this topic addresses the critical problem of safety while recovering unmanned vessels back aboard their mother ships in a timely manner.

Many different types of hardware interfaces on UUVs exist. The government is seeking a UUV launch and recovery system that is highly adaptable to various configurations. All UUVs may be outfitted with hardware that provides a connection point to the MLARS strongback. The prototype demonstration should be capable of using a model of the REMUS at 19 feet long and 26 inches in diameter. The moon pool on T-AGS 67 measures 18 feet long x 18 feet wide. Wave tank testing is desired at a recognized test facility. Validate the prototype system during at sea or similar environment testing using the existing MLARS installed on a T-AGS vessel. The transition target would include all Navy ships outfitted with moon pool or over the side handling equipment large enough to carry, launch, and recover UUVs and Unmanned Surface Vessels (USVs).

PHASE I: Develop a proof-of-concept design to address the Objective and the details and requirements provided in the Description. Feasibility will be determined through a computer simulation of the solution and provide analyses of system features and a concept of operations to assess overall feasibility and risks. The Phase I Option, if exercised, will include initial design specifications and capabilities description adequate to build a scaled prototype solution in Phase II.

PHASE II: Develop the Phase I design further and provide additional analyses of key subsystems and components. Build a prototype, including supporting test fixtures, at a scale attainable in Phase II, while still sufficient to validate the system design. Prototype demonstration should be capable of using the model of a Remote Environmental Monitoring UnitS (REMUS) UUV as specified by the Navy. Wave tank testing is desired at a recognized test facility. It is also intended that the design of the UUV launch, and recovery system developed under this SBIR topic will be validated during at sea or similar environment testing using the existing MLARS installed on a T-AGS vessel. Develop a preliminary timetable and budget to advance a successful Phase II demonstration of a full-scale prototype.

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology for Navy use. UUVs are proliferating throughout the fleet and may be used to minimize risks to civilians, naval personnel, and surface ships engaging in high-risk operations. In addition to application through a moon pool, the technology would have application for over the side operations and operations from USV mother ships, Expeditionary Fast Transport (EPF), and other ships that host USVs. The technology developed under this SBIR topic would also have application to civilian ocean industries such as offshore oil and gas exploration, fisheries, and environmental monitoring.

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KEYWORDS: Unmanned Underwater Vehicle; UUV; Strongback; Mother Ship; Oceanographic Survey Ship; Moon Pool; Launch and Recovery

N251-038 TITLE: Energy Conserving Power Control Module System for Unmanned Underwater Vehicle (UUV)

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

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

OBJECTIVE: Develop a compact, configurable power control module system for 28 Volt Direct Current (VDC) battery systems for small Unmanned Undersea Vehicles (UUV) to enable power conservation and extend mission duration.

DESCRIPTION: Current small UUV systems are often limited by the capacity of the battery that provides power to the vehicle and its onboard electronics. The Navy seeks a power control module system that has advanced control, optimization, and management capabilities to conserve power and enable longer duration missions.

The Navy seeks an innovative compact, configurable power control module system that can optimize power consumption of up to 28 VDC batteries in battery-powered small UUV systems to maximize energy utilization and extend operational capability. The module shall provide effective power management of all onboard electronics, including sensors, control, and navigation systems to conserve power and achieve a 10% or greater energy savings. Additionally, the module shall provide real-time monitoring and control of power distribution.

The power control system shall be capable of autonomously regulating/optimizing power system components while maintaining a low power impact on the system itself. The module may consist of advanced power management algorithms, software, hardware, or a combination; however, due to limited available Size, Weight, and Power (SWaP), there is a preference for minimal hardware integrated into the UUV. The module must be compact enough to be incorporated within the SWaP envelope, as well as the computing environment and power supply and distribution environment, of existing systems and systems in development. The allowable space for hardware should be no larger than 8 cubic inches, with no single component larger than 1 cubic inch and weighing less than 16 ounces.

The solution must work with existing Navy systems' power buses. However, the Navy is also interested in innovative systems that could involve new power bus schemes which can be included in proposed solutions as a potential for future systems or upgrades.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for an Energy Conserving Power Control Module System that meets the requirements described above. Establish feasibility by developing system diagrams, as well as Computer-Aided Design (CAD) models that illustrate the power control module concept and provide the estimated weight and dimensions of the conceptual system. Feasibility will also be established; and by computer-based simulations that show the module's performance is suitable for the Navy's needs.

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

PHASE II: Develop and deliver a prototype system for in-water testing and measurement/validation of the Phase I performance attributes. Perform detailed analysis and live demonstration in a test environment as part of the evaluation. Provide detailed technical documentation of the design, including an interface control drawing and interface specification, to allow successful transition of the product.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use.

Although a fully operational power control module is initially targeted for use in small UUVs, it should have the ability to support additional Navy applications and be suitable for shipboard use. Application of this product would provide commercial UUVs a longer duration to explore, map, survey (pipelines, cables, piers, bridges), and perform work (repair, salvage) in underwater.

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KEYWORDS: Energy Conserving; Power Control Module System; Mine Warfare; DC Voltage Systems up to 28 VDC; Configurable; Extend Mission Profile

N251-039 TITLE: Physics-based Data Augmentation for Machine Learning (ML) Models

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

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

OBJECTIVE: Develop a tool to synthesize realistic physics-based sonar data for use in training Artificial Intelligence/Machine Learning (AI/ML) algorithms to enable rapid approaches to fielding sonar-oriented AI/ML capabilities.

DESCRIPTION: For imagery and vocal audio, tools exist to allow individuals to generate realistic audio and video clips for speeches, also known as deep fakes. These tools use a variety of AI/ML tools and limited exemplars of training data.

For sonar, there are tools to compute representative acoustics on sonar arrays to support sailor training objectives. Recording data at sea is currently used to obtain training data for sonar signal processing and it is cost prohibitive to obtain the quantity of data required to train AI/ML algorithms. The complex, physics-based models used in current simulations require a fundamental understanding of the entire phenomenon in question and requires extreme computational power. Data-generation tools exist in industry. However, these tools are not oriented toward sonar and existing tools are not sufficient to develop dynamic scene content covering 360 degrees at extended ranges to support mid-frequency sonar (1 kHz to 10 kHz) across the worldwide range of bathymetric, weather, volume scattering, and contact density conditions. Innovation is required to support the generation of phenomenologically representative data sets. The Navy seeks a tool to synthesize realistic physics-based sonar data for use in training AI/ML algorithms to enable rapid approaches to fielding sonar-oriented AI/ML capabilities. Currently, there are no commercial tools that can do this.

Success with video and vocal audio generation using AI/ML tools suggests that it may be possible to combine recorded exemplars obtained during exercises such as Rim of the Pacific (RIMPAC) with physics-based contact attributes to generate high quality sonar data. The primary use for this generated data would be to train emerging AI/ML algorithms.

AI/ML synthesis tools can enable development of realistic synthetic sonar data for use in training AI/ML algorithms. A limiting factor is the availability of recorded training data and the absence of recorded data from real-world conflict situations involving realistic numbers of enemy contacts. High-quality synthesis approaches that utilize AI/ML would provide an alternate means to creating the large volumes of data needed to train detection and classification algorithms.

The solution must include using generative adversarial models and deep predictive coding models. It must be capable of producing large volumes of diverse high-fidelity data to train ML algorithms that will improve target detection, classification, and tracking systems. Metrics for the solution includes computational performance, “image” similarity metrics, and user assessments.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for a tool to produce realistic synthetic sonar sequences suitable for training signal processing algorithms that meet the feasibility of parameters in the Description. Feasibility will be established through modeling and analysis of the design.

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

PHASE II: Develop and deliver a prototype tool of the realistic synthetic sonar sequences. Demonstrate the tool's ability to meet the parameters in the Description through testing. Testing will include benchmarking computational performance, "image" similarity metrics compared to recorded sonar exemplars (which will be provided by the government), and user assessments. Validate the prototype through application of the approach for use in a simulation environment. Provide a detailed test plan to demonstrate that the simulation achieves the metrics defined in the Description.

Due to the nature of recorded sonar data, it is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the tool to Navy use in training current Navy sonar signal processing algorithms as well as with training systems or simulators. Work with the IWS 5.0 Undersea Systems program working groups for ML and training to increase the fidelity of the sonar sensor data used for training AI/ML algorithms and used within high fidelity sonar trainers.

The technology developed under this SBIR topic could provide an improved approach to creating dynamic scene content for other DoD programs. If this AI/ML-generated sonar data can be generated with less computational power than current physics-based models, this technology may also be of use in trainers for sailors.

Complex, physics-based models are often used in current simulations. This requires a fundamental understanding of the entire phenomenon in question and requires extreme computational power.
The innovation sought would reduce reliance processing capacity while retaining traceability to physical attributes of sonar returns. This new approach could be used for sensor data prediction and interpolation for scenarios where it is not possible to record data (e.g., wartime conflict situations) or to produce sonar data to train for salvage operations, oil and gas exploration, and border protection.

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KEYWORDS: Train emerging AI/ML algorithms; AI/ML synthesis tools; High-quality synthesis approaches that utilize AI/ML; mid-frequency sonar; deep predictive coding models; physics-based contact attributes

N251-040 TITLE: Algorithms for 3 Axis Magnetometer in the Water Column

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

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

OBJECTIVE: Develop innovative real-time signal processing algorithms to optimize sensor performance and detect objects in water using commercial low-power 3-axis magnetometers.

DESCRIPTION: Recent developments in smaller and more sensitive 3-axis magnetometer sensing devices, coupled with ever smaller signal processing target detecting devices, has opened up the possibility for the development of algorithms for object detection based on magnetic sensing. However, the magnetic background of data collected is compromised due to the inherent motion induced noise of conventional scalar magnetic sensors.

Utilizing a 3-axis magnetometer in the water column of the earth's large magnetic field is difficult because 3 axis magnetometer production is imperfect. Commercial fluxgate axis sensitivity mismatches and axis misalignment create noise issues when computing the total magnetic field while the sensor experiences yaw, pitch, and roll associated with being in the water column. Calibration can reduce these effects, but an attitude, and heading reference sensor (AHRS) compensation scheme will likely be required for effective object detection performance. Limitations on the ability to suppress noise in realistic environments versus manufacturing imperfections (sensitivities and alignments) must be minimized and characterized to maximize and understand moored underwater persistent system performance. To mitigate these limitations, the Navy seeks advanced signal processing object detection algorithms with calibration and noise cancelation schemes for commercial, low power, 3-axis magnetometers to optimize sensor performance and improve detection, localization and classification of underwater threat objects.

The algorithms will be integrated into the software module of a low-power commercial magnetometer system and will not be part of a towed magnetometer. The commercial magnetometer can be either a fluxgate or a total field magnetometer. However, the threshold power requirement must be under 0.45 watts.

The algorithms should be modular, configurable, and able to be recalibrated for mission or sensor housing type to be used in various magnetometer systems. Algorithms must be capable of processing magnetic sensor data in real time and support high probability of detection with low false alarm rate as well as prevention of false positives created by geomagnetic noise and motion induced noise. Algorithms should be capable of detecting and identifying object features.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able

to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept to facilitate object identification, detection, and localization using 3-axis magnetometers that meets the requirements described above. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be feasibly developed into a useful product for the Navy. Feasibility will be established by testing and analytical modeling.

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

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

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

PHASE III DUAL USE APPLICATIONS: Provide technical and transition support for the incorporation of the solution into Navy program(s). Depending on the particular program, support for additional testing may be needed. Explore the potential to transfer the system or technology to other military and commercial systems, including the scientific community for geological exploration of deep structures of the Earth and altitude control on satellites.

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KEYWORDS: Algorithms; Magnetometer; Water Column; Object Detection; Compensate for Noise and Changes to the Magnetic Field; Triaxial; Magnetic Calibration

N251-041 TITLE: Generalizable Artificial Intelligence/Machine Learning (AI/ML) Undersea Warfare (USW) Quick-Look Tool

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

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

OBJECTIVE: Develop a configurable Artificial Intelligence/Machine Learning (AI/ML) tool that generates USW quick-look reports for laboratory testing and at-sea tests data collection events.

DESCRIPTION: Documenting the outcome of laboratory testing and at-sea tests procedures involves including time-consuming manual processes, variability in expertise, and subjectivity in interpretation. Manual interpretation of test results incurs potential for human error and requires substantial time. The potential for error and delay increases with the complexity and volume of data. Delay may also occur when multiple professionals must come to consensus on the interpretation of the data.
Not all test engineers have the same level of experience or knowledge when interpreting test results, leading to unnecessary inconsistencies in reported outcomes. This variability can result in unnecessary variation in management decisions based on test results that are not consistent due to interpretation of the data by various individuals.

Further, engineers may draw contrasting conclusions from the same test data, contributing further to the variability in outcomes, as may occur when the test is simple (e.g., calibration of a sensor array). These challenges are compounded by other factors, such as quality of results, factors related to the purpose of the test procedure, and the reliability of test measurements.

The Navy seeks a Generalizable USW Quick-Look Tool that reduces variability in outcomes and facilitates an advanced state of expertise among inexperienced test and manufacturing personnel. There is currently no commercial tool that can accomplish this.

The initial target of the technology would be relatively simple and repeatable tests, such as towed receive array calibration and inspection. The solution must be extensible to more complex test procedures, with the tool being evaluated based on accuracy of results in the report, useability of provided information, and latency reduction in the time it currently takes. The solution must show a range of quick-look test summaries to include representative tests, from simple calibrations to complex test series across multiple days, test objectives, and environmental conditions to demonstrate its abilities. It must also do pre-test quality assurance check that could detect mechanical inconsistencies between the planned test setup and the actual hardware configuration.

The concept will be evaluated based on feasibility, range of extensibility across test complexity (calibration test to multi-day multi-objective testing) and type (in-lab testing to at-sea testing), ease of use for test engineers, and clarity of test result presentation.

The minimum viable product (MVP) version of the end result will undergo independent testing by the IWS 5.0 Machine Learning Working Group. This independent testing will include using the prototype with classified data sets.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for an AI/ML USW Quick-Look tool and demonstrate that it will feasibly meet the parameters of the Description. Demonstrate feasibility through modelling and testing.

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

PHASE II: Develop and deliver a prototype AI/ML USW Quick-Look tool based on the results of Phase I. Demonstrate the technology through performing independent evaluation of the MVP prototype with the government Machine Learning Working Group. The government Machine Learning Working Group will test the prototype using classified data sets.

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

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology to Navy use. It is anticipated the final product will eventually be used across PEO Integrated Warfare Systems (IWS) and USW to develop quick-look reports for both laboratory testing and at-sea tests. The Space, Weight, Power, and Cooling (SWAP-C) associated with the final product will determine details of how test engineers may utilize the resultant product in cases where cloud-based test infrastructure may not be available.

The Generalizable Quick-Look Tool will be of use in numerous applications where engineering tests must be rapidly summarized to support product decisions or provide insight to customers. Given the anticipated domestic reshoring of product manufacturing, the Generalizable Quick-Look Tool could become a major help to future manufacturers who will often lack sufficient seasoned personnel to mentor the rising workforce using traditional master-apprentice techniques.

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KEYWORDS: Quick-look test summaries; calibration of a sensor array; independent quality assurance check; complex test procedures; inexperienced test and manufacturing personnel; reduces variability in outcomes

N251-042 TITLE: Resilience against Supply Chain Cyber Vulnerabilities

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

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

OBJECTIVE: Develop a technology that ensures computing hardware technologies integrated into future combat systems are trustworthy and cyber secure.

DESCRIPTION: Shipboard computing infrastructure has evolved to over 3,000 Central Processor Unit (CPU) Cores that are distributed across multiple military grade cabinets. The cabinets can be in multiple spaces within a ship to ensure survivability if a set of cabinets are disabled or destroyed. Current CPUs within the cabinets are on Advanced Telecommunications Computing Architecture (ATCA) standard single board computer (i.e., blades).

The distributed nature of shipboard computing poses significant challenges in ensuring security, robustness, trustworthiness, and performance of computing infrastructure. Infrastructure resilience is the ability of a computer infrastructure to adapt, mitigate, and respond to stresses within the Information Technology (IT) environment via the integration of software and applications. The IT system can transform itself to ensure that essential business functions and processes are maintained. In today’s environment, cyber security is managed using a security information and event management (SIEM) embedded within the computing infrastructure (i.e., NIST SP 800-145 Infrastructure as a Service (IaaS)) or application services (e.g., NIST SP 800-145 Platform as a Service (PaaS)).

Computer research in the area of advanced multi-die systems is achieving previously unheard-of levels of performance. Instead of one-size-fits-all monolithic silicon, multi-die systems are comprised of an array of heterogeneous dies (or “chiplets”), optimized for each functional component. Given the increase in performance and evolutionary trend of shipboard computing hardware over the past 30 years, it’s fair to predict that eventually chiplets will find their way onto surface ships to meet evolving surface ship warfighting requirements (e.g., AI/ML, decision support, weapons coordination). While multi-die systems offer new levels of flexibility and achievement in system power and performance, they also introduce a high degree of design complexity and new security challenges.

The Universal Chiplet Interconnect Express (UCIe) standard was introduced in March of 2022 to help standardize die-to-die connectivity in multi-die systems. UCIe can streamline interoperability between dies on different process technologies from various suppliers. But while a UCIe-compliant multi-die system may work great through development, testing, and manufacturing, can the system’s die-to-die connectivity be ensured to continue—robust, secure, and tested— even while it’s operating in the field? Having a mix of suppliers in a supply chain from various countries introduces security challenges within a chiplet-based architecture. Solving these challenges is of utmost importance for stakeholders. A comprehensive, multi-layered approach to address computing infrastructure resilience (CIR) and enhance the overall reliability and efficiency of edge computing environments is sought. There is no current commercial solution to address the approach needed.

A solution needs to protect all surfaces beyond the trusted computing base (e.g., processor chip) as data moves around the system. It must ensure zero trust by always verifying data and sources within the computing infrastructure (attestation). It must also ensure least privilege by software and hardware components only having access to what they need to complete work (access control). This research needs to demonstrate the ability to modify settings and controls to ensure CIR under various conditions. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for CIR that meets the requirements stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy's need through a combination of analysis, modeling, and simulation. The Phase I Option, if exercised, will include initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype CIR based upon the results of Phase I. Demonstrate the prototype's functionality through various cybersecurity use cases that demonstrate that it meets the requirements of the Description.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. Provide a final CIR product that includes a set of design patterns, code examples, and compliance tests that provide guidance for CIR compliant implementations. Provide necessary product-level objective quality evidence to support product certification for use.

It is anticipated that this CIR can become a standard industry and DoD computing infrastructure implementation. Commercial cloud environments (e.g., Amazon, Microsoft Azure) can benefit from this CIR as well as computing environments located within industry facilities.

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KEYWORDS: Chiplet Architecture; Universal Chiplet Interconnect Express; UCIe; Infrastructure Resilience; Computing Infrastructure; Zero Trust; Supply Chain

N251-043 TITLE: Development of Toroidal Propellers for Torpedo and Unmanned Underwater Vehicles (UUV) Applications

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

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

OBJECTIVE: Design toroidal propellers for the MK54 Lightweight Torpedo (LWT) with focus on the metrics of speed, efficiency, and quieting.

DESCRIPTION: A toroidal propeller design consists of a hub supporting multiple elongated elements. The novelty lies in the tips of these elements curving to contact with one another to form a closed structure. This design encloses the huge open space usually seen in conventional propellers, increasing the stiffness of the entire propeller, and providing enhanced strength. The configuration of the propeller also reduces the noise that these mechanical devices usually generate, translating to a reduced acoustic signature. This technology is differentiated by these two innovative aspects: increased stiffness and reduced acoustic signature, unlike conventional propeller designs whose open structure both for aeronautical and marine environments makes them less rigid and noisier. This propeller design offers a unique adaptation that makes the propeller tougher, quieter, and more effective.

The Mk54 LWT Design of Record (DOR) utilizes a torque balanced inner/outer shaft design to propel the torpedo with a set of counter rotating propellers. These propellers operate at similar RPM with the forwards propeller operating at an RPM of ~0.5-3% greater than the aft propeller.

Any newly designed propeller set will need to meet the current system capabilities in fuel efficiency, top speed, and transmission of noise to environment. Ideally this upgraded design would be able to improve upon all aspects of the system and provide a better all-around propeller for the LWT. The Navy priorities for design, in order are: top speed, fuel efficiency, cavitation mitigation. These three topics will be the primary benchmarks for modeling and will be compared against the current system abilities. The secondary goals will be to look at maneuverability, system quieting, and survivability due to damage. The LWT torpedo is a long cylindrical body that tapers in a streamline fashion in the aft section. This section contains the control fins and the two rotors. The rotors maintain the streamline taper for the hub designs and then uses specifically designed blades for minimizing noise and increasing the thrust capability of the device.

As can be seen in Figure 1 (https://navysbir.com/n25_1/N251-043-Figures-1-and-2.pdf), the system normally uses two counter-rotating shafts on an inner/outer installation. The overall streamline dimensions for the shape are detailed in Figures 1 and 2.

A closer look at an Initial Capabilities Document (ICD) of the Mk54 torpedo shows the dimensions allowed for creation of a new set of propellers. The internal design is a spline, which is detailed in Figure 4, while the dimensions of the available space for propeller design is detailed in Figure 3.

The LWT operates from the surface down to LWT Depth and from RPM's from 600 to 3000 RPM. This produces a torque balanced system with the two propellers balancing each other's torque load. The Forwards propeller operates at a maximum of 3% less RPM at 600 RPM and 0.5% less at 3000 RPM. The speed range is between Low and High operation; with RPM Forwards being 300 and 2500, RPM Aft being 315 and 2690 low/high respectively. Associated Speeds and Depths are classified and may be shared after award.

Only direct drop in replacement designs will be considered. There is no design envelop for hardware modifications to the LWT. RPM ranges for different operating modes can be modified. The propeller hardware may be designed with any material and any manufacturing process so long as the design can conform to current DOR shock and vibration requirements. The Navy is seeking +10% improvement on top speed and fuel efficiency, meaningful noise reduction, and significant acquisition cost savings. Current DOR LWT propellers are approximately $22K per set.

The awardee will demonstrate new propeller design performance in a representative environment. The prototype design should provide no less than 8% improvement to top speed and fuel efficiency, and reduced cavitation compared to the DOR. The awardee will deliver a minimum of five of these prototypes to the Navy for evaluation. The awardee will perform detailed analysis to ensure materials are rugged and appropriate for Navy application. The proposer will provide a manufacturability and cost analysis in support of Navy Business Case Analysis for upgrading to the new propeller design. Environmental, shock, and vibration analysis will also be performed.

The awardee will conduct computational fluid dynamics (CFD) analysis of the design, which the Navy will measure against the current DOR propellers. The proof of design analysis will inform as to the anticipated improvements to the priority topics of top speed, fuel efficiency, and cavitation. The awardee will also include a projected manufacturability and cost analysis.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept to meet the needs for an innovative propeller design. Design a proof-of-concept propeller set for the MK54 LWT using the provided design parameters in the Description. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver Phase II prototypes for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II Statement of Work (SoW) and the Navy's need for improved top speed, fuel efficiency, and cavitation mitigation.
It is probable that portions of the work under this effort will be classified under Phase II (see the Description section for details).

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II to refine and finalize the propeller design and characterize performance as defined by Navy requirements. Working with the Navy and applicable industry partners, demonstrate the final propeller design with a series of in-water runs equipped on a MK54 LWT. Support the Navy for test and validation to certify and qualify the system for Navy use. Explore the potential to transfer the propeller design to other military and commercial systems (e.g., other torpedoes, UUVs). Market research and analysis shall identify the most promising technology areas and develop manufacturing plans to facilitate a smooth transition to the Navy.

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KEYWORDS: Toroidal Propeller; Closed Loop Propeller; Cavitation Reduction; Noise Reduction; Increased Thrust; Fuel Efficiency; Tip-Vortices

VERSION 2

N251-044 TITLE: Data Converter Cabinet for the AEGIS Weapon System MK99 Fire Control System

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: Design a solid-state data converter cabinet that maintains or exceeds existing functionality and performance to replace wire wrapped plane cabinets.

DESCRIPTION: The Navy's MK99 Data Converter Cabinets (DCC) rely on a wire wrap backplane which relays power and logic to Circuit Card Assemblies (CCAs) via analog signals to process the necessary data to feed the many information systems of the AEGIS Weapon System (AWS) MK99 Fire Control System (FCS). A wire wrap system consists of individually wrapping wire around metal posts, collectively known as a bed of nails, to create logic and/or power circuit paths. Maintenance for these backplanes becomes time consuming should the bed of nails suffer damage, need repair, or for even simplest of wiring. The skill of wire wrapping is fast falling out of favor in the technical community and there is a need to find solutions such as Printed Circuit Board (PCB), surface mountable technologies, or other industry concepts and approaches that are adaptable innovations that can enable retrofit to existing MK99 FCS installations aboard DDG 51 Class ships, development and tactical sites, and international ships. The Navy is seeking a solution that minimizes requirements for wholesale cabinet rip-out and installation to include man-portable modular electronic components, hatchable equipment enclosure architectures, and mechanical/electrical compatibility with existing ship services and cables. Currently there are no commercial solutions that can meet the desired capability.

Design of this below-deck equipment solution seeks to maintain existing interfaces to the SPG-62/MK82 topside antenna and director as well as digitizing the FCS loop from the current antiquated analog MK200 system (largely unchanged since 1992). The solution for the below-deck equipment will retrofit to the existing AEGIS fleet with minimal interface changes and minimal impacts to existing cables and ship services (i.e., power, cooling, electrical, etc.), and equipment will comply with new construction DDG 51 shipbuilding delivery dates.

The solution will be a modular cabinet with system configurations with extensible future upgrades toward hatchable and readily upgradable electronic systems in the future. It must address mitigating supply chain issues through form-fit-function component selection and qualification. It will identify data converter cabinets, sensors, data acquisition hardware, technologies, and design. A solution will show advancements in contrast to existing devices. The solutions must be functionally equivalent to the current design and meet qualifications for shipboard equipment shock, vibration as specified in MIL-STD-810, airborne noise, and electromagnetic interference as specified in MIL-STD-461. The solution must meet testing requirements of the government in relevant environments. Define and demonstrate how to compare new solid-state data to legacy data. The design must be capable of integration with current cabinetry.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for a solid-state DCC and show it can feasibly meet the requirements of the Description. Feasibility will be demonstrated through modeling and analysis. Define and demonstrate how to compare new solid-state data to legacy data. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype of the DCC based on the results of Phase I that meets the capabilities listed in the Description. Demonstrate the prototype meets the required parameters in the Description. Testing will be accomplished by the government in a relevant environment provided by the government.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the prototype to Navy systems. The prototype will be integrated into the MK99 FCS. Assist in testing and integration. Potential commercial applications involve the conversion of wire wrap backplanes to surface mounted technologies capable of providing power and logic to Circuit Card Assemblies (CCA).

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KEYWORDS: Address mitigating supply chain; Data Converter Cabinets; Solid-state CCA; man-portable modular electronic components; hatchable; minimal interface changes

N251-045 TITLE: Water Mist Pipe Repair Kit

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

OBJECTIVE: Develop a methodology for a high integrity repair of the DDG 1000 High Pressure Water Mist Fire Fighting System while deployed underway.

DESCRIPTION: Current piping system repairs are done through building pipe sections onboard, welding, or soft patches with sealant materials. Temporary piping repairs must be reliable, effective, and quickly implemented allowing for continued operations. While one can expect there is enough good pipe wall for the mastic and patch to adhere, the challenge is knowing the integrity of the pipe wall surrounding the leak in order to have confidence in the quality of a pipe repair method in a high energy system. Even a successful hydro of such a patch doesn't guarantee that the patch won't give way when next exposed to operating pressure.

Recently, a ship could not get underway due to water mist pipe header and branch line leaks that reduced system pressure in machinery spaces. The machinery spaces were shut down and created redline impacts for getting underway due to the level of defined risk. Ships Force and support activities have utilized epoxy and soft patches, with long cure times, and limited success. Regional maintenance centers evaluated the repairs and provided guidance for acceptable operations. However, further repairs were required which led to a one-month delay in test and trials. Current piping system repairs are done through building pipe sections onboard, welding, or soft patches with sealant materials. A new repair methodology must be quickly implemented to allow for continued operations and testing. The repair method should be suitable for emergent underway repair for a variety of fluid types and system pressures with primary concern being the DDG 1000 High Pressure Water mist firefighting system.

PHASE I: Develop a concept for an improved method for underway repair of the DDG 1000 High Pressure Water Mist Firefighting System. Demonstrate the feasibility of the concept in meeting Navy needs and establish that the concept can be developed into a useful product for the Navy. Feasibility will be established via computer modeling or other means deemed appropriate. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop a prototype to be tested to demonstrate its core functionality. Test the prototype at a Land Based Test Facility to ensure its suitability to shipboard use. The results of these tests will be used to refine the prototypes into a design that will meet Navy requirements. Prepare a Phase III manufacturing and development plan to transition the CKMS to Navy use.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the repair system to Navy use. As High-Pressure Water Mist systems become more prevalent across the fleet and industry, quick high integrity repair methods will be needed. Transition the product through sole source justification and utilizing Logistics outfitting and provisioning of approved products, technical manuals, and maintenance documentation through the program offices and fleet type commanders. Major industrial systems incorporating engines, generators, and turbines will benefit from capabilities developed under this SBIR topic.

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1. "Water Mist Fights Shipboard Fires" Commander John P. Farley, U.S. Navy (Retired), and Dr. Frederick W. Williams, June 2008 Proceedings Vol. 134/6/1,264 usni.org/magazines/proceedings/2008/june/professional-notes

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KEYWORDS: Pipe Repair; Water Mist; High Pressure; Temporary Repair; Damage Control; Fire Fighting

N251-046 TITLE: Joint Track Manager Data Synchronization

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

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

OBJECTIVE: Develop an innovative software algorithm that seamlessly interacts with the Joint Track Manager (JTM) to provide a consistent and reliable transmission and reception of tactical data link (TDL) messages for real time comparison of track databases.

DESCRIPTION: The Command and Decision (CND) element of the AEGIS Weapon System (AWS) consists of multiple track management applications working in conjunction to create and maintain source and system level track data for use by the overall AEGIS Combat System (ACS). These applications include, but are not limited to, Product Line Architecture (PLA) System Track Manager/Track Server (STM/TS), System Track Processor (STP), Link Interface Function (LIF), AN/SPY-1(6) Processing Functions (SPF/SPF6), and Cooperative Engagement Function (CEF). Combat system baseline configuration dictates which source managers are contained within a specific version of the AWS. While the STM implements a TS to store all Source and System level track data, each of the other source managers utilize local, internal track stores, maintained in parallel to the TS, while receiving and processing Source and System level track data. At times, these internal track stores can become out of synch with the TS, leading to the potential for a degraded state of track management functionality, and overall situational awareness. The Navy seeks an innovative software application that performs real-time monitoring of all link message types for interoperability to interface with CND and make corrections as necessary to keep them all in synch with the TS. This capability would ensure that the most accurate and up to date track data is available to the weapon system. This leads to increased situational awareness and decision-making abilities for the warfighter. This provides the Navy with a reduction in manning and maintenance costs. Currently there are no commercial solutions available to provide the synchronization needed.

This solution shall run in the background and not constrain the flow of track data between source and system level track management applications. The application will compare, at a minimum, track numbers, track identification/classification, and Identification Friend or Foe (IFF) modes and codes, with an objective to compare and synchronize all track attributes from incoming and outgoing link messages. The solution will benefit the Navy in improving product quality to ensure all track management subsystems are in synch and provide for the highest level of situational awareness in the Command and Control (C2) Track Management domain. The speed and accuracy of the solution must exceed existing ACS performance by 10% or better.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able

to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for JTM data synchronization that meets the objectives stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy's need by any combination of analysis, modelling, and simulation. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype in Phase II.

PHASE II: Develop and deliver a prototype JTM data synchronization software application based on the results of Phase I. Demonstrate performance of the prototype in an existing Government-approved modeling and simulation environment. The demonstration will be conducted in a Government-provided facility. Analyze the accuracy of the software through assessment of the logic in mathematical algorithms developed to accurately represent a passive reporting capability approach to integrate into the Aegis Test Bed (ATB) environment. Deliver prototype software to the Navy along with complete test data, installation and operation instructions, and any auxiliary software and special hardware necessary to operate the prototype.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for government use. The prototype will be incorporated into the AEGIS baseline testing modernization process. This will consist of integration into a baseline definition, incorporation of the baselines existing and new threat capabilities, validation testing, and combat system certification.

STM/TS algorithms could provide assistance to air traffic controllers in monitoring potential collisions by increasing the accuracy and throughput of data.

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KEYWORDS: Product Line Architecture (PLA); System Track Manager/Track Server (STM/TS); System Track Processor (STP); Link Interface Function (LIF); SPY Processing Function (SPF); Cooperative Engagement Function (CEF).

N251-047 TITLE: Multi-sensor and Acoustic Contact Localization through Artificial Intelligence/Machine Learning

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

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

OBJECTIVE: Develop a technology that can localize maritime entities from passive sensor contact information using artificial intelligence or machine learning (AI/ML) algorithms.

DESCRIPTION: Modern submarines are fitted with numerous arrays with the intent of minimizing blind spots. However, the parameters associated with these disparate arrays makes it difficult to create a unified picture, particularly where entities are detected by multiple sensor arrays. Submarines and other undersea warfare systems use passive sensor information to develop track information (bearing, range, course and speed vs. time) of maritime entities. It does so by leveraging multiple separate algorithms and observations of changes in the dynamics of acoustic sensor data such as signal arrival angle at the sensor array, Doppler shift, and data from spatially separated arrays. Often the submarine will maneuver to drive changes in how the entity appears to the sensor to enable Target Motion Analysis (TMA). The sensor data feeds various algorithms that suggest the proper 4-state solution (bearing, range, course, and speed) for entity location and velocity. The quality of the solution depends on the completeness and accuracy of the data fed into the algorithms and how the submarine maneuvers.

Several of the acoustic arrays that submarines rely on are towed, with estimated shape and position used when computing entity positions.

The operator typically cycles between multiple separate solution development and evaluation tools to arrive at candidate contact track solutions. This process becomes increasingly inaccurate as the incoming information becomes more complex, as might occur with noisy, sparse, or weak contact signals or when a large number of contacts must be managed. Advances in solution accuracy have been achieved through refining the operator machine interface to support efficient operator workflow based on the current paradigm of cycling through multiple algorithm-generated displays to assess validity of multiple hypothetical track solutions.

The Navy seeks to shift to an integrated technology for simultaneously evaluating all available information for localizing maritime entities. A solution for obtaining this shift is not commercially available.

AI/ML algorithms for U.S. Navy Undersea Warfare sensors have been used to assist in detection and classification of signals within the current cyclic process. This SBIR topic seeks to migrate to AI/ML technology where detection information such as operator-promoted contact followers are used to achieve rapid and accurate localization of individual maritime entities in support of a holistic tactical contact picture. The tool developed will need to demonstrate an ability to develop contact track solutions using all promoted sensor data and associated environmental propagation information as measured by estimated 4-state solution (bearing, range, course, and speed) when compared to the true track.

In addition to producing rapid estimates of contact position and speed, the desired AI/ML technology should also be able to provide refined array shape and position estimates in real time, rather than relying on predicted shape and position using high-level parameters such as platform speed and tow cable scope. The technology architecture must be extensible to multiple arrays and array types as well as contact follower data from multiple vehicles. It must use data that is diverse and representative of real world acoustic data. The data should be representative of both hull mounted and line array configurations. It is desirable for the technology to provide a confidence value in addition to track solution estimates. The solution will provide novel visualization tools or processes that suggest track solutions, the quality of constituent data sources, and instances where operator-specified information (e.g., propagation paths) do not make sense in light of the larger sets of data considered by the AI/ML technology.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for an AI/ML TMA tool that meets the parameters of the Description and demonstrates the feasibility of the concept using unclassified data obtained or created by the awardee and that is clearly extensible to the acoustic data use case. Show feasibility through analysis, modelling, simulation, and testing. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype AI/ML TMA tool with architecture and methodology for incorporating the capability into submarine sonar contact management. Demonstrate that the prototype meets the required range of desired performance attributes given in the Description. System performance will be demonstrated through installation and prototype testing on a testbed with the lead system integrator provided by the government.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use in Anti-Submarine Warfare (ASW). Demonstrate and report on performance during laboratory testing. The prototype will be integrated into ASW combat systems for which IWS 5.0 develops updates, which include the AN/SQQ-89, AN/BQQ-10, and AN/BYG-1 systems.

The technology can be extended to any passive sensor, including non-acoustic sensors. This technology can be used in a wide range of complex systems of systems where AI/ML is used to characterize operator proficiency and just-in-time performance assistance is crucial to mission performance. The technology would be of greatest use in complex safety-critical systems where mistakes carry disproportionate risk of mission failure.

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KEYWORDS: Artificial intelligence or machine learning (AI/ML); acoustic sensor data; undersea warfare systems; data that is diverse and representative; Target Motion Analysis (TMA); Holistic Tactical Contact Picture

N251-048 TITLE: Analog to Digital Converter for Low Noise Electromagnetic Measurements

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

OBJECTIVE: Design a specialized Analog to Digital Converter (ADC) to support the data acquisition needs of extremely low-noise underwater electromagnetic (UEM) sensors, enabling measurements of lower UEM signals.

DESCRIPTION: The Navy seeks a specialized ADC technology that interfaces with low-noise Underwater Electromagnetic (UEM) sensors to achieve extremely low system noise levels. The ADC shall support specific magnetometers and electropotential sensors that are currently used by U.S. Navy measurement facilities.

UEM sensor technologies (i.e., magnetometers and underwater electropotential sensors) continue to improve at a rate that is faster than the available commercial off-the-shelf (COTS) ADC solutions. This disparity in technology growth has resulted in UEM sensors no longer driving the noise floor of the acquisition system. The COTS ADC solutions were generated from a demand in significantly different sensors and mediums. With some of the modern sensors on the market, ADCs are the limiting factor for improving total system noise levels. There is evidence from the research communities and industry, that shows ADC performance can be optimized for specific applications.
Research into the specific composition of ADC circuits is needed to acquire either magnetic field or electropotential data. This needs to be done to ensure the most optimal performance. Additionally, the form factor of existing COTS ADCs can drive the minimum size requirements of UEM measurement systems. A smaller form factor would allow for more flexibility in arrangements, locations, and quantity considerations of field-able systems.

The ADC will be evaluated against other commercially available ADCs supporting identical sensors, including the ADCs that have historically been leveraged by U.S. Navy UEM measurement systems. These criteria may include the following, but may not be limited to:

- Dynamic Range
- Resolution
- Sampling Rate (Specifically 6-10 kHz desired)
- Power Consumption
- Effective Signal to Noise Ratio (SNR)

A successful candidate will show the ability to design an ADC that is tailored to a specific measurement device while optimizing ADC performance for common ADC parameters like the ones mentioned above.

PHASE I: Design and develop a concept ADC to meet the requirements in the Description section. The Phase I Option, if exercised, will include the initial ADC design that would be leveraged to build out a prototype for testing in Phase II. Additionally, performance simulations demonstrating the expected noise levels will also be required to move forward with a Phase II award. The circuit design will need to demonstrate simulated noise levels meeting or exceeding advertised noise levels for existing COTS ADC solutions.

PHASE II: Fabricate and deliver a prototype ADC to be lab tested to demonstrate component noise performance to be compared with the simulated results from Phase I. Additionally, the prototype ADC will also be integrated with a UEM sensor in a lab setting to demonstrate system noise performance. After lab testing is completed and noise levels are demonstrated, if satisfactory with U.S. Navy expectations, the next portion of Phase II will be integrating the ADC prototype into a U.S. Navy measurement system that will be deployed at the South Florida Ocean Measurement Facility (SFOMF) in

Dania Beach, FL to demonstrate the total system noise levels in an operational environment to achieve TRL 7.

PHASE III DUAL USE APPLICATIONS: Integrate the Phase II developed ADC prototype into a standard form factor capable of back-fit to existing hardware or forward-fit current and future data acquisition system designs and architectures. Designs would likely support SFOMF systems and other facilities with deployed UEM sensors.

The ADC developed under this project could be utilized for the same type of sensors that are frequently employed for the oil and gas industry. UEM sensors are commonly utilized for oil and gas exploration and lower noise sensors would be more capable for this purpose.

The product will be initially validated in a similar method the prototype was evaluated in Phase II with lab and SFOMF testing with a deployed system. Component certification would be completed by NSWC Carderock, NAVSEA's engineering agent for underwater electromagnetic measurement systems.

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KEYWORDS: Analog to Digital Converters (ADC); Acquisition Systems; Underwater Electromagnetic Signatures; Magnetometers; Electropotential; electric field; magnetic field.

N251-049 TITLE: Emergency & Short-term Structural Repair System

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

OBJECTIVE: Develop a patching and repair system able to replace or strongly reinforce the original form and function of a damaged structure or component.

DESCRIPTION: Several past incidents (e.g., collisions, fires, drone/missile hits, and general material failure) have created hull penetrations and structural failures or scenarios where internal structural repairs are required on an immediate basis. The Navy seeks the development of a cost-effective durable patching and repair system that is convenient to store, can be easily applied to a variety of surfaces, and can be set or stiffened to the extent the patch material is able to substitute or strongly reinforce the original form and function of a damaged structure or component. The Navy seeks to develop a product that functions as a temporary repair in the event of a hull penetration or structural failure. The solution must be able to be applied while underway in a wide range of environmental conditions. The primary purpose of the repair will be to allow the ship to safely return to a destination where a more permanent repair is possible. Current commercial repair methodologies are not suitable for remediation of emergent damage while underway.

The solution should be able to be applied to a range of irregularly shaped openings and provide support for structural loads and restore the environmental integrity of the space. The repair system must stiffen to form a temporary but strong, durable, and water-tight seal. Examples of repairs include but are not limited to bracing, bonding, joining, encapsulating, plugging or patching. The repair technology will be required to be applied either indoor or outdoor and should cure regardless of temperature, humidity, and dampness. The desired product should fully cure within 1 hour. The solution must not emit toxic fumes during application and curing. Innovative joining and bonding methods are expected outcomes of this SBIR topic. The developed product should be applicable to all traditional ship steel and aluminum construction materials as well as support structures. Repair work should require minimal surface preparation such as degreasing, removal of foreign matter, or smoothing to allow for maximum contact with the patch material.

The repair material once cured should be resilient against normal pressures and in-plane ship motion/system stresses/loads. Repairs should survive wave slap green sea pressures of 4.65 Pounds Per Square Inch (psi) (normal to the deck) to 14.33 psi (normal to vertical surfaces/bulkheads), weapon blast pressures up to 20 psi, and survive a lap shear strength of the joint > 3 kilopound per square inch (ksi). In-plane structural stress levels expected are 7-9 ksi for aluminum structures and 20-30 ksi for steel. The largest damage to be addressed in this topic would be a 4’ diameter hole from a missile or drone penetration. The patch may or may not employ a system of ribbing for reinforcement to achieve the necessary strength; however, the ribbing must use the same patch material (either in flat sheets or geometric configurations) and must be able to be stiffened upon application within the same hour of set-time allotted for the primary patch. In repair applications, the repair must be resilient against tensile and torque forces.

Repair materials should meet Navy Fire, Smoke, and Toxicity (FST) standards. NAVSEA has published Design Data Sheet (DDS-78-1) to facilitate the transition of the new composite materials in U.S. Navy shipbuilding [Ref 3]. The material fire performance requirements described in this design data sheet are intended to provide consistent safety criteria for the application of composites aboard ships. These requirements have been developed based on Navy fire safety policy and international maritime standards for fire safety. Fire performance requirements for surface flammability, fire growth, smoke generation, fire gas toxicity, fire resistance, and structural integrity under fire have been established. Initial FST performance testing should include flame spread testing ASTM E162, E662, E800.

PHASE I: Develop a concept for a rapid damage repair system that meets the requirements in the Description. Demonstrate the feasibility of the operational concept with development and initial testing of the repair system. Demonstrate by Modeling and Simulation (M&S) or Finite Element Analysis (FEA) of the predicted performance of the proposed repair system to meet the requirements defined in the Description. The Phase I Option, if exercised, should include the initial layout and capabilities to demonstrate the application in Phase II.

PHASE II: Develop and deliver a prototype able to demonstrate the hardened patch material to the requisite specs, and ultimately be tested to failure. Evaluate the durability and how long the patch/repair holds. Perform a test plan as defined in Phase I to include applicable FST standards. Incrementally increase the stress loads to induce a failure point while observing and recording the failure. Prepare a Phase III development plan and cost analysis to transition the technology to Navy use.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the Emergency & Short-term Structural Repair System for use on the Large Surface Combatant Modernization and Sustainment program. Strong temporary repairs that rapidly set have a wide range of applicability in the U.S. Navy as well as the commercial marine industry. The specifications cited are generally more rigorous and designed to allow for a strong temporary repair while a ship is underway and in a range of weather conditions. Such a repair will allow the ship to safely arrive at a destination where a more permanent repair is possible. The repair system also has universal applicability for non-maritime repairs.

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KEYWORDS: Temporary Patch; Patching and Repair System; Ductile strength; Tensile strength; Emergent repair capability; Structural Patch.

N251-050 TITLE: Compact Underwater Electromagnetic Sensor with Internal Data Logging

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

OBJECTIVE: Develop an Underwater Electromagnetic (UEM) sensor package that includes magnetic and electric field sensing, and internal data logging. The sensors need to be sensitive to small field variations, stable in underwater environments, and packaged in a compact design with self-contained data logging.

DESCRIPTION: Current UEM measurement systems on the market are typically bulky and are not designed to support simple transportation methods and ad-hoc stand-alone deployments. A majority of these systems are limited to specific sensors and the electronics supporting the measurement components have not been optimized for smaller form factors. Over the last decade, sensors and electronic improvements to power consumption and form factor could enable smaller sensor packages and increased endurance.

The end product of this SBIR topic will be a stand-alone compact UEM sensor that can be easily deployed and recovered in an ocean environment that can measure magnetic and electric fields. When deployed, the UEM sensor will land and operate from the seafloor. The UEM sensor is expected to be able to be deployed and collect data for up to 7 days.

The magnetic field sensing should be capable of collecting magnetic field in all three orthogonal vector components. The electric field sensing capability should also be capable of collecting electric field in all three orthogonal vectors components. The compact UEM sensor should also consist of a pressure sensor to enable post-processing of system depth during the data collection windows.

The UEM sensor should be programmable to enable delayed operations and allow for targeted data collection windows.

The UEM sensor should be packable into a 6.75” diameter cylinder and shall not exceed 80 inches in length. Upon deployment, the system can expand as required to support data collection operations and recovery.

The awardee will be expected to fabricate 3-5 prototype compact UEM sensors to test in the lab and on land to ensure all the capabilities are integrated, power consumption is verified, and data storage is adequate for the length of deployment. Additionally, the electric field and magnetic field measurement capabilities will be tested to ensure noise levels are satisfactory.

After lab testing is completed and noise levels are demonstrated, if satisfactory with U.S. Navy expectations, the next effort will be to deploy and test the compact UEM sensor at the South Florida Ocean Measurement Facility (SFOMF) in Dania Beach, FL to demonstrate the total system performance in an operational environment to achieve TRL 7. The sensor recoverability will also be demonstrated.

PHASE I: Define and develop a concept for a compact underwater UEM sensor with internal data logging that can meet the performance and the SWaP constraints listed in the Description. Perform modeling and simulation to provide initial assessment of concept performance. The Phase I Option, if exercised, includes the initial layout and capabilities description to build the unit in Phase II.

PHASE II: Develop and deliver 3-5 prototypes based on Phase I work for demonstration and validation. Three to five prototypes should be delivered during the Phase II for lab and field testing as identified in the Description. Additional testing as identified in the Description will be performed to demonstrate the total system performance in an operational environment. Sensor recoverability will also be demonstrated.

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology to Navy use. The Navy would use these sensors as an alternative to collect UEM signature measurements of ships and submarines that don't have operational measurement arrays available. The compact design and portability allow for low-cost, feasible shipping methods that could be rapidly deployed in various locations.
The sensors could also benefit civilian uses including geologic surveys of the ocean floor, ocean wave dynamics research, and other related areas of interest. Reducing sensor and acquisition noise, optimizing sensor battery life and data storage, and other issues would decrease maintenance costs of existing systems, providing additional feasibility for a variety of applications.

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KEYWORDS: Compact Acquisition Systems; Underwater Electromagnetic Signatures; Magnetometers; Electropotential; Electric Field; Magnetic Field

N251-051 TITLE: Aegis System Track Manager/Track Server

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

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

OBJECTIVE: Develop an automated software capability that ensures mismatches between internal track management components of the AEGIS Weapon System are identified and corrected in a real-time environment.

DESCRIPTION: The Command and Decision (CND) element of the AEGIS Weapon System (AWS) consists of multiple track management applications working in conjunction to create and maintain source and system level track data for use by the overall AEGIS Combat System (ACS). Track management is the process of utilizing all available sources of track data and supporting information, including on and off-board sensors and external communications systems, to create and maintain an accurate and consistent track picture, providing reliable Command and Control (C2) capabilities to the war fighter. Track management includes the processes of managing track numbers across disjointed track databases, maintaining track attributes such as, but not limited to, kinematic state, identification, classification, and Identification Friend or Foe (IFF) modes and codes, as well as providing for track data availability throughout the combat system. These applications include, but are not limited to, Product Line Architecture (PLA) System Track Manager/Track Server (STM/TS), System Track Processor (STP), Link Interface Function (LIF), SPY Processing Function (SPF), and Cooperative Engagement Function (CEF). Combat system baseline configuration dictates which source managers are contained within a specific version of the AWS. While System Track Manager (STM) implements a Track Server (TS) to store all Source and System level track data, each of the other source managers utilize local, internal track stores, maintained in parallel to a TS, while receiving and processing Source and System level track data. At times, these internal track stores can become out of synchronization with a TS, leading to the potential for a degraded state of track management functionality, and overall situational awareness.

The Navy seeks an innovative software application that will perform real-time monitoring of all track databases within CND elements and automatically make corrections as necessary to keep them all in synchronization with the TS. This capability is not currently found anywhere else commercially and will provide for reduced hands-on maintenance of the systems, improved decision making with less researching of items, and provide smoother operation of the system.

This solution shall run in the background and not constrain the flow of track data between source and system level track management applications. The application will compare, at a minimum, track numbers, track identification/classification, and IFF modes and codes, with an objective to compare and synchronize all track attributes. The solution will benefit the Navy in improving product quality to ensure all track management subsystems are in synch and provide for the highest level of situational awareness in the Command and Control (C2) Track Management domain. The speed and accuracy of the solution must exceed existing ACS performance by 10% or better.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for an Aegis STM/TS software application that meets the objectives stated in the Description. Demonstrate the feasibility of the concept in meeting the Navy's need by any combination of analysis, modelling, and simulation. Analyze the accuracy of the software results through assessment of the logic in mathematical algorithms developed to accurately represent a passive reporting capability approach to integrate into the Aegis Test Bed (ATB) environment. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype in Phase II.

PHASE II: Develop a prototype Aegis STM/TS software application based on the results of Phase I. Demonstrate performance of the application in an existing Government-approved modeling and simulation environment in a Government-provided facility. Deliver the prototype software to the Navy along with complete test data, installation and operation instructions, and any auxiliary software and special hardware necessary to operate the prototype.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for government use. The prototype STM/TS software application will be incorporated into the AEGIS baseline testing modernization process. This will consist of integration into a baseline definition, incorporation of the baselines existing and new threat capabilities, validation testing, and combat system certification.

STM/TS algorithms could provide assistance to air traffic controllers in monitoring potential collisions by increasing the accuracy and throughput of data.

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KEYWORDS: Track identification/classification; Track Management domain; System Track Manager (STM); Track Server (TS); Product Line Architecture (PLA); synchronize all track attributes

N251-052 TITLE: Multi-Observer Multi-Spectral Passive Object Detection

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: Develop a remote sensor capability that can identify and provide a wide range of targets and objects into the existing active sensors within the battlespace using multi-spectral passive sensing capabilities.

DESCRIPTION: Currently real-time detection and targeting capabilities are limited to shipborne and controlled aircraft organic sensing equipment. The surface force can and does leverage additional capabilities from off-board and non-organic sources but often these commercial sources do not meet time critical needs.

The Navy is seeking to add passive sensor capability that can identify and provide a wide range of targets and objects into the existing decision-making process. Developing and incorporating a multi-spectrum passive detection enhancement capability, integrated and fused with current surface navy sensors, will expand the current battlespace, contribute to a robust Common Operational Picture (COP), enhance decision maker situational awareness, and allow end users to operate in contested environments. In addition to addressing time critical needs, the addition of robust multi-spectral passive sensing will operate in all environmental conditions and account for atmospheric phenomena that can clutter traditional active sensors. The passive sensors shall account for environmental factors, weather interference and debris associated with military applications.

The Navy seeks an innovative tracking software algorithm(s) that accurately and reliably provides data to be integrated into the battlespace from passive sensors. The solution shall not degrade current capability. A solution will not increase combat system processing time to achieve its primary objective. It will integrate with all elements of the Aegis Combat System (ACS). This includes track managers, weapons, and missile systems. The software will permit realistic testing of all threat types and configurations in a dynamic test environment designed for use in operational and testing environments. Track visualization will be delivered through existing ACS console Graphical User Interfaces (GUIs). It will support operator track management and decision-making. The solution will integrate with the AEGIS Test Bed (ATB) to facilitate system evaluation against more advanced and prolific threats. Integrated "in-stride" testing utilizing the ATB will facilitate a shortened certification timeline and ferret out deficiencies and software errors in the testbed, thus increasing product quality at delivery.

The solution will provide an enhanced capability to address targets in all configurations and provide optimal engagement options to the sailor. This will increase mission capability and effectiveness against the latest threats. The modeling and simulation will optimize weapon system testing; thereby reducing test costs associated with fielding new ACS baselines.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National

Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVSEA in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Develop a concept for Multi-Observer Multi-Spectral Passive Object Detection software algorithm(s) for instant and accurate reporting of objects of interest and threats. Demonstrate feasibility in meeting the requirements in the Description to support the test and operational environments. Feasibility will be established through analysis and modelling. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype in Phase II.

PHASE II: Develop and deliver a prototype Multi-Observer Multi-Spectral Passive Object Detection software algorithm based on the results of Phase I. The application will be implemented in an existing Government-approved and provided modeling and simulation environment to validate performance. It will be evaluated by Government subject matter experts for validation.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the prototype passive sensors software applications to allow for further experimentation and refinement. The prototype passive sensors software application will be incorporated into the AEGIS baseline testing modernization process. This will consist of integration into a baseline definition, incorporation of the baselines existing and new threat capabilities, validation testing, and combat system certification.

Passive sensors algorithms could aid air traffic controllers in monitoring potential collisions.

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VERSION 2

KEYWORDS: Passive Sensors; Multi-Observer; Multi-Spectral; Software Algorithm; Track Managers; Off-Board

N251-053 TITLE: Autonomous Charging and Energy Management for Large Drone Fleets

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

OBJECTIVE: Develop a common system of energy monitoring, electrical generation, charging configurations, and autonomous behaviors for a fleet of 100+ unmanned entities (Class 1 drones and other small unmanned vehicles) to maintain their own charge cycles without human intervention for up to 1 week.

DESCRIPTION: Small drones and unmanned air/surface/ground vehicles are present in increasingly large numbers at smaller units of force (company-level and below), and the appetite for more unmanned assets continues to grow. However, their utility is presently hampered by the energy management demands that are incurred by charging cycles, a problem that is only expected to worsen as more and more unmanned systems make their way into small units. With some flight durations as short as 20 minutes, but charge cycles on the order of hours, the users are often relegated to carrying and swapping large numbers of charged batteries or waiting long periods of time without any capability during charge cycles. An innovative solution for improving the operational availability of drone fleets is to utilize the self-tending nature of intelligent autonomy to manage energy requirements on their own, with all energy management tasks relegated to the entities themselves. This will free up human teammates to focus on their own priorities and reduce or eliminate the requirement to carry and swap batteries for extended coverage.
The outcome of this SBIR topic is a set of universal standards, configurations, and equipment for autonomous power management. The required elements include:

- Deployable electrical power generator complexes that fuse traditional fuel-powered sources with non-traditional and renewable sources (solar, wind, small hydro and found fuels via Stirling engine generators) to fully exploit all charging energy sources and reduce/eliminate dependence on fuel chain logistics
- Energy management software that resides in on-board processing and monitors usage, predicts time remaining, and assumes control of the entity to direct its movement to a charging source prior to battery exhaustion
- Connector configurations that allow single charge stations to support multiple customers simultaneously
- Command and Control (C2) interfaces that alert humans to charging “break-offs” and provide an opportunity for override and an option to assign standby assets

Performance Goals include using self-charging protocols to:

- Continuously maintain fleets of up to 100 entities for periods of up to 1 week
- Utilize the full range of available energy sources to provide uninterrupted charging power without sole reliance on fossil fuel generation
- Maximize deployability by minimizing size and weight of generating station components to 2-person lift and setup

Related state-of-the-art available technologies include recent advances in small Stirling cycle electrical generators that utilize “found fuels” such as sticks, trash or any burnable material to produce useful amounts of power, along with direct-conversion (heat to electricity) technology that can be scaled up for charging purposes. Also, tactical networks and advances in Command and Control (C2) systems for coordinated operation of large numbers of unmanned assets by few or one human, and vehicle-agnostic autonomous control systems. The key attribute of the generation component is a diversity of methods that reduce or eliminate the need to transport volatile fuels from a distance for the 1-week notional period of the engagement.

The focus of technology development is on:

- The selection of and integration of diverse power generating approaches into a single component that can be transported and set up by a typical United States Marine Corps (USMC) squad-sized element. Approaches can utilize either small modules with human carry or self-transport via wheels, tracks or unmanned airlift. The technical challenges are in developing a package that produces stable charging power on demand from diverse sources while maintaining low Size, Weight, and Power (SWaP).
- The capability of a single charge source to meet the diverse needs of autonomous platforms that do not share a common battery configuration. The technical challenges are in standardizing battery configurations across an array of in-use autonomous systems, or in developing controllable charging stations that can sense the charging requirements and vary their output to match.
- The development of docking stations and charge connections that allow a variety of in-use vehicles to autonomously connect, charge, and disconnect when needed
- The development of on-board or remote autonomous charge/monitoring behaviors that continuously sense state of charge, locate charge sources, predict transit requirements, and break off mission to execute charging protocols without battery exhaustion

Performance Parameters:

- Transportable by a 13-member squad-sized element for distances of 5Km, or self-transporting
- Integrated into existing autonomous vehicles and control systems (no new vehicles)
- Two or more independent generation methods in a single package
- One week of unattended operation (exception for fueling at 6-hour intervals by 1-2 people)

PHASE I: Conduct a feasibility study utilizing existing vehicles in ONR Code 34’s current fleet of unmanned assets and ONR Code 34’s sequence of virtual and real-world experimentation to explore configuration options, interfaces, communication protocols, and autonomy software to assess options specified in the Description section. Investigate all known options that meet or exceed the minimum performance parameters suggested in the Description. Address the tradeoffs and risks in accordance with the level of innovation. Prepare a report to ONR on designs, simulations, prototype production, and a Phase II testing plan.

PHASE II: Design, develop, and produce prototype generators, hands-off automatic charger connections, and software that can support the charging requirements of up to 10 users for a period of 72 hours with no human interaction other than fueling Stirling generators at 6-hour intervals. This requirement is different from the 1-week, 100 user requirement to allow phased upscaling within the Phase II and the Phase III transition, and because servicing more users for longer periods can be accomplished by using more generators and extending fueling cycles. Develop, demonstrate, and validate the Concept of Operations (CONOPs) using ONR Code 34’s Kobol sequence of virtual and real of force-on-force unscripted simulated combat operations (4x yearly at multiple Department of Defense locations in the continental U.S.).

PHASE III DUAL USE APPLICATIONS: The final (Phase III) state of the technology is a set of rugged multi-source generators with unmanned connection capability that can operate for extended periods with limited human contact to supply the electrical needs of a large drone fleet.

The dual-use capability is for any user who operates unmanned fleets of similar size, and desires to transition to unattended charging in austere environments. Examples include law enforcement, forestry services, firefighting, humanitarian assistance, and disaster relief.

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KEYWORDS: Stirling engine; Energy conversion; Automated management, Battery Management, Unmanned Power, Direct Conversion

N251-054 TITLE: Rifleman-Assisted Instructional Device (RAID)

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

OBJECTIVE: Develop a fieldable, small arms/weapon mounted device (e.g., M27, M4, M18) and associated software application that detects and provides individual and group level feedback regarding marksmanship performance during dry- and live-fire training.

DESCRIPTION: Dry-fire weapon simulators provide safe mechanisms in which service members can practice weapon handling and marksmanship fundamentals [Refs 1-2]. However, these systems are large, obtrusive, require maintenance, and support personnel to operate. A simplified, more scalable platform is needed to provide the capability to conduct weapons training in resource constrained environments or at larger scale. The development and employment of a modular and scalable weapon mounted sensor/device that can track and provide feedback about weapon handling and marksmanship fundamentals would greatly enhance training time dedicated to small arms proficiency. Anecdotal reports from Marine Corps commands indicate that using a commercial product designed for individual shooters may reduce training resources (e.g., time and ammunition) required to make Marine recruits into proficient shooters [Ref 3]. Dry-fire training is a fundamental component of the Marine Corps revamped marksmanship training programs, such as Infantry Marksmanship Training Program (IMTP), and supporting these programs will lead to a more lethal force. However, the current devices used are missing key components to support training doctrine, such as: military focused design, group level training, and after-action review at aggregate level.

The objective of this SBIR topic is to develop a device for use with Marine Corps issued small-arms (i.e., M4, M27, M18) that can capture data during dry-fire marksmanship training (and live-fire) at the individual and aggregate level. The software product should provide group reporting and accountability, create powerful data dashboards for training cadre to review, and provide immediate, comprehensive, and specific answers regarding marksmanship capability – based on the data captured by the device. The device should allow for group monitoring by an individual instructor or cadre for up to 20 shooters at the same time, where the instructor can also create specific drills, and user-defined performance parameters associated with those drills. The device and associated software should maintain historical records, provide comparisons, and add group-level features that drive competition, competency, and capability improvement.

The weapon mounted device sensor (WMDS) prototypes should be developed to be employed via picatinny attachment, modified magazine/bolt, or other novel means so as to not encumber upon normal and safe weapon handling. The prototypes should not significantly add or reduce the felt weight of the weapon, nor should they interfere with normal weapon functions, such as holstering. The WMDS should be rated to IPX7 water resistance and store at least 150 minutes of training data. The WMDS should connect wirelessly in real-time, or post-hoc in event of transmission loss, to a smartphone or tablet device, that houses the associated software, which provides the analysis, data aggregation, data display, and controls the training sessions. The software application should have a readily understandable user-interface (UI) which allows users to navigate to the training or analyses dashboards with ease and maintains a search function to find historical data.

PHASE I: Define and develop a plan for the design, development, and fabrication of a small arms weapon (i.e., M27, M4, M18) mounted device with integrated sensors, and a corresponding software application, that can capture weapon handling fundamentals and small arms dry-fire training performance. The device should be capable of transmitting data wirelessly to a tablet that contains software application that interprets real-time dry-fire and weapons handling performance at both the individual and group level. The WMDS should be ruggedized to handle regular training use in military settings and should be rated to

IPX7 water resistance. The proof-of-concept hardware device should be able to transmit data wirelessly, in real-time and store up to 150 minutes of training data when out of range of transmission. Multiple devices (n=20) should be able to connect wirelessly to a single tablet with the program's software application so that an instructor can view multiple users simultaneously. Phase I will result in a proof-of-concept for testing and refinement in Phase II. The deliverables for the Phase I are to include, but are not limited to, conceptual development of the WMDS and detailed plans for the software application to perform the data capture, aggregation, analyses, display, and storage. In addition, the Phase I will deliver a defined plan to improve any existing capabilities to support disconnected military relevant environments.

PHASE II: Focus on prototype development and refinement of at least 150 devices of the proof-of-concept small arms WMDS conceptualized in Phase I; along with a software prototype. The prototypes will be demonstrated in a military relevant environment in Phase II. Additionally, the WMDS should be capable of storing at least 150 minutes of training data onboard the device should wireless signals be interrupted or unable to be established during a training session. During normal use, the WMDS should transmit data wirelessly to a smartphone or tablet with a preloaded software application that will store the data locally on the smartphone or tablet and can also analyze and interpret the data for user and instructor feedback. The WMDS should use accelerometry or other means to determine actions taken by the user such as, but not limited to: reloading, accuracy, and trigger press. A detailed definition of the device requirements will be provided to the firm(s) selected for Phase II award. The Phase II awardee should also provide a detailed plan that will occur for testing and evaluation (to include data type, frequency, and structure).

PHASE III DUAL USE APPLICATIONS: Further refine the products developed in Phase II to include adding more automated processes for data analyses for Marine Corps end-users. Phase III will focus on integrating the finalized products into current and future training programs, such as IMTP, under USMC TECOM, as well as expand out to active-duty operational units to maintain small arms weapon handling and performance during time in the fleet. The Phase III effort should lay out a plan for longitudinal evaluation of their Phase II product in a real-world training environment. This evaluation will consist of a comparison of the performance and skill retention in Marines provided the training tool and those not. In Phase III performers shall outline the ability to mass produce, support, and service the developed wearable devices. The small business should also aim to leverage the products developed under this SBIR effort for commercialization to federal and local law-enforcement agencies, as well as the civilian market.

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KEYWORDS: Lethality, Dry-Fire, Live-Fire, Marksmanship, Human Performance, Shooting, Small-arms

VERSION 2

N251-055 TITLE: Reduced Cost Thermoplastic Composite Fabrication by Thermoforming Drapable Pre-pregs

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

OBJECTIVE: Develop and demonstrate technologies to produce high quality thermoplastic composite parts with complex geometries at a high rate using emerging materials and fabrication techniques.

DESCRIPTION: Thermoplastic parts offer unique advantages, such as room temperature storage, recyclability and lighter weight compared to both metals and thermoset composite parts. A common and relatively cost-effective way to make thermoplastic parts is thermoforming. In this process thermoplastic pre-pregs are heated until pliable and then formed over a mold under pressure and/or vacuum.
The challenge in this process is avoiding wrinkles and maintaining tight tolerances of the formed part. This limits the formability especially when large deformation over a mold with complex geometry is required. However, a new generation of drapable "dry" pre-pregs and processing techniques is available now to address these challenges. The drapable materials can closely conform to the shape of the mold. These materials conform to the mold and thus have the potential of forming complex parts. Even for parts that can be formed by traditional methods, these materials reduce the number of steps, while maintaining tighter tolerances and reducing overall time and cost for forming a part.

The available drapable pre-pregs are still limited, but new forms are actively being developed and coming to market. Examples include, KyronTEX® by Mitsubishi Materials and ET40 by Toray. These materials are cited as examples only, and this SBIR topic does not exclude any other suitable material system.
This is not a material development effort. The primary focus of this SBIR topic is to use an available material that can be used as is or with incremental changes to develop and demonstrate it by fabricating a representative aerospace part that demonstrates the capabilities of these drapable prepregs. This is not a material development effort, however, incremental changes with the support of the pre-peg manufacturer to make it more suitable for aerospace applications is acceptable.

PHASE I: Choose one or more aircraft component that has sufficient complexity and yet can be successfully formed with drapable pre-pregs. Examples include deep drawn manifolds, and aircraft rib structures. The Phase I study should include assessment of drapability and formability of the pre-preg. This should include a modeling component to predict drapability, and an experimental campaign to validate. Additionally, coupon level studies should be done to assess changes in porosity and mechanical properties during the process. Wrinkling during forming also should be evaluated. The results should be used to establish the feasibility of the prototype(s). The feasibility assessment should be complete at the end of Phase I base period.

PHASE II: Develop a forming plan for the prototype component. Develop tooling needed for the project. Develop a test plan to assess the prototype qualitatively and quantitatively. Fabricate the part. Assess part quality. Develop and perform a mechanical test campaign to assess strength and stiffness.

PHASE III DUAL USE APPLICATIONS: Support the transition to Navy use. Use of thermoplastic composites is on the increase in navy fixed wing and rotary wing airframes. This is especially true for unmanned air systems. On the civilian side the technology is very relevant to the urban air mobility market.

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KEYWORDS: Composite manufacturing; lightweight; deep drawn component; affordable airframe; aerospace composite

N251-056 TITLE: Compact Prime Power Source for Unmanned Aerial Systems

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

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

OBJECTIVE: Develop a compact, highly efficient prime power source that provides a power density exceeding currently available technologies for future Department of Defense (DoD) unmanned aerial systems (UASs) while maintaining an acceptable form factor, exhibiting reliability for extended endurance operation, providing compatibility with multiple payloads, and demonstrating suitability for potential re-use.

DESCRIPTION: Many industries and DoD systems utilize turbine-generator (turbo-generator) powertrains due to their unmatched energy density and power to weight ratios. In airborne applications, these powertrains can distribute electric power to both propulsion systems and tactical payloads. In theory, this permits ideal dynamic allocation of power to both aircraft performance (e.g., dash / climb speed) and payload functions. Platforms that support Modular Open Systems Approach (MOSA) payloads naturally benefit from increased available payload prime power. Increased platform prime power permits larger or more capable MOSA payloads and increases the platform operational flight envelope.

Turbo-generators are the identified (incumbent) solution of choice due to their high specific power, ability to use approved high energy density liquid fuel sources such as Jet Propulsion-10 (JP-10), low vibration, reduced maintenance, and overall safety when compared to other potential solutions such as lithium batteries. However, turbo-generators (or other prime power sources) meeting the stringent size, weight, performance, reliability, operational lifecycle, and environmental requirements for existing DoD UASs are already at the limits of available technology. Small turbines and generators suffer from scale effects that drive their ideal operating point to higher turbine inlet temperatures and shaft speeds greater than conventional materials and designs allow. Operating at off-ideal conditions reduces the overall thermal efficiency, mass-specific performance, and operational life of miniature turbine generator systems. Solutions that mitigate these challenges and meet overall performance objectives may require innovation in multiple technical areas including:

- Cycle design – such as recuperation or supercritical carbon dioxide
- Advanced high-performance materials (ceramics or superalloys)
- Novel manufacturing or machining techniques
- Advanced miniature high-speed bearing, lubrication, and seal systems
- 3D optimized magnetics (rotor / stator)
- Highly integrated power conversion and engine / generator control electronics
- Thermal management

While turbo-generators using JP-10 are currently the solution of choice, alternate solutions will be considered. However, the potential safety impact of alternative designs (relative to a baseline of JP-10 fueled system) will be weighed during selection. Proposers should therefore identify any required mitigation elements (e.g., storage, handling, disposal, etc.) necessary to provide a credible path to qualification and approval for shipboard use.

The main objective of this SBIR effort is to maximize power density and efficiency where power density is defined as the ratio of generated electrical power to weight. However, the source must also be operationally useful so the solution must also be capable of meeting a number of performance objectives. Principally, the proposed solution should:

1. deliver a full rated net DC power (averaged over 1.0 sec into an ideal load), at 270VDC nominal (in accordance with MIL-STD-704F), of 20 kW (threshold) to 25 kW (objective),
2. be capable of rapid start without operator intervention and be capable of ramping up output power from idle to 75% of the full rated output power within approximately 200 msec of receiving the command to do so (idle is defined as the minimum state of operation required for the power source to maintain its own function),
2b. time from cold-start to idle will also be factored in during the selection process
3. be capable of storage, start, and operation in horizontal and vertical orientation, and
4. be capable of rapidly increasing (surging) power output when commanded. For this requirement, a nominal surge rate of 2.5 kW per 50 msec, starting at 50% rated power, is desired. Note that, in meeting this requirement, the source controller may assume feedforward information regarding load surge demand. However, absent this information, the source shall maintain safe operation.

Note that acceptable solutions must also anticipate the intended application of UAS deployment. Therefore, solutions that can be realized in an axially symmetric form factor with the center of gravity located on the center axis are desired. For demonstration purposes, a cylindrical form factor of 90 mm radius should be assumed. Mating interfaces (e.g., fasteners, connectors, fittings, etc.) should not break the 90 mm radius cylindrical boundary. Within these constraints, the most power-dense solution is desired to have a mass less than 11.5 kG for fuel based systems (this weight does not include the fuel). As weight is a critical design factor, all solutions (fuel and non-fuel) will be compared by Wh/kg (fuel will be considered in this calculation). Any ballast required to meet the center of gravity requirement is included in the mass. Within the cylindrical form factor, a target volume of 0.0125 m3 is desired. However, for highly efficient solutions, this may be relaxed provided the increase in efficiency results in a comparable decrease in the volume required for energy storage/fuel. For fueled systems, the exhaust should not interfere with the intake and preferably be directed along the axis. Solutions should accommodate communications with the UAS using a standardized digital, differential (balanced), and galvanically isolated interface, preferably CAN, Ethernet, or RS-422, to provide command and control signals and receive status, diagnostic, and built-in-test information from the power source.

To simplify the design trade-space, the baseline for comparing the Specific Fuel Consumption (SFC) of each proposer will be conducted at sea level and at 50°C. As such, each proposer shall present SFC (kg/kWh) and fuel flow (ml/min) data with respect to the power setting at a voltage of 270 VDC at sea level and at 50°C. The proposer shall describe how their SFC changes with respect to temperature and altitude. The proposer shall also define their "specific power" (kW/kg), defined as their threshold power level of 20kW, at sea level at 50°C divided by the weight of their engine system, to include the weight of everything except fuel. If a proposer presents a solution which does not include fuel, their specific power solution will be compared to the fueled solutions by adding the weight of the fuel required to match the endurance of the non-fueled solution. Acceptable solutions should anticipate and address the operational environment through design, as supported with analysis, modelling and simulation, limited testing, and proven practice. The application is intended for a maritime environment with operation anticipated over a temperature range of -32° to +55° C and non-operation (storage) over a range of -40° to + 70° C. A launch acceleration of 50 G, aligned with the center axis, is expected. In addition, the solution should be designed to withstand normal shipboard shock and vibration requirements (defined in the applicable Military Standards).

The solution should be designed for reliable service over at least three mission cycles (10 objective) with a mission cycle defined as start and operation, followed by six hours of non-operation during which time, refueling, recharging, and minimal maintenance (e.g., lubrication) are acceptable. For fueled solutions, mission operational time is fuel dependent and should not be fundamentally constrained to less than four hours other than by the fuel supply. However, for demonstration purposes, the operational time is 60 minutes. In comparing fueled versus non-fueled solutions, the baseline (weight, volume, form factor) is a JP-10 fueled turbo-generator with fuel sufficient for 60 minutes of continuous operation at full rated power. Within the constraints detailed herein, power density and efficiency are the primary measures of success for this SBIR effort. Therefore, in assessing both fueled and non-fueled solutions for power density and efficiency, the total weight (power converter plus energy storage) shall be considered. Therefore, fueled solutions shall use the total weight of the turbo-generator plus fuel storage required to provide full rated power for 60 minutes as the metric for comparison. Non-fueled solutions shall use the total weight of the converter plus the energy storage system required to provide full rated power for 60 minutes as the metric for comparison.

Finally, logistical and operational realities have shown that the system might sit idle for extended periods of time in a fueled (charged) and ready state. The solution should therefore anticipate long periods of system standby and provide for a service life of at least 10 years. During periods of system standby, low-level electrical power will be provided to the prime power source to maintain system diagnostics and provide fault monitoring. However, during the service life (unless deployed for a mission), maintenance will not be performed nor will the energy storage be changed. Therefore, lubricants, seals, filters, etc., and the energy source must be chosen for long-term stability meeting the service life. For fueled solutions, the fuel must remain stable and not degrade other system components.

PHASE I: Propose a concept for a compact prime power source suitable for UAS deployment that meets the objectives stated in the Description above. Define an architecture, develop initial designs for key components, and identify critical areas requiring innovation. Demonstrate the feasibility of the concept in meeting the Navy need through analysis, modeling and simulation, and limited testing of key components or subsystems, where possible. Produce a development plan with specific tasking and milestones to support the Phase II effort. Manufacturing is anticipated to be a critical issue in realizing the power source. Identify areas of the proposed design that are likely to present manufacturing challenges. In the Phase I Option if exercised, identify and propose manufacturing processes to address key manufacturing challenges, develop test procedures, specifications, interface requirements, and a capabilities description necessary to build and demonstrate a prototype in Phase II.

PHASE II: Develop, demonstrate, and deliver a prototype prime power source based on the concept, architecture, specifications, plans, and processes resulting from Phase I. Demonstrate performance through stationary (fixtured) testing at the proposer's facility or at a facility of their choosing (flight testing is not required). Collect, organize, and summarize test results and deliver to the Naval Research Laboratory. For demonstration purposes, the prime power source shall be oriented so that the longest axis is vertical. For fueled solutions, the fuel tank may be located separately from the power source, provided performance is not affected. Develop an initial technical data package including key drawings, schematics, assembly drawings, and process documents for key components and especially those components identified as requiring innovative manufacturing techniques. Develop a cost estimate for the power source in production quantities (use 100 and 400 units as a baseline). Upon completion of the effort deliver the prototype to the Naval Research Laboratory.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Government use. Assist in integrating the power source into specific Navy systems and support environmental testing and qualification. Modify electrical, control, and mechanical interfaces to meet individual system configurations and produce application-specific source control drawings. Create production-ready technical data packages. Assist the Navy in development of operation and maintenance documentation, safety procedures, performance predictions, and training materials. Identify and propose manufacturing cost reduction initiatives and long-term product improvement programs.

The prime power source developed under this effort is expected to have multiple future applications in the area of military UASs. It potentially has land-based applications including serving as the power source for remotely deployed repeater stations and weather monitoring stations. As commercial use of medium size drones expands, innovative elements of the power source (especially components benefiting from affordable manufacturing technologies) will find their way into the commercial market.

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KEYWORDS: Turbine-Generator; Turbo-Generator; Power Source; Power Conversion; Unmanned Aerial Systems; Novel Manufacturing

VERSION 2

N251-057 TITLE: Dispersive Optics for Vacuum Ultraviolet Applications

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

OBJECTIVE: Develop innovative methods to fabricate and replicate high quality dispersive optical components specifically geared for applications at ultraviolet (UV) and vacuum ultraviolet (VUV) wavelengths, for use within sensors in space on microsats and smallsats.

DESCRIPTION: The Navy is interested in the development of methods to fabricate and replicate cost-effective concave gratings and other dispersive optical elements needed to meet the demands of compact, proliferated optical systems designed for operation in space. Such elements are expected to be critical components of the next generation of small satellites to study the upper atmosphere, ionosphere, aurora, Sun, and solar-terrestrial space environment. Availability of customizable, high-quality optics of different optical figures, shapes, and dispersive properties will allow for future mission growth. The Navy is seeking to foster the development of affordable optical components and systems that could have broad application to space sensors and systems. Current UV and VUV grating technology involves substrates with machined or holographically ruled grooves, usually customized for single-use applications, with trade-offs on efficiency, scattered light, and often at high cost. For VUV applications, the product is typically coated to provide improved efficiencies, but with materials that are reactive to atomic and molecular oxygen, hydrocarbons, and other contaminants in the spaceflight environment. Advances in standard technology and innovative concepts and methods are sought to provide small-scale optics (target dimensions on the order of 5-10 cm) that have the potential to improve the cost, speed-of-manufacture and replication, customization, and applicability across the UV and VUV spectrum, while meeting or exceeding the optical performance, ruggedness, mass, and material properties necessary to meet the evolving demands of these new classes of space-based remote sensing instruments.

Dispersive elements applicable to both the UV and VUV (30-300 nm) are reflective due to the lack of refractive and transmissive materials at the shorter wavelengths. Total grating on-blaze efficiencies are typically on the order of 30% (near-normal incidence angle), but solutions including improvements in the combined blaze efficiency and coating reflectivity to achieve a higher overall efficiency will be taken into account. Low scattered light is a primary concern for space-environment applications where bright out-of-field and out-of-spectrum scattered light can obscure dimmer atmospheric emissions being observed. Spectral resolutions ranging from 0.1 to 2.0 nanometers, and/or groove spacing capabilities from 500-4000 l/mm, are desirable targets, with tolerances on the order of 20 l/mm. Precisely formed shapes ranging from flat to concave with radii of curvature as small as 10 cm are desired, including both spherical and toroidal surfaces. Additional consideration will be given to concepts that address grating-standard qualities including groove homogeneity, surface roughness, figure precision, or other corresponding performance factors.

Additional factors related to spaceflight compatibility are hardiness to contaminants, a coefficient of thermal expansion (CTE) compatible with typical spacecraft materials, low outgassing, survival at temperatures of -50° – +60°C, and the ability to survive a NASA GEVS3 vibration specification and thermal test environment, all typical of the requirements imposed for flight on small spacecraft. Technologies proposed should not contain hazardous or high outgassing materials and should be capable of being integrated into typical optical systems. It is desired that they be moderately electrically and thermally conductive to avoid developing static charge and thermal gradients in space. They should be durable and able to withstand normal optical component handling procedures. They should be delivered in an optically clean state and be robust enough to withstand precision cleaning and vacuum baking as part of normal spacecraft processing.

PHASE I: Demonstrate and document the feasibility of a dispersive optics concept and/or methodology for meeting Navy needs for compact satellite optical systems in the UV/VUV. Demonstrate the new methodologies for proof-of-concept and technical feasibility. Provide a demonstration by test or analysis that clearly identifies the possible gains of the concept made by advancing innovative methodologies, improving performance, and/or reducing cost and timeline for customized fabrication and replication from concept to delivery. Address performance capabilities, advantages, and limitations at all wavelengths in the spectrum from 30-300 nm as related to the optical performance metrics as presented in the Description in the Phase I report. Optical test reports and samples may also be provided for evaluation.

PHASE II: Develop a minimum of two prototype units of 10 mm size class, with different design parameters, for evaluation. The prototype designs should provide areas no less than 4 cm by 4 cm (objective) but not to exceed 10 mm in any dimension. Work with the Navy to define the complete set of details of the prototype based on the technology and methodology being developed. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II Statement of Work (SoW) and the Navy need. Perform detailed environmental, shock, and vibration analysis to ensure materials are rugged and appropriate for Navy application. An optical performance report will be included to document the relevant physical and performance aspects of the samples provided. Deliver the prototypes to the Navy for evaluation.

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II to build two lines of flight-demonstration units, suitably configured for a smallsat application, including flight spares, and characterize its performance in the UV/VUV as defined by Navy requirements. Working with the Navy and applicable Industry partners, demonstrate application to a Navy Space Test program (STP) flight test. Support the Navy for test and validation to certify and qualify the system for Navy use. Explore the potential to market and transition this capability to other military and commercial systems (NASA, University, Optics Industry). Commercial industries that may be able to use the developed technology include telecommunications and laser optics industries, and developers of systems designed for inspecting materials and medicines. Advances in EUV lithography for manufacturing integrated circuits may also provide a burgeoning opportunity for applying the developed technology. Market research and analysis shall identify the most promising technology areas and the awardee shall develop manufacturing plans to facilitate a smooth transition to the Navy.

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KEYWORDS: Spectroscopy; gratings; ultraviolet; vacuum ultraviolet; optics fabrication; remote sensing; optical imaging; spaceflight

N251-058 TITLE: Kinetic Projectile Ammunition Design & Demonstration for 50-foot Standoff with Service Weapons or EOD Disrupters

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

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

OBJECTIVE: Design, develop, build, and demonstrate a ballistically stable projectile/cartridge that can be used with the current service issue ammunition and rifles and/or the Explosive Ordnance Disposal (EOD) 12-gauge disrupter [Ref 1]. The desired target effect is to cause an explosive reaction of the munition. The explosive fill must be fully consumed with a high order reaction preferred. The proposed solution shall be effective for targets at a minimum of 50 feet of standoff. The accuracy shall be one minute of angle (MOA) with a circular error of probability of 50% at one inch. The proposed projectile/cartridge must meet the performance specifications of the service weapon or disrupter. Service issue ammunition for consideration includes: 1) 5.56x45; 2) 7.62x51; 3) .300 NM; 4).338NM and 5) 6.8x51 common cartridge. Targets shall include Blu-97, M118, Blu26, M38, Area Denial Munitions such as Volcano, PTAB family, artillery projectiles such as 155/105mm and Mk 80 series bombs.

DESCRIPTION: EOD operators currently use disrupters of all types (including service weapons) to address explosive hazards and mitigate threats. These threats can include Unexploded Ordnance (UXO) and/or Improvised Explosive Devices (IEDs). According to JP-3-42, Joint Explosive Ordnance Disposal, render safe procedures are the part of the EOD procedures involving the application of special EOD methods and tools to provide for the interruption of functions or separation of essential components of UXO to prevent an unacceptable detonation or intentionally cause a detonation [Ref 2]. As a defensive force, EOD must understand the reliability to detonate and NOT detonate explosive hazards with a high confidence level.

The objective of this effort is to design, develop, build, and demonstrate a ballistically stable projectile that can be used to meet the stated objective. Any service weapon cartridge must meet Sporting Arms and Ammunition Manufacturers Institute (SAAMI) specifications for the relevant caliber [Ref 2].

PHASE I: Develop kinetic projectile/cartridge designs with ballistic models/calculations. This will be in the forms of a PowerPoint presentation and design report. The report shall include the Computer Aided Design (CAD) file for analysis and data to verify that it can perform within the service weapon/disrupter specifications.

Build a statistically relevant number of projectile(s)/cartridges for testing to SAAMI specifications (service weapon solutions only). Test and demonstrate the projectiles/cartridges to assess ballistic performance, accuracy, and precision. Produce a test report with the round configuration, results from the firings, conclusions, and recommendations for Phase II maturation. Deliver 40 projectiles/cartridges to the government for testing.

PHASE II: Characterize the projectile/cartridge interior and exterior ballistics, specifically muzzle velocity, velocity at distance, and flight characteristics.

Characterize the barrier limit thickness with mild steel (1018/A36 steel).
Build an additional 100 projectiles/cartridges for testing against live targets at a government test facility.
Refine the design of the proposed capability based on performance and lessons learned.
Repeat the characterize, build and test steps above with an additional 100 projectiles/cartridges.
Test and validate the projectile capability performance with a statistically supported demonstration.
Document the proposed final design via a CAD file and technical data package.
Provide a final test report with all test results, analysis and recommendations.
Provide 100 projectile/cartridges for the final design to the government.

PHASE III DUAL USE APPLICATIONS: Support transition of the technology for Navy use.
The projectile developed from this effort could be commercialized for industry to provide to the EOD acquisition community in response to EOD requirements. The dual-use aspect of this capability is that it could be supplied to state and local bomb squads.

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KEYWORDS: Explosive Ordnance Disposal; EOD; kinetic; projectile; disrupter; ammunition

N251-059 TITLE: Low Cost, Rugged Laser Eye Protection for Sailors, Marines, Soldiers, and Ground Support

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

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

OBJECTIVE: Develop and deliver innovative, low cost, rugged, scratch resistant, lightweight, dismounted soldier-wearable Personal Protective Equipment (PPE) in the form of interchangeable flexible lenses that can be inserted into currently existing and used U.S. Marine Corps (USMC) ballistic protection eyewear or eyeglass frames that will greatly reduce the hazards from adversarial threats or unintentional friendly high energy laser (HEL) on the battlefield.

DESCRIPTION: High energy lasers (HELs) have been and are being deployed on the current battlefield, and these threats are only forecast to increase in power and spectral diversity in the future. HELs use in both conventional and non-conventional warfare means that the risks to the human eye are increasing and include their potential use on the battlefield by allied and friendly forces. The threat of optical damage within the eye, from intentional or inadvertent illuminations, can result from lower powers and spectral frequencies that are significantly different than those that can be physically seen with the eye (e.g., infrared (IR) or ultraviolet (UV)) or felt (e.g., thermally sensed on skin). Current laser eye protection (LASPRO) systems are expensive, prone to damage (scratched easily), and not compatible with currently issued ballistic protection eyewear. These issues drive this SBIR topic for innovation in new LASPRO PPE for USMC ground troops and front-line soldiers. The sought solution to the problem of lack of easy to obtain LASPRO does not have to provide complete protection against all HEL types with one single lens, but instead the development of an easy to swap out series of multiple, inexpensive lenses that can be used to provide spectrally-specific protection over a known portion of the entire electromagnetic or light spectrum. For example, if a soldier can have a group of four or five lenses that provide sufficient protection from a majority of potential threats and hazards, this would enable mission completion with lower potentials for injury or fratricide. More specifically, if a lens could be clipped into an existing ballistic eye protection frame offering near infrared (NIR) wavelength protections such as that used with neodymium-doped yttrium aluminum garnet (Nd:YAG) lasers based on other warnings or tactical protocols, permanent eye damage may be completely avoided. However, such PPE developed for industrial users of HELs are far too fragile, costly, and difficult to wear when using military hardware. The PPE LASPRO proposals should focus on researching and evolving a rugged, soldier wearable "clip in" product that is low cost (objective of under $50/lens in production quantities of 10,000 or more) while offering protective optical densities (OD) of 6 or more. Further, since HEL sources can have irradiances greater than 10 W/cm2 or powers greater than 500 W, innovative techniques may be necessary to shield from damage while allowing standard military operations to continue. Where possible, Photopic Luminous Transmittance (PLT) should be maintained for the visible light spectrum (400-750nm), even though some lasers encountered may use visible light sources (e.g., blue, green, or red color spectrums) and have eye damaging level of illumination. In these cases, transmittance in a specific pre-determined band (e.g., green, 500-560nm) should be reduced to below nominal ocular hazard damage levels when the appropriate lens is used. While some degradation may be acceptable for some operations, others may find it unacceptable to limit the spectrum completely through complete reflection, absorption, or scatter. In those cases, the amount of optical density for wavelengths may require special tailoring to meet mission based on those needs and may have higher cost acceptance. And while some technologies like photochromatic change may be useful, the cost and reaction time required to achieve the desired levels of protection (or speed of change in optical density) may be seen as unacceptable. Ultimately, the LASPRO PPE must demonstrably reduce the potential for burn injury/retinal/eye damage. Proposers should also note that HEL LASPRO PPE that spectrally reflects laser light versus scattered reflections or defused reflections could also result in eye injuries of unprotected bystanders. The HEL LASPRO PPE must be unpowered, durable, wearable, flexible, temperature insensitive (-40°F to +140°F) and able to be carried by an individual soldier in a small case or protective cloth drawstring bag which is easily put on or attached to a jacket, vest, or pants pocket.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Research and develop innovative approaches to personal HEL LASPRO. Deliver technical reports detailing scientific and programmatic progress and potential options for configurations and lens development. At minimum, provide a technical report detailing the proposed materiel solution with expected (from accepted modeling and simulation methods) or laboratory testing to collect protection data and levels in terms of spectral OD capability from laser direct illumination, expected cost, and ability to be ruggedized. Address manufacture readiness levels (MRL), wearability, flexibility, weight, and size. Ensure that the approaches' ability to preserve visual performance, visual acuity, contrast sensitivity, and color perception while increasing readiness of soldier or ground troops when in the use of a laser (friendly or threat) is supportable by verifiable, documented technical data collected, sound reasoning, and substantial evidence. Any modeling and simulation shall use commonly available software tools and also shall be shared with military services and government agencies for peer review. If possible, an initial functional prototype should have completed within the laboratory. (Note: No direct or indirect human or animal testing shall be permitted or conducted in Phase I. All preparation for initial Institutional Review Board (IRB) shall be prepared in Phase I for entrance into Phase II.)

PHASE II: Develop a prototype lens for laboratory testing. The R&D is a baseline for a system or series of easily available, functional, future HEL LASPRO PPE clip in lenses for Marines, Sailors, and ground crews offering effective battlefield eye shielding shall be established and advanced for laboratory testing. The end-state is the ability to provide soldiers individual LASPRO at a cost and availability that supports mission activities in otherwise restrictive or adversarial conditions. An Institutional Review Board (IRB) shall be required in Phase II at the end of laboratory testing. Human factor and human subject testing are critical in follow-on Phases of this topic and ultimately support the warfighter, Navy and Marine Corps training and operational capability, and ensure the competency of the Navy medical department- includes the development of personal protective equipment such as body armor, hearing protection, helmets and of course, eyewear. Please carefully review the requirements of approval for proposals that include testing of human subject and compliance with Institutional Review Board (IRB): https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections

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

PHASE III DUAL USE APPLICATIONS: Support transition of the product to a Program of Record through a USMC MCSC, Navy, Army, USAF, or OSD level Product Manager. The baseline is for HEL LASPRO PPE for Soldiers on the battlefield or where tactics are being practiced with emerging high energy laser sources. The end-state is the ability for Soldiers to have extra time if and when irradiated, to complete a mission, or to evade or engage any threats. Additional tasks in follow on testing, evaluations, refinement and modification to improve user acceptance, provide wider spectrum protections, enhance usability or performance are possible.

Additionally, a commercial need for such low cost, rugged LASPRO exists and would help in driving down fabrication costs as the market grows. Potential markets include industrial users of lasers or other intense sources of heat and radiant energy in the field.

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8. OPNAV INSTRUCTION 5100.27C 2 /MARINE CORPS ORDER 5104.1D, Navy and Marine Corps Laser Hazards Control Program

KEYWORDS: Directed Energy Weapons, Lasers, High Energy Lasers, HEL, Eye Protection, LASPRO, Eyewear, Optical Materials, Personal Protection Equipment, PPE

N251-060 TITLE: Automated, Fast Computational Fluid Dynamics (CFD) Solver Technologies for Hypersonics

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

OBJECTIVE: Develop automated and fast computational fluid dynamics (CFD) solver technologies for accurately predicting laminar hypersonic base flows in thermo-chemical non-equilibrium, significantly reducing the dependency on user expertise and computational costs during the early design phases of hypersonic vehicles.

DESCRIPTION: Boundary layer transition (BLT) is critically important for the design and performance of hypersonic weapons. The transition from laminar to turbulent flow significantly impacts the heating rates experienced by the vehicle. Laminar flow heating rates are 4 to 7 times lower than those in fully turbulent flow, which reduces the requirements for Thermal Protection Systems (TPS) and insulation [Ref 1]. Additionally, BLT affects the aerodynamic performance of slender high lift-to-drag (L/D) ratio vehicles, where a significant increase in drag due to turbulent flow can lead to a reduced range. Therefore, assessing BLT early in the design phase is essential to optimize vehicle performance and ensure the effectiveness of hypersonic weapons.

Significant progress has been made in the computation of hypersonic boundary layer instabilities, which are crucial for predicting BLT. Advanced methods such as quiet and forced Direct Numerical Simulation (DNS) [Ref 2] and Planar Parabolized Stability Equations (PSE) [Ref 3] have enhanced our understanding and compute flow instabilities. Input-Output analysis [Ref 4], One-Way Navier-Stokes [Ref 5], and Adaptive Mesh Refinement Wavepacket Tracking (AMR-WPT) [Ref 6] techniques further contribute to accurate predictions. Examples like instability computations on the fin-cone [Ref 7], BOLT [Ref 8] and HyTRV [Ref 9] illustrate these advancements.

Accurate prediction of the BLT process requires a high-quality laminar base flow, which depends on user-generated computational grids and chosen numerical schemes. A key challenge for obtaining a high-quality laminar base flow at high Mach numbers is maintaining low noise levels to avoid premature transition and using steady-state marching techniques to avoid disturbance amplification. Obtaining base flows at Mach numbers high enough to produce thermal and chemical non-equilibrium also provides significant challenges.

Incorporating realistic features into hypersonic boundary layer stability analysis remains challenging. Simulations are complicated by factors such as thermo-chemical nonequilibrium, ablation, steps and gaps, surface roughness, realistic wall temperature distribution with spatiotemporal variations, and surface deformations or Outer Mold Line (OML) morphing. These elements are critical for accurate modeling but increase the complexity and computational cost.

Performing reliable and fast stability analysis on complex geometries presents several challenges: Generating high-quality grids for these simulations requires significant time. Achieving convergence can be problematic. Robustness of the methods is often an issue. The overall cost of obtaining accurate solutions is high. These challenges hinder the timely and efficient design of hypersonic systems. Emerging approaches show promise in improving solution time and robustness for hypersonic simulations. High-order, low-dissipation numerical methods can enhance accuracy while reducing computational costs. Adaptive Mesh Refinement (AMR) focuses computational resources on critical areas, improving efficiency. Implicit shock tracking techniques can handle complex shock interactions more effectively. Additionally, leveraging efficient computing architectures such as graphics processing units (GPUs) can significantly reduce computation time, making high-fidelity simulations more practical for hypersonic vehicle design.

Integrating data-driven methods like Artificial Intelligence (AI), Machine Learning (ML), and neural networks can significantly enhance stability analysis and system optimization. However, the training costs for these models are prohibitive. Developing automated fast CFD solvers can enable the rapid training of ML models for reduced-order modeling. This integration can facilitate BLT analyses earlier in the design cycle within a Multi-Disciplinary Analysis and Optimization (MDAO) framework, enhancing the overall efficiency and effectiveness of hypersonic weapon development. Automating grid-generation and solver parameter selection is crucial to reducing the sensitivity of predictions to user expertise and shortening design cycles, while ensuring the tools can run efficiently on both existing and emerging high-performance computing architectures (Central Processing Unit [CPU]/GPU).

This SBIR topic aims to implement fully automated fast CFD solvers. The target requirements are:

- Order of Magnitude Improvement: Achieve at least 10X improvement in solver efficiency and time to solution on heterogeneous computing platforms, ensuring platform-independent performance gains.
- Complex Configuration Simulation: Ability to simulate realistic, complex hypersonic vehicle configurations along a flight trajectory, including the effects of surface roughness, thermo-chemical nonequilibrium, steps, gaps, wall temperature distribution, and other relevant physical phenomena.
- Automated Integration: Provide automated solver interface BLT prediction tools and MDAO frameworks.
- Pre- and Post-Processing Automation: Automate pre-processing (solver parameters setup and grid generation) and post-processing tasks to minimize user intervention and expertise requirements.

The objective is to achieve operational readiness and integration into existing design and analysis workflows.

Preference will be given to approaches that do not require large HPC systems and can run on affordable GPU hardware.

PHASE I: Develop a prototype CFD solver for automated grid-generation and grid-adaptation for hypersonic laminar flows. Demonstrate this approach on canonical problems, including both sharp and blunt leading edges, using existing experimental data. Showcase the accuracy and computational cost of the proposed automated method for a 3D problem. Highlight a path forward for platform-independent computation on existing and emerging high-performance computing architectures (CPU/GPU).

PHASE II: Implement a fully integrated automated simulation approach for computing hypersonic base flows for transition prediction. Key requirements include the ability to automatically track shocks, employ low-dissipation numerics, adaptively mesh to track relevant flow features, and include reacting flow and ablation capabilities. Ensure efficient utilization of computational resources on both existing and emerging high-performance computing architectures. The solver should compute hypersonic flow fields with minimal user interaction and be operable by non-expert users through an effective user interface. Demonstrate the solver technology on realistic, non-canonical hypersonic flow scenarios, including non-equilibrium effects, steps and gaps and efficient ablation simulation. Preference will be given to approaches that do not require large HPC systems and can run on affordable GPU hardware.

PHASE III DUAL USE APPLICATIONS: Transition the developed solver technology to practical applications within the Department of Defense (DoD) and commercial sectors. Perform extensive validation and optimization of the solver for a broad range of hypersonic vehicle configurations and flight conditions. Achieve operational readiness and integration into existing design and analysis workflows. Collaborate with industry partners and DoD agencies to ensure the solver meets the required standards for deployment. Additionally, develop comprehensive training programs and documentation to facilitate widespread adoption and use by non-expert users.

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KEYWORDS: Hypersonic Flows, Boundary Layer Transition (BLT), Computational Fluid Dynamics, CFD Solver, Thermo-Chemical Nonequilibrium, Automated Grid Generation, Adaptive Mesh Refinement (AMR), High-Performance Computing (HPC), Laminar Base Flows, Ablation, Multi-Disciplinary Analysis and Optimization (MDAO)

N251-061 TITLE: Carbon Dioxide Modular Refrigeration System

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

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

OBJECTIVE: Develop a non-hydrofluorocarbon (HFC), shipboard modular refrigeration system (MRS) using carbon dioxide (CO_2/R-744) as the refrigerant.

DESCRIPTION: Shipboard refrigeration systems are used to store perishable foods and operate at temperatures between 41°F (5°C) and 33°F (-0.6°C) for chilled food storerooms and 0°F (-17.8°C) and -4°F (-20°C) for freeze food storerooms. The Navy currently relies on R-404A and R-407A for its MRSs sized for 0.75 and 1.5 tons-refrigeration (rTons) at freeze conditions. Each MRS consists of a modular refrigeration unit (MRU) located in the refrigerated storeroom (hung from the ceiling), a control panel with programmable logic controller (PLC), and a condenser located external to the refrigerated storeroom cooled with 44°F (6.7°C) chilled water. Each MRU contains a compact scroll compressor, refrigerant suction accumulator (receiver), motorized impeller to circulate air from the space through dual evaporators configured in a horizontal vee, controlled by two thermal expansion valves, a pressure regulating valve, and a solenoid valve to allow either chill or freeze operation. Each refrigerated storeroom contains at least two MRSs with integrated electrical defrost cycles (one installed as a spare) . Production and import of hydrofluorocarbons (HFC) are now being phased down in a step wise fashion due to their high global warming potentials (GWP), as mandated by the Kigali Amendment to the Montreal Protocol and the American Innovation and Manufacturing (AIM) Act of 2020 culminating in an 85% phase-down by 2036.

R-744/CO_2 has reemerged as a credible very low GWP (GWP = 1) natural refrigerant, particularly for refrigeration systems that have condensers cooled by chilled water. But the use of CO_2 is a far greater technical challenge than fluorinated refrigerants requiring additional engineering expertise to incorporate additional components of greater complexity with more complex controls. The toxicity and pressure safety aspects of CO_2 are far more complex than fluorinated refrigerants. A R-744 MRS would need to be designed for transcritical operation to account for shutdown conditions, as well as transients that are inherent to a Naval combatant. Transcritical compressors are commercially available, but they are typically reciprocating designs, about three-times larger/heavier than scroll compressors. Developmental prototypes are necessary to fully understand the benefits and issues required for a CO_2-MRS to be successful shipboard. The objective of this SBIR topic is to explore potential opportunities surrounding a non-HFC, shipboard transcritical carbon dioxide (CO_2/R-744) MRS.

PHASE I: Design a compact 0.75 rTons MRS. Verify feasibility using modeling and/or component demonstration. Perform rough size, weight, electrical power, reliability, operating charge, and manufacturing cost analysis. Develop a Phase II plan.

PHASE II: Demonstrate a working prototype of the system and test in a laboratory environment. Validate analytic models developed in Phase I and scale design to a 1.5 rTon application. Complete a cost analysis of concepts established to ensure the selected technology is competitive with current approaches.

PHASE III DUAL USE APPLICATIONS: Optimize the concept design for manufacturability, performance and military requirements using the knowledge gained during Phases I and II. Develop the next generation of MRS that meets unique military requirements, such as shock and vibration. Explore similar commercial applications such as retail and supermarket refrigeration systems.

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3. "ASHRAE Standard 15, Safety Standard for Refrigeration Systems and ANSI/ ASHRAE Standard 34-2022, Designation and Safety Classification of Refrigerants.

KEYWORDS: refrigeration; carbon dioxide; low global warming potential; vapor compression

N251-062 TITLE: Asymmetric Large Language Model Aided Cyber Effects (ALL ACES)

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

OBJECTIVE: Develop a comprehensive Cyber/Electromagnetic Spectrum Operations (EMSO) platform to support timely effects-based targeting, mission planning, as well as access and employment by utilizing Artificial Intelligence/Machine Learning (AI/ML) for "Human-AI Partnered" automated technical workflows to improve efficiency, capability, breadth and deployment of effects, and decision support.

DESCRIPTION: The latest evolution in Generative AI/Large-Language Model (LLM) technology presents a strategic opportunity to address challenges in cost, processing-latency, and talent shortages in Offensive Cyber Operations (OCO) and/or Defensive Cyber Operations (DCO). Solutions should demonstrate secure, efficient processing of real-time Cyber Threat Intelligence to inform agile (e.g., same-day) response to new threats, vulnerabilities, and exploits, thereby speeding and simplifying cyber risk mitigation through aligned security operations and threat-specific response.

Technology areas of interest are below. Proposals should focus on or incorporate one or more of the following areas technology areas of interest. Please indicate the technology areas of interest within the Abstract section of the Cover Sheet, Volume 1.

1. Artificial Intelligence: This area encompasses the integration of computing solutions to use learning and intelligence to take actions that maximize their chances of achieving defined goals. This includes the use of LLMs to understand and provide reactive capabilities for mission-defined tasking and workflow automation. The AI component would perform the heavy lifting that operators can fine-tune to quickly yield the best and most desired results.
2. Cyberinfrastructure and Advanced Computing: This area focuses on ensuring solutions push the boundaries of current hardware and software technologies to ensure efficient and scalable solutions while still focusing on security. Focusing on a wholistic approach to solutions ensures effectiveness and increases the reach for operational use.
3. Cybersecurity: This area explores the use of both offensive and defensive cyber strategies for exploitation utilization and vulnerability mitigation. The offensive side would seek to collect existing and novel mission-specific exploitation solutions and facilitate delivery when necessary. The defensive side would gather information from various up-to-date sources and guard against the latest cyber vulnerabilities. Both pieces would use the same collage of vulnerability knowledge for performing their respective tasks.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

PHASE I: Provide architecture definition, AI Model selection, and concept refinement to support OCO and DCO operations. In addition, prototyping should be used as for validation for technology selection. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Create a demonstrable system prototype for evaluation by USN/USMC personnel to support OCO and DCO operations. Ensure the prototype's capability for showing ingestion of specified data and ability to interface with it with a chat-style interface in natural language, as well as demonstration of automated analysis of the ingested threat intelligence, overlaid on the real or simulated environment for relevance and actionability. The technology should reach TRL 6 at the conclusion of this phase. Successful completion of Phase II is expected to result in Phase III funding.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support transition for Navy use. Further develop and productize the prototype(s) for the intended mission in an operational environment and then test to ensure requirements are satisfied. The prototypes shall be TRL 7 at the conclusion of testing. The concept also will allow potential product opportunities in the Information Security vendor market. The Information Security vertical has a systemic and historical need for skilled practitioners. The technology developed by this SBIR opens an opportunity for product development in this vertical that helps create more productive Information Security practitioners faster. This productivity increase has the potential to reduce the skills gap that currently exists.

REFERENCES:
1. "DoD Digital Modernization Strategy - DoD Information Resource Management Strategic Plan Fy19-23. Goal 3: Evolve Cybersecurity for an Agile and Resilient Defense Posture." https://media.defense.gov/2019/Jul/12/2002156622/-1/-1/1/DOD-DIGITAL-MODERNIZATION-STRATEGY-2019.PDF
2. U.S. Department of Defense. "Summary 2023 Cyber Strategy of the Department of Defense." https://media.defense.gov/2023/Sep/12/2003299076/-1/-1/1/2023_DOD_Cyber_Strategy_Summary.PDF
3. "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

KEYWORDS: Artificial Intelligence, AI, Machine Learning, ML, Offensive Cyber Operations, OCO, Defensive Cyber Operations, DCO, Large Language Models, LLM, Electromagnetic Spectrum Operations, EMSO

N251-063 TITLE: Aerial Refueling Latch Indicator

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

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

OBJECTIVE: Develop a prototype sensing system that can positively identify when a refueling drogue is securely latched onto the refueling probe.

DESCRIPTION: The U.S. Navy (USN) uses the probe and drogue style of aerial refueling. This involves a receiver aircraft maneuvering its probe tip into the coupling portion of a refueling drogue that flies on the end of a refueling hose. Once in the coupling, the probe is pushed into the coupling until a latch occurs. This latching provides a retaining force holding the drogue onto the probe, keeping the fuel valve open, and allowing fuel to flow to the receiver. Maintaining a positive latch is critical to ensuring fuel flow and preventing fuel spillage. Currently, with manned aviation, the receiver pilot visually confirms the drogue stays latched onto the probe by looking for excess movement, positive fuel flow, and no leakage. As unmanned receivers come into the fleet, a visual indication will not be enough to confirm latch. Sometimes, a soft contact occurs where the drogue is in the right position (visually looks OK), but is not fully seated, that results in fuel leakage, or a drogue coming unseated. This would present a safety risk to the unmanned receiver.

A device must be developed that can be used as a sensor to provide input to an unmanned receiver to confirm positive latch, or to alert when the nozzle becomes unseated. This device by design will have to be very low power, and have a very small form factor, to fit inside either the probe nozzle, or the refueling coupling/drogue. It will need to be powered by either existing aircraft power on the receiver, or by on board power generation on the refueling drogue/coupling. No power can be run down the hose. It must be extremely damage tolerant as the refueling mission involves the collision of the refueling probe with the drogue at up to 15 ft/s. It must have some means of providing the indication to the receiver aircraft.

The probe nozzle used by the Navy conforms to MIL-N-25161 [Ref 1]. MIL-PRF-81975 is the specification for the MA-3 coupling that the refueling nozzle mates with [Ref 2]. MS-24356 gives the basic nozzle dimensions [Ref 4].

PHASE I: Develop and refine initial design concepts that converge on a final prototype design. Assemble system requirements and complete a preliminary prototype design to the extent that the USN can determine technical feasibility. Implement the design in a CAD software of choice. It is expected that some level of bench/breadboard testing will be completed to evaluate technology solutions and justify the preliminary design. A final report shall address requirements generation, lab testing completed and document the prototype design. The system design shall allow for easy adaptation to the current aerial refueling hardware.

The Phase I Option, if exercised, will continue the prototype design refinement and prepare for system level demonstration and validation in Phase II.

PHASE II: Produce a full up prototype design and prototype full up system hardware/software. Throughout Phase II, requirements will be reassessed against original design assumptions and a requirements document will be produced outlining path to full system qualification. Component level testing shall be conducted on actual hardware and software, and ultimately, a system level test will be conducted to demonstrate and validate the system meets the requirements. It is expected that GFE hardware in the form of a refueling coupling and refueling nozzle will be provided to awardees.
The robustness of the system must be considered so that the vendor can capitalize on any developmental flight opportunities that might exist.

PHASE III DUAL USE APPLICATIONS: Update and finalize system design based on system level testing and conduct full qualification testing. This product is intended to transfer to the USN via the MQ-25 and/or PMA-201 Aerial refueling store. With multiple commercial aerial refueling companies in the market, this system would have commercial viability as well.

REFERENCES:
1. “MIL-N-25161 Nozzle, Aerial Refueling, Type MA-2.” http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-N/MIL-N-25161C_AMENDMENT-4_22245/
2. “MIL-PRF-81975 COUPLINGS, REGULATED, AERIAL PRESSURE REFUELING.” http://everyspec.com/MIL-PRF/MIL-PRF-080000-99999/MIL-PRF-81975C_NOTICE-1_56541/
4. “MS 24356, Nozzle, Type MA-2, Flight Pressure Refueling.” https://www.document-center.com/standards/show/MS-24356/history/REVISION%20D

KEYWORDS: Refueling; Aerial Refueling; Unmanned Refueling; In Flight Refueling; Drogue; Probe

N251-064 TITLE: Sparse Data Initialization for Machine Learning Weather Prediction Models

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

OBJECTIVE: Develop a machine learning weather prediction (MLWP) system to generate a complete model analysis, initialization, and produce skillful forecasts from an incomplete, non-gridded set of observations that may include sparse and irregular spatial and temporal sampling of in-situ, remote sensing, satellite, and qualitative forecaster-based information.

DESCRIPTION: In the last few years, there has been a substantial increase in the number of skillful MLWP models that have demonstrated competitive results with state-of-the-art traditional physics-based numerical weather prediction (NWP) systems. However, these efforts not only require multiple decades of high-quality full physics reanalysis information to train the model, but similar quality high-resolution gridded fields from which to initialize the model. This latter point limits the utility of running MLWP systems operationally since full scale traditional data assimilation and reanalysis methods are needed to inform the MLWP model initial conditions.

While MWLP model development requires sufficiently large and balanced datasets to train appropriate physical relationships, it is not clear that a full data assimilation system is needed as with traditional NWP. MWLP time integration is not achieved via discretized partial differential equations, and thus does not share some NWP limitations such as requirements for Courant-Friedrichs-Lewy stability conditions or dynamically balanced states. The need to map real-world data onto a numerically regular grid necessitates smoothing, observation thinning, and methods to spread observational influence in space and time, all of which may lead to a loss of information. This topic solicits innovative machine learning development to build off of recent references (see selection below) that inform methodologies capable of initializing a MWLP model without the need of a full end-to-end NWP-type of data assimilation capability.
Given operational constraints of real-time data quality and quantity, this SBIR topic seeks to scope, prototype, and demonstrate a technique to create a MLWP analysis/initialization capability that: 1) is informed by and transcends state-of-the-science data assimilation methods and practices; 2) accepts a variety of observations and data sources, types, qualities, and characteristics; and 3) can be processed with varying and irregular amounts of data over consecutive model cycles.

PHASE I: Focus on understanding and documenting the technical limitations of initializing MLWP forecast models with sparse observations and formulating innovative concepts to overcome those challenges. Perform a background study of both data assimilation and state-of-the-art forecast analysis methods that will be required to motivate and inform how the proposed effort will address gaps in current processes. Develop a theory and/or simple method to demonstrate the feasibility of the initialization methods to produce robust analyses and stable, skillful forecast fields based on AI/ML techniques. It will be important to properly scope the breadth of analyzed and model environmental variables as well as the appropriate downstream applications for their use.

PHASE II: Using results from the Phase I, develop, demonstrate, and validate an end-to-end prototype MLWP software suite focused on the novel data ingest, initialization, and analysis scheme. Ensure that the toolset must be able to accept widely varying modalities, qualities, and types of observational data, including in-situ state variables, remotely sensed raw and retrieved quantities, gridded background fields of varying age and accuracy, and qualitative assessments of the environment including forecaster notations of important features and locations of environmental phenomena. Ensure that the prototype software must also allow for discontinuities in data streams (temporally or spatially) and have the ability to run or restart with old/degraded information. Intermediate processing outputs of data impacts and sensitivity to the analysis and/or forecast fields is highly desired. The developed workflow should also include robust methods of validation and verification as well as identify strengths and weaknesses of the product compared to traditional NWP modeling. Perform multiple demonstrations in coordination with field testing (may be required). Submit required Phase II deliverables to include regular reporting, participation in program reviews, technical documentation, and the end-to-end prototype software at the conclusion of the effort.

PHASE III DUAL USE APPLICATIONS: Operational hardening and establishing utility and trust for real-time application forms the main effort for transition and commercialization. Dynamic analysis software tools that quickly and accurately convey software system health, error logging and debugging, and processing metadata will need to be created and demonstrated. Develop additional metrics and diagnostics to facilitate expert forecaster guidance on using the product (and comparing to current state-of-the-art weather forecast information). Ensure that the system has a formalized methodology and data/compute needs for model training and a separate, leaner set of requirements for operational runs. Techniques should be generalizable to apply to a variety of environmental modeling use cases such that follow-on work and commercial applications can be addressed.

Dual-use applications will include partnering with other intergovernmental meteorological agencies such as USAF, NOAA, and NASA as well as commercialization for multiple potential markets with decision making requirements based on forecast skill.

REFERENCES:
1. Brajard, Julien et al. "Combining data assimilation and machine learning to emulate a dynamical model from sparse and noisy observations: A case study with the Lorenz 96 model." Journal of computational science 44 (2020): 101171. https://www.sciencedirect.com/science/article/abs/pii/S1877750320304725
2. Irrgang, Christopher et al. "Towards neural Earth system modelling by integrating artificial intelligence in Earth system science." Nature Machine Intelligence 3.8 (2021), pp. 667-674. https://www.nature.com/articles/s42256-021-00374-3
3. Geer, Alan J. "Learning earth system models from observations: machine learning or data assimilation?" Philosophical Transactions of the Royal Society A 379.2194 (2021): 20200089. https://royalsocietypublishing.org/doi/epdf/10.1098/rsta.2020.0089
4. Lam, Remi et al. "GraphCast: Learning skillful medium-range global weather forecasting." arXiv preprint arXiv:2212.12794 (2022). https://arxiv.org/abs/2212.12794
5. Buizza, Caterina et al. "Data learning: Integrating data assimilation and machine learning." Journal of Computational Science 58 (2022): 101525. https://www.sciencedirect.com/science/article/abs/pii/S1877750321001861
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KEYWORDS: Data assimilation; initialization; machine learning; artificial intelligence; ai/ml; meteorology; oceanography; METOC; weather; forecast; machine learning weather prediction; mlwp

N251-065 TITLE: Active Scenarios Learning of Evolving Situations, Multimodal Counterfactual Reasoning, and Explanations Toward Artificial Intelligence-assisted Wargaming

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

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

OBJECTIVE: Develop a multimodal Artificial Intelligence (AI)-based scenario learning technology that continually adapts to the formation of emerging situations. Develop counterfactual augmentation machine reasoning and explanation techniques to correct human feedback behaviors that may cause bias in scenario learning. Scenarios forewarn risks, elicit decisions, and induce human-AI collaboration to exploit vulnerabilities. Apply large language models to explain scenarios, risks, recommend decisions, and course of action. These explanations serve as a crucial tool for evaluating the efficacy of human-AI wargaming collaboration.

DESCRIPTION: Creating unbiased adaptive scenarios as situations unfold is crucial for effective wargaming and conflict simulations. The aim is to predict events and trends that could have a significant impact on U.S. National Security Interests. It requires decision-makers to focus on various situational details, such as adversary strength, leadership temperament, past and present operational performance, logistics, and exploitation opportunities for friendly cross-domain actions and effects. Currently, a diverse team consisting of decision-makers, analysts, and warfighters invests significant time and resources into anticipating adversarial strategies and tactics through wargaming and brainstorming. However, this human-centric approach is vulnerable to costly errors, biases, and omissions, which can seriously undermine the assessment of evidence, statistical analysis, and the understanding of cause and effect.
To achieve the objectives, this SBIR topic will develop the following technologies:

- Multimodal active AI-scenario generator that continually monitors, assesses, and exploits all-source-INT (ASI) datasets and streaming ISR data to detect, understand, and reason about hostile activities, interactions, and operational changes over time. It tracks and identifies assets including deceptive decoys based on their distinct deployment patterns. It provides warning signals as events develop and evaluates the potential consequences. The system remains impartial and helps to reduce human cognitive biases through counterfactual reasoning. It calculates various engagement options and outcomes for human consideration that may not have been recognized or properly understood. Additionally, it assesses the risk of escalation, identifies potential triggers of escalation, and helps with preparations. This capability is critical when it's too uncertain to rely solely on human judgments about potential engagements and their implications.
- Collaborative human-AI course of action learning, reasoning, and explanations of engagement plans. It is a collaborative interplay of machine-to-machine (M2M) prediction of alternative futures integrated with the human-to-machine (H2M) supervisory system that examines and validates the end-state scenario risks. H2M interactive path allows for joint sensemaking, contextual reasoning, logical consistency checks, and Q&A query to probe AI generated scenarios and observed warning signs. The key technology development components are as follows:

1. Machine learning (ML) to uncover opponent's multimodal assets (people, places, things), movements, and activities.
2. AI Red Team Reason-and-Act (ReAct) agents that discern and simulate opponent's Tactics, Techniques and Procedures (TTP) and reactions.
3. AI Blue team ReAct agents, as a collaborative human-AI team executing strategic and tactical plans and maneuvers.
4. Counterfactual augmentation multimodal ML to prevent human perception biases influencing the course of action.
5. Apply large language models to explain multimodal events (text, voice, video, electro-optical/infrared (EO/IR) imagery, acoustics, synthetic aperture radar (SAR), etc.), decision points, course of action, interactions between Red vs. Blue teams, Player's behaviors, and engagement outcomes are coherently expressed in natural language.

- Wargaming applications may include scenarios that capture a joint military and commercial mobilization activities or exercise activities to control contested waters such as amphibious landing and sea-lane blockade.
- Analytic tools that support the development include wargaming databases, engagement rules for all players, whether human or machine, and a multimodal exploitation gaming environment.

PHASE I: Determine the technical feasibility of designing and developing collaborative human-AI wargaming and AI-generated scenarios technologies as described in the Description section. Testing and demonstrations may use datasets from the Department of the Navy (DoN), Marine Corps Warfighting Laboratory (MCWL), Automatic Identification System (AIS) maritime traffic, commercial satellite imagery, and open-source intelligence (OSINT). The wargaming datasets and engagement rules need to take into consideration the littoral maritime environment and seaside terrain, including weather, view/geo-effects, routes; the maritime order-of-battle and movement; engagement rules/doctrine; engagement attrition; victory, standoff, and defeat conditions and status; logistics and supply demands, etc. Utilize associative data mining techniques for entity extraction (people, places, and objects) and related transactional activities. Accuracy metrics for ingesting and classifying multimodal data: structured data mining and interpretation - accuracy of 95% over 98% captured content; unstructured data mining and interpretation – accuracy of 90% over 95% captured content.

Software validation and verification must assess AI scenario structuring and logic-tree performance, consistency, and credibility as it relates the initial scenario states to the final scenario states through intervening events and processes. Performance criteria must include sensitivity (true-positive rate), specificity (true-negative rate), precision (positive predictive value), miss rate (false negative rate), false discovery rate, and false omission rate. Conduct performance assessment on the following human sensemaking and decision-making:

- TTP Confidence on engagement plans, options, and risk reduction associated with the ups and downs of encounters.
- Cause and effect sensitivity analysis on contextual understanding of AI-generated scenarios.
- Efficiency gains in human responsiveness through timely decision-making, chain-of-actions, and resources spent.

Deliverables include end-to-end initial prototype technology, T&E, demonstration, a plan for Phase II, and a final report.
Note 1: Phase I will be UNCLASSIFIED and classified data is not required.

Note 2: Awardees must provide appropriate dataset release authorization for use in their case studies, tests, and demonstrations, and certify that there are no legal or privacy issues, limitations, or restrictions with using the proposed data for this SBIR project.

PHASE II: Develop a prototype of the candidate technologies. Test and demonstrate the prototype with representative operational data sources. Assess the prototype's performance against the metrics detailed in Phase I. Conduct an end-user satisfaction assessment, on a scale of 0 to 5, on the following matters: a) Situational understanding for events that go dark, disguised activities and maneuvers, and dormant targets; b) Alignment with formal warning signals; c) Alignment with prioritized deterrence and engagement options; and d) Timeliness for responsive decision-making across different domains and collaborating effectively. Deliver prototype software, systems interface requirements for mobile and stationary devices, design documentation, source code, user manual, and a final report. Additionally, develop a plan for the Phase III transition into a program of record.

Note 3: Work produced in Phase II may become classified. However, the proposal for Phase II will be UNCLASSIFIED. The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations.

Note 4: If the selected Phase II contractor does not have the required certification for classified work, the Office of Naval Research (ONR) or the related DoN Program Office will work with the contractor to facilitate certification of related personnel and facility.

PHASE III DUAL USE APPLICATIONS: Advance these capabilities to TRL-7 and integrate the technology into the Maritime Tactical Command and Control Program of Record (POR) or Intelligence, Surveillance and Reconnaissance (ISR) processing platforms at the Marine Corps Information Operations Center. Once conceptually and technically validated, demonstrate the dual-use applications of this technology in the video gaming industry.

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1. Robinson, E.; Egel, D. and Bailey, G. "Machine Learning for Operational Decision-making in Competition and Conflict, A Demonstration Using the Conflict in Eastern Ukraine." RAND Corp, 2023
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5. Yannakakis, G.N. and Togelius, J. "Artificial Intelligence and Games." Springer, 2018
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

KEYWORDS: Artificial Intelligence; Machine Learning; Machine Reasoning; Scenario; Multimodal; Counterfactual; Wargame; Bias; Explanations

N251-066 TITLE: Carbon-Carbon Modular Structures

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

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

OBJECTIVE: Develop the manufacturing capability to create precise, rugged, and consistent high tolerance carbon-carbon (C/C) structures that allow for modularity of a hypersonic vehicle.

DESCRIPTION: Current C/C technology is very expensive, time consuming, and difficult to produce. These factors limit the ability to perform research and development for modification to current designs. New designs will allow for more advanced vehicles. The Conventional Prompt Strike (CPS) Program desires a manufacturing capability to create very strict tolerances that allows for different architectures/designs for hypersonic vehicles. The ability to modularly construct, mold, carve, form, or alter the C/C material in the manufacturing process is of interest. In the case of additive manufacturing capabilities, there is high risk of failure to withstand the shock, vibration, heat, and other environmental conditions of hypersonics. This new manufacturing capability shall provide significant proof of concept to meet these requirements. The C/C manufacturing capability should have mitigations for these considerations along with all other capability considerations. This capability shall follow standard manufacturing readiness level (MRL) progression.

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 SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material 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: Demonstrate the feasibility of the C/C manufacturing capability to demonstrate modular integration of aeroshell components while maintaining robust structural integrity of the entire system. Show the design considerations such as size of piece that can be constructed, thermal limits, shear limits, compression limits, tensile strength limits, etc. Compare these metrics to current state of the art C/C manufacturing capabilities and other C/C processes. Show the trade space between the process presented and these other processes. For consideration of Phase II, there is significant emphasis on the ability to have a technical and rigorous process flow for manufacturing that demonstrates the repeatability and reliability of the process. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: The modular C/C structure shall be tested with multiple environmental conditions. A successful demonstration shall be presented by the end of the Phase II. Unlike technology readiness levels (TRLs), MRL requires testing similar environments throughout Phase II. The Technical Point Of Contact (TPOC) shall approve the validity of the test environment meets the requirements given in Phase II.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the government in transitioning the technology for government use.

The transitioned product is expected to be able to support current and future weapon and space systems, as well as a wide range of other air, land, and sea-based systems. Commercial applications should be considered for transition (i.e., ocean exploration, space exploration, commercial autonomous vehicles, and mapping systems). The primary objective of this project is for transition to defense contractors for high-speed weapons and space systems. To meet these needs, maturation and packaging of the technology to meet practical size, weight, and power constraints will be required. Extreme environments may require special considerations to conform to airframe shape and shielding from the aerothermal environment.

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2. Paek, Sung Wook; Balasubramanian, Sivagaminathan and Stupples, David. "Composites Additive Manufacturing for Space Applications: A Review." Materials 15.13, 2022, p. 4709.
3. “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

KEYWORDS: Novel; Creative; Innovative; Advanced; Rugged; Hypersonic; Manufacturing; Additive Manufacturing; Modular; Carbon-Carbon; Carbon Structures: Embedded; Aerospace

N251-067 TITLE: Radiation Hardened Gallium Nitride Electronics

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

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

OBJECTIVE: Characterize Gallium Nitride (GaN) materials and develop the techniques to design radiation hardened GaN electronics for power and/or radio frequency (RF) applications. Additional objectives include development of radiation hardened discrete GaN High-Electron Mobility Transistor (HEMT) devices and radiation hardened GaN integrated circuits for power conversion and/or RF applications.

DESCRIPTION: The desire for smaller and more efficient power and RF devices has led the electronics community in the direction of wide band gap power devices. GaN HEMTs offer improvements in size, weight, and power (SWaP) over silicon transistors. The enhanced capabilities and SWaP reductions are desirable for DoD and Space system deployments. Commercially available GaN HEMTs have been demonstrated to show sensitivity and permanent damage due to exposure to radiation, specifically heavy-ion radiation while the part is biased [Refs 1-3]. This radiation-induced damage is a significant concern for mission-critical applications. Additionally, many GaN HEMT and integrated circuit products face supply chain uncertainty through an evolving GaN manufacturing landscape and fabrication facilities that are not domestic to the continental United States (CONUS). It is highly desirable to develop radiation hardened by design (RHBD) GaN HEMT and integrated circuit solutions, to mitigate radiation effects damage and performance degradation, within a fabrication flow with a path to Defense Microelectronics Activity (DMEA) certified transited status. The final designs should be suitable for packaging in standard commercial footprint packages. Development of a screening flow, similar to a MIL-PRF-19500 screening, should be established and included in part productization and qualification.

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 at least 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 SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part2004.20 of the Code of Federal Regulations.

PHASE I: Identify candidate GaN foundry processes and characterize the baseline technology for radiation-response and RHBD potential. Comparison to currently available GaN products for commercial applications should be made for target electrical performance capabilities. Develop design concepts for radiation hardened GaN HEMT devices and integrated circuits for power conversion and/or RF applications. Simulation results to establish the feasibility of design concepts. Target specifications for radiation resiliency may include

- Total Ionizing Dose: 1×106 rad (Si) equivalent dose
- Neutron Fluence: 5×1013 n/cm2
- Single-Event Burn Out: 60 MeV-cm2/mg
- Single-Event Upset: 15 MeV-cm2/mg
- Dose Rate Survivability: 1×1012 rad(Si)/sec equivalent
- Dose Rate Upset: 1×109 rad(Si)/sec equivalent

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

PHASE II: The concept design and specifications from Phase I will be developed as fabrication-ready designs. Final designs will be demonstrated through simulation across process corners, the standard military temperature range, and modeled strategic radiation environments. The designs will be fabricated, in a trusted foundry and a CONUS fabrication facility, and tested to confirm device and circuit functionality and radiation resiliency. A lot of twenty (20) threshold to twenty-five (25) objective prototype devices should be delivered by the completion of Phase II.

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

PHASE III DUAL USE APPLICATIONS: The final version of the HEMT devices and/or integrated circuit designs will be productized at the selected foundry from Phase II. The final designs should be suitable for packaging in standard commercial footprint packages. Development of a screening flow, similar to a MIL-PRF-19500 screening, should be established and included in part productization and qualification.

Many military, commercial, and scientific systems that operate in hard environments require radiation hardened electronics. Space radiation effects impact systems such as communication and navigation satellites. Systems operating in adverse environments in and around nuclear reactors and particle accelerators also require a degree of radiation hardness electronics.

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KEYWORDS: Gallium Nitride; GaN, High-Electron Mobility Transistor; HEMT; power conversion; radio frequency; radiation hardened electronics; radiation-hardened by design; RHBD; prompt dose; foundry

N251-068 TITLE: Smart Contracts for Supply Chain Risk Management (SCRM)

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

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

OBJECTIVE: Develop an acquisition and sustainment contracting framework to implement Smart Contracts for Supply Chain Risk Management (SCRM) (blockchain technology) for Strategic Systems Programs (SSP) . This technology can be applied to acquisition or sustainment programs across the DoD. This collaboration between government and industry will provide the government greater visibility of sub-tier vendors in the supply chain.

DESCRIPTION: As noted in the February 2022 memorandum, “Securing Defense-Critical Supply Chains An action plan developed in response to President Biden's Executive Order 14017”; The Department of Defense (DoD) is aligning its priorities and capabilities to enhance our readiness. By modernizing our approach to supply chain resilience, DoD can deliver decisive advantages to our Warfighters in a dynamic threat landscape. In an effort to improve supply chain resilience and protect against material shortages, President Joseph R. Biden Jr. signed Executive Order (E.O.) 14017, America's Supply Chains. In response to the EO, this report provides DoD's assessment of defense critical supply chains in order to improve our capacity to defend the Nation [Ref 1].

As stated in the SSP Director’s Mission Priorities section of Sea Based Strategic Deterrence (SBSD) Director’s Intent: “Through programmatic excellence in shipboard sustainment and modernization programs across the Strategic Weapons System (SWS) subsystems and in Nuclear Weapons (NW) surety, and through diligent oversight of the logistical supply chains, SSP not only will maintain a credible and reliable weapons system, but will also continue unlocking new capabilities the warfighter can leverage to enhance strategic deterrence and act decisively should deterrence fail.” A significant aspect in delivering and maintaining a credible and reliable weapon system is having a thorough understanding of our global supply chain.

New concepts to improve visibility and responsiveness to address issues for sub-tier vendors within the global supply chain are necessary to ensure weapon system delivery. The implementation of smart contracts backed by blockchain technology can provide government with visibility into all sub-tier vendor activities. This can provide program managers with an understanding of where critical parts and technologies are coming from (around the world). Implementation of this technology provides a revolutionary increase in the government’s ability to conduct Supply Chain Risk Management, Systems Security Engineering, and Program Protection Plans.

The April 2024 Investopedia article “What Are Smart Contracts on the Blockchain and How Do They Work?” provides a high level description of smart contracts and blockchain technology [Ref 4]. It states, “A smart contract is a self-executing program that automates the actions required in an agreement or contract. Once completed, the transactions are trackable and irreversible. The best way to envision a smart contract is to think of a vending machine—when you insert the correct amount of money and push an item's button, the program (the smart contract) activates the machine to dispense your chosen item. Smart contracts permit trusted transactions and agreements to be carried out among disparate, anonymous parties…”.

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 SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material 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: Provide a concept to incorporate smart contract (blockchain based) technology into Navy contracting and supply operations. This concept will be captured in a Word document that describes “to-be” business processes, potential technology solutions, and potential pilot industry partners for Phase II. This should also discuss integration of supply chain data into SCRM and related efforts and insights that may be gleaned to help the Government better understand industrial base capability, capacity constraints, risks, and opportunities. The concept should describe how this solution can provide:

- Manufacturing Visibility
- Inventory Visibility
- Logistics Visibility
- Visibility into “Nth Tier” subcontract vendor information and associate parts/material delivery

Perform data discovery, examination of supply chain challenges from both the Government and Vendor perspectives, operational use cases, and a governance mode.

PHASE II: Develop and deliver a prototype SCRM system for Smart Contracts that utilizes blockchain technology (immutable ledger) in order to achieve the visibility described in Phase I. Collaborate with Government, industry stakeholders, and active partners. The prototype will be evaluated on its ability to operate from a manager and end-user perspective, data security, and data analytics capabilities. This should include chosen technology solutions and agreed upon business practices. An additional deliverable will be a “scalability assessment.”

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. Phase III should result in a small number of SSP contracts executed as Smart Contracts. These contracts will serve as use cases that will be managed and executed at multiple layers of the supply chain. Data analysis should provide information regarding all supply chain sources (company level information) and identify products/parts they are under contract to deliver. This information must be easily transferrable to other SCRM and Supply Chain Illumination tools in use by SSP and the Navy. Due to the sensitive nature of some contracts, it is expected that pricing data may not be maintained on the blockchain or will have very limited access. The Defense Information Systems Agency (DISA) will likely need to validate and accredit the new system.

This technology can be applied to any industry (commercial or government) that is concerned with understanding and managing risks of sourcing/procurement of parts that end up in their products/platforms. All industries can benefit from having more clarity on sub-tier vendors.

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1. "Securing Defense-Critical Supply Chains: An action plan developed in response to President Biden's Executive Order 14017 (February 2022)." https://media.defense.gov/2022/Feb/24/2002944158/-1/-1/1/DOD-EO-14017-REPORT-SECURING-DEFENSE-CRITICAL-SUPPLY-CHAINS.PDF
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KEYWORDS: Blockchain; Smart Contract; Supply Chain; Contracting; Industrial Base; Acquisition; Sustainment; Supply Chain Risk Management; Program Protection; Critical Programs & Technologies

N251-069 TITLE: Highly Applicable Mechanical Metamaterial (HAMM) for High G-Load Flight Structures.

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

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

OBJECTIVE: Develop a mechanical metamaterial with adaptive hierarchical periodic microarchitecture that can survive increased mechanical loading at high temperatures. The design will provide an increase in overall specific strength using novel high entropy alloys per volumetric performance.

DESCRIPTION: Flight vehicle structures operating in hypersonic environments are traveling at speeds above MACH 5 and may experience structural G-force loads above 50Gs. These variables make the material property requirements very stringent for survivability. To account for these conditions, structural alloys designed must have high strength, creep resistance, and high operating temperature. Historically, new material systems have always played a transformative role in advancing these capabilities. In the operation of flight structures, reducing weight while increasing strength improves flight performance with each new design iteration. For structural materials, aluminum and titanium alloy manufacturing have made advances by providing structures with high specific strength in operation. These alloys are used in a limited number of flight applications for hypersonics, due to operational temperatures of ~300°C (Al alloys) and ~540°C (Ti alloys). Nickel based alloys, like Inconel, provide a solution when extreme temperatures, mechanical loads, and high corrosive environments are persistently present. Inconel has been able to withstand temperatures up to 1200°C, which makes it very unique for these environments. The caveat is that traditional manufacturing makes Inconel production expensive due to machining and overall material cost. For sustainability, Inconels have a material design limitation due to the requirements for a high nickel concentration, > 50%. Advanced manufacturing methods that use less material, reduce machining time, or provide a whole new materials solution without significant loss of mechanical properties are of need.

Mechanical metamaterial provide a unique approach by specifically using advanced manufacturing to create hierarchal lattice structures. These structures have macroscopically high mechanical strength in the designed principle direction due to their multiple instances of material orthotropy. Topological optimization has been utilized to research hierarchal structures that are specifically designed for higher loads. These designs seek to use less material without sacrificing mechanical capability. This SBIR topic looks for a Mechanical Metamaterial structural design that is able to maintain or improve upon the properties of a forged structural component. This topic intends for the use of new high entropy alloys that reduce or provide alternatives to nickel based alloys. The design should be informed by using modern topological optimization tools driven by machine learning. The final design will be a representative component structure to be tested under loading conditions experienced by hypersonic flight environments. 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 SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material 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: Develop a high entropy alloy and architecture with an optimized design for incorporating high mechanical loads via advanced manufacturing. Produce sample test articles using advanced processing and characterize them under tension, compression, and hardness. Assess the alloy through crystallography, microscopy, calorimetry, and gravimetric analysis to access ablative mass loss at high temperature. The resulting article must have a low oxygen concentration and be able to operate in extreme temperatures above 1000°C. Use an understanding of characteristics to demonstrate a viable proof of concept.

PHASE II: Create a larger mechanical test architectures to conduct a side-by-side comparison of properties to other comparable structural alloys. Perform a manufacturing repeatability analysis on the manufacturing process for this optimized mechanical metamaterial. Establish a manufacturing process workflow to incorporate an optimization design of experiments to allow for future concept variability.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Integrate manufactured metamaterial into a component scale flight experiment and begin developing a pilot line for transition to full production.
Support the government in transitioning the technology for government use. The transitioned product is expected to be able to support current and future weapon and space systems, as well as a wide range of other air, land, and sea-based systems.

Commercial applications should be considered for transition (i.e., 5G, navigation systems, and tracking systems). The primary objective of this project is for transition to defense contractors for high-speed weapons and space systems. To meet these needs, maturation and packaging of the technology to meet practical size, weight, and power constraints will be required. Extreme environments may require special considerations to conform to airframe shape and shielding from the aerothermal environment.

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KEYWORDS: Mechanical Metamaterial, Light Weight High Entropy Alloys, Hypersonic, Lattice Structures, HEAs, Advanced Manufacturing, Machine Learning

N251-070 TITLE: Carbon-Carbon Structures with Embedded Electronics

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

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

OBJECTIVE: Develop the capability to create precise modifications, rugged, and consistent high tolerance carbon-carbon (C/C) structures that allow for antennas or other electronics to be embedded into the C/C structure (no window or cover required) while able to operate in a hypersonic regime.

DESCRIPTION: Current C/C technology is very expensive, time consuming, and difficult to produce. These factors limit the ability to perform research and development for modification to current designs. New designs will allow for more advanced vehicles. The Conventional Prompt Strike (CPS) Program desires the ability to create C/C structures with very strict tolerances that allow for different architectures, designs, or configurations of the thermal protection system in a hypersonic regime. This would require advanced manufacturing capabilities, facilities, and expertise. The CPS Program desires these capabilities for antennas and other electronic integration with large C/C structures. This capability will increase the effective volume in which electronics may reside. The ability to modularly part, mold, carve, form, or alter the C/C material in the manufacturing process is of interest. In the case of additive manufacturing capabilities, there is high risk of failure to withstand the shock, vibration, heat, and other environmental conditions of hypersonics. This new manufacturing capability shall provide significant proof of concept to meet these requirements. Note that when the C/C material is in close contact with other metals and semiconductors there is room for additional manufacturing demands such as thermal expansion effects, bonding/reactive effects, and warping of the metals at high temperature. The C/C manufacturing capability should have mitigations for these considerations along with all other capability considerations. This capability shall follow standard manufacturing readiness level (MRL) progression.

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 SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material 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: Demonstrate the feasibility of the C/C manufacturing capability to embed antennas or electronics within the structure while maintaining robust structural integrity of the entire system. Show the design considerations such as size of piece that can be constructed, thermal limits, shear limits, compression limits, tensile strength limits, etc. Compare these metrics to current state of the art C/C manufacturing capabilities and other C/C processes. Show the tradeoffs for this comparison. Demonstrate the feasible functionality of embedded antennas or electronics. Show the trade space between the process presented and current state of the art processes. For consideration of Phase II, there is significant emphasis on the ability to have a rigorous process flow for manufacturing that demonstrates the repeatability and reliability of the process. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: The C/C antenna or electronic structure shall be tested with multiple environmental conditions. A successful demonstration shall be presented by the end of the Phase II. Unlike technology readiness levels (TRLs), MRL requires testing similar environments throughout Phase II.) The Technical Point Of Contact (TPOC) shall approve the validity of the test environments and that the test meets the requirements given in Phase II.

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

PHASE III DUAL USE APPLICATIONS: Support the government in transitioning the technology for government use.

The transitioned product is expected to be able to support current and future weapon and space systems, as well as a wide range of other air, land, and sea-based systems. Commercial applications should be considered for transition (i.e., ocean exploration, space exploration, commercial autonomous vehicles, and mapping systems). The primary objective of this project is for transition to defense contractors for high speed weapons and space systems. To meet these needs, maturation and packaging of the technology to meet practical size, weight, and power constraints will be required. Extreme environments may require special considerations to conform to airframe shape and shielding from the aerothermal environment.

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KEYWORDS: Novel; Creative; Innovative; Advanced; Rugged; Hypersonic; Manufacturing; Additive Manufacturing; Carbon-Carbon; Carbon Structures: Embedded; Aerospace

N251-071 TITLE: Novel Autonomous Dead Reckoning Navigation

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

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

OBJECTIVE: Develop a novel, State Of The Art (SOTA) autonomous navigation capability, utilizing dead reckoning, to improve navigation accuracy, over longer distances, while traveling in a hypersonic regime.

DESCRIPTION: Development of a novel, dead reckoning navigation technique may provide an increase in robust updates, at discrete intervals, to aid in the navigation of a hypersonic vehicle. These discrete interval updates provide time, vector (direction), and velocity information of the system's current position. Dead reckoning uses these updates, with the previous update as a reference, to identify the vehicle's current position. Dead reckoning is known to be accurate only over short distances. Corrections from navigation aids (such as GPS) are needed to fix the drift error over longer distances. With the use of increased accuracy, the hypersonic vehicle can perform autonomous travel for longer distances. While an increase in Inertial Measurement Unit (IMU) performance helps the dead reckoning accuracy, IMU accuracy alone may lack the unique innovation desired. Additional sensor information for drift error correction in the IMU allows for increased accuracy, redundance in sensor options, and resilience from external effects. Individual sensors shall utilize a modular design that is integratable with multiple different types of IMUs to show interoperability. Software used to communicate with the IMU and other hardware shall be open source and/or with no proprietary limitations that would require significant changes to any system it may be integrated. A successful autonomous dead reckoning travel advancement may utilize sensory updates in the local area of the hypersonic vehicle such as temperature, altitude, vibrations, light produced by/near the hypersonic vehicle, etc. Updates that do not apply are external feedback from a known reference outside the local area of the hypersonic vehicle such as GPS, antennas on the ground or in space, light from stars, etc.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by 32 U.S.C. § 2004.20 et seq., National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material 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: Develop a concept for a technology with superior accuracy over long distances to SOTA dead reckoning navigation systems. The technology shall show improvement in technical parameters while maintaining similar Size, Weight, and Power (SWaP) compared to current, commercially available, SOTA technology. The technical parameters will vary significantly based on the type of dead reckoning technology, and will be compared to similar current SOTA technology in an "apples to apples" comparison. The following SWaP constraints should be considered:
Size of the design should fit within 64 inches cubed (4 inches in all axis).
Weight of the design should weigh less than three pounds.
Power of the design should draw less than 100 Watts.

These considerations should be treated as bare minimum requirements, and may change based on the type of technology selected. If awarded a Phase I, reduction in SWaP is important for Phase II.

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

PHASE II: Develop any hardware and/or software required to demonstrate a refined prototype solution for the advanced dead reckoning navigation system. The refined prototype shall not use any known external references other than initial starting position and IMU data, unless previously approved by the Government Technical Point of Contact (TPOC). Identify a work plan that provides proof of concept to meet the performance goals and reduce SWaP. Focus on reduced SWaP and increased accuracy of dead reckoning algorithms while operating in a hypersonic regime. The prototype hardware, software, and all modeling and simulation, shall be delivered to show technically measurable improvements to dead reckoning navigation. By the end of Phase II, the final prototype is intended to be integrated into test asset(s) for verification and validation of the technology.

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

PHASE III DUAL USE APPLICATIONS: Support the government in transitioning the technology for government use.

The transitioned product is expected to be able to support current and future weapon and space systems, as well as a wide range of other air, land, and sea-based systems. Commercial applications should be considered for transition (i.e., ocean exploration, space exploration, commercial autonomous vehicles, and mapping systems).

This technology has use in the Department of Defense (DoD) and also has significant interest in industry from many autonomous navigations such as deep sea and deep space.

REFERENCES:

1. Dicu, N.; Andreescu, G.D. and HoratiuGurban, E. "Automotive Dead-Reckoning Navigation System Based on Vehicle Speed and YAW Rate." 2018 IEEE 12th International Symposium on Applied Computational Intelligence and Informatics (SACI), Timisoara, Romania, 2018, pp. 000225-000228. doi: 10.1109/SACI.2018.8440934
2. Topini, E. et al. "LSTM-based Dead Reckoning Navigation for Autonomous Underwater Vehicles." Global Oceans 2020: Singapore – U.S. Gulf Coast, Biloxi, MS, USA, 2020, pp. 1-7. doi: 10.1109/IEEECONF38699.2020.9389379
3. Ugale, H.; Patil, P.; Chauhan, S. and Rao, N. "IoT System for Sensing Condition of Roads Using IMU Sensors." 2021 2nd International Conference on Secure Cyber Computing and Communications (ICSCCC), Jalandhar, India, 2021, pp. 344-349. doi: 10.1109/ICSCCC51823.2021.9478080

4. “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

KEYWORDS: Navigation; Dead Reckoning; Autonomous; Guidance; Sensors; Sensor Fusion; Rugged; Resilient; Hypersonic; Network; Neural Network; Internet of Things

VERSION 2

N251-072 TITLE: Lithium Niobate Fabrication and Processing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Quantum Science;Space Technology

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

OBJECTIVE: Develop innovative solutions for the fabrication, production, and processing of optical quality lithium niobate substrates.

DESCRIPTION: Lithium niobate ($LiNbO_3$ or LN) is a versatile optical material used in a range of active optical components such as acousto-optic and electro-optic modulators, Pockels cells, and non-linear optics [Ref 1]. It supports optical wavelengths spanning the visible through infrared bands favored for telecom applications. It is an excellent substrate for optical waveguides either in bulk form or in the form of thin film lithium niobate (TFLN) on insulators. TFLN provides a versatile platform for the development of photonic integrated circuits (PICs), providing a path to the miniaturization and integration of complex optical systems into packages of lower size, weight, and power (SWaP). LN is a critical material used in many high precision inertial sensors for DoD applications, which includes an integrated optical component (IOC) that is typically a y-branch LN crystal waveguide. It also plays a key role in various active components that support cold atom based quantum inertial sensors, such as electro-optic phase and frequency shifters.

LN substrates exist in a variety of grades. Though somewhat loosely defined, optical grade represents the highest quality grade, best suited for use in optical waveguides and modulators. This is characterized by its highly uniform composition, typically achieved by tightly controlled crystal growth conditions, and lack of impurities and defects. For the purposes of this SBIR topic, the following goal specifications for optical quality are defined:
• Composition uniformity: +/- 0.01 mol% Li_2O
• Curie temperature uniformity: +/- 1 °C
• Refractive index / birefringence uniformity: +/- 1e-4
• Impurities: < 1 ppm (each transition metal)

Over time, the U.S. supplier base for optical quality LN substrates has declined to the extent that nearly all single crystal LN must now be obtained from foreign sources [Ref 2]. The Navy has an interest in developing a robust supply chain for LN source material that can support the U.S. photonics industry. This SBIR topic seeks innovative approaches for LN fabrication processes for the growth of LN single crystals through wafer processing.

PHASE I: Perform an initial study to assess the feasibility of the proposed production methods and the expected material specifications. Optimize for any crystal composition (such as congruent, stoichiometric, doped) and provide an assessment of the targeted uniformity and purity of the material (neglecting any proposed dopants) and the expected optical quality. Propose methods of testing substrates to be developed in Phase II for defect concentration and other relevant measures of optical quality.

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

PHASE II: Grow and process LN wafers with the following target specifications:
• Orientation: x-cut or z-cut (+/- 0.5 degrees)
• Minimum wafer diameter: 150 mm
• Wafer thickness: 1 mm (nominal)
• Wafer flatness: 15 microns (total thickness variation)

Characterize both the surface quality of substrates and the concentration of material defects according to methods defined in Phase I. Deliver five (5) wafer substrates to the Navy at the conclusion of Phase II.

PHASE III DUAL USE APPLICATIONS: Continue development in collaboration with the Navy and potential industry transition partners. Refine the wafer substrates to the requirements for LN substrates relevant for Navy applications. Define specific crystal specifications.

This work will result in a more robust supply chain for components and quantum inertial sensors. This work will have relevance for commercial dual use applications for telecommunications components, Light Detection and Ranging (LIDAR), and quantum information processing.

REFERENCES:
1. Andreas Boes et al. “Lithium niobate photonics: Unlocking the electromagnetic spectrum.” Science, Vol 379, Issue 6627, 2023. DOI: 10.1126/science.abj4396
2. “National Strategy on Microelectronics Research A Report by the Subcommittee on Microelectroncs Leadership Committee on Homeland and National Security of the National Science and Technology Council.” March 2024. https://www.whitehouse.gov/wp-content/uploads/2024/03/National-Strategy-on-Microelectronics-Research-March-2024.pdf

KEYWORDS: Lithium niobate; thin-film lithium niobate; wafer processing; optical modulation; non-linear optics; photonic integrated circuits

N251-073 TITLE: Robust Fiber-to-Photonic Integrated Circuits (PIC) Coupling for the Near-Infrared (NIR)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Quantum Science;Space Technology

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

OBJECTIVE: Develop a robust method of achieving efficient optical coupling between PICs and single mode optical fiber operating at NIR wavelengths relevant for quantum sensing (700 nm to 900 nm).

DESCRIPTION: Atomic accelerometers and clocks are important elements of advanced inertial navigation and timing systems. In recent years, there has been significant effort to reduce the size, weight, and power (SWaP) of various subsystems. For the laser subsystem in particular, this is typically anticipated to be accomplished by a transition from bulk optics to PICs [Ref 1].

One challenge of this transition is the efficient on- and off-coupling of light between PICs and off chip components such as laser sources and sensor elements such as vapor cells. Single-mode polarization-maintaining fiber provides a convenient mode of transferring light between subcomponents because it maintains optical mode quality and decouples the mechanical interface between subcomponents. It is also crucial in the testing and development of subcomponents, as it enables light to be coupled to external instruments for analysis and component testing.

Mature processes exist for robust fiber attachment at telecommunications wavelengths [Refs 2, 3]. These include grating coupling, prism coupling, and edge coupling into tapered waveguides. Active alignment techniques involving the attachment of one fiber at a time ensure coupling efficiency but at the expense of being labor intensive. Passive and multi-fiber alignment techniques may reduce labor at the expense of reduced coupling efficiency. While coupling losses on the order of 1 dB are achievable at telecom wavelengths, losses at wavelengths relevant for quantum sensing (700 nm to 900 nm) are typically less efficient. Quantum sensors often utilize high optical powers (up to 1 W), which impacts the robustness of fiber interconnects and demands greater efficiencies. The goal of this SBIR topic is to develop robust PIC to fiber connections that are labor efficient, optical power efficient, and robust to high power operation.

Target specifications for the desired process include:
• Optical power handling: Up to 1 W continuous wave
• Optical wavelength: 700 nm to 900 nm (any photonic architecture compatible with this range is acceptable for demonstration purposes)
• Fiber type: Single mode polarization maintaining
• Coupling loss: 1 dB

PHASE I: Perform a design and materials study to assess the feasibility of the proposed technology or process to meet the target specifications listed in the description. Prepare a final report that must include an assessment of:

• The SWaP implications of the proposed technique (particularly the size and density of fiber connections)
• A discussion of the technology's compatibility with PIC architectures
• The scalability of the approach and the labor involved in making fiber connections both for an envisioned production environment for low quantity prototypes, low rate production, and full rate production

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a PIC-fiber attachments in Phase II.

PHASE II: Demonstrate the proposed fiber attachment technique and characterize its performance against the target goals listed in the Description. At the conclusion of Phase II, deliver five (5) representative photonic chips demonstrating fiber attachments on both the input and output of a waveguide.

PHASE III DUAL USE APPLICATIONS: Continue development to assist the Government in integrating the technology with other PIC components.

In addition to advancing a quantum sensing capability for military/strategic applications, this technology will improve the SWaP and lower the development cost of commercial photonic components that utilize wavelengths down to the visible spectrum, including, Light Detection and Ranging (LIDAR) systems, spectrometers, data communications, and quantum technologies.

REFERENCES:
1. Sanna, Matteo; Baldazzi, Alessio; Piccoli, Gioele; Azzini, Stefano; Ghulinyan, Mher and Lorenzo Pavesi, "SiN integrated photonic components in the visible to near-infrared spectral region." Opt. Express 32, 2024, pp. 9081-9094. https://doi.org/10.1364/OE.514505
2. Lu, Z.; Yin, P. and Shi, K. "Bent Metal-Clad Waveguides for Fiber-to-Waveguide and 3D Chip-to-Chip Light Coupling Applications,. Frontiers in Optics 2016, OSA Technical Digest (online), Optica Publishing Group, paper JTh2A.161. https://doi.org/10.1364/FIO.2016.JTh2A.161
3. Nauriyal, Juniyali; Song, Meiting; Zhang, Yi; Granados-Baez, Marissa and Cardenas, Jaime. "Fiber array to chip attach using laser fusion splicing for low loss." Opt. Express 31, 2023, pp, 21863-21869. https://doi.org/10.1364/OE.492752

KEYWORDS: Photonic integrated circuit; PIC; optical fiber interconnect; silicon nitride photonics; optical fiber attachment; grating coupler; edge coupler

VERSION 3

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

IMPORTANT

- **The following instructions apply to Direct to Phase II (DP2) SBIR topic only:**
  - **N251-D01 through N251-D07**

- Information on the 25.1 SBIR and 25.A STTR Topics Workshop can be found at https://navysbir.com/nw25_1.htm.

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

- The information provided in the DoN Proposal Submission Instructions takes precedence over the DoD Instructions posted for this BAA.

- A submitting small business concern **MUST** use the DP2 Phase I Feasibility proposal template for Volume 2. This template is specific to DoN DP2 topics and meets DP2 submission requirements. The DP2 Phase I Feasibility proposal template can be found at https://navysbir.com/links_forms.htm.

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

- DoN provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.

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

INTRODUCTION

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

The Department of Defense (DoD), including the Department of the Navy (DoN), may issue an SBIR award to a small business concern under Phase II , without regard to whether the small business concern received a Phase I award for such project. Prior to such an award, the head of the agency, or their designee, must issue a written determination that the small business concern has demonstrated the scientific and technical merit and feasibility of the technology solution that appears to have commercial potential (for use by the government or in the public sector). The determination must be submitted to the Small Business Administration (SBA) prior to issuing the Phase II award. As such, DoN issues this portion of the BAA in accordance with the requirements of the Direct to Phase II (DP2) authority. Only those proposing small business concerns that are capable of meeting the DP2 proposal requirements may participate in this DP2 BAA. No Phase I awards will be issued to the designated DP2 topic.

For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	**When**	**Contact Information**
Program and administrative	Always	DoN SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil or appropriate Program Manager listed in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic on the DoD SBIR/STTR Innovation Portal (DSIP). Refer to the Proposal Submission 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 Submission section of the DoD SBIR/STTR Program BAA for details.
Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DSIP Support via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	DoN SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil

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

Topic Numbers	Point of Contact	SYSCOM	Email

N251-D01 to N251-D03	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N251-D04 to N251-D05	Mr. Jason Schroepfer	Naval Sea Systems Command (NAVSEA)	NSSC_SBIR.fct@navy.mil
N251-D06 to N251-D07	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@us.navy.mil

Each DoN SBIR DP2 topic requires documentation to determine that Phase I feasibility, described in the Phase I section of the topic, has been met.

The DoN SBIR DP2 is a two-step process:

> STEP ONE: Prepare and Submit a Phase I Feasibility Proposal (instructions and link to template provided below). The purpose of the Phase I Feasibility Proposal is for the proposing small business concern to provide documentation to substantiate that both Phase I feasibility and the scientific and technical merit described in the topic have been met. The Phase I Feasibility Proposal must: demonstrate that the proposing small business concern performed Phase I-type research and development (R&D) and provide a concise summary of Phase II objectives, work plan, related research, key personnel, transition/commercialization plan, and estimated costs. Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work. The government will evaluate Phase I Feasibility Proposals and select small business concerns to submit a Full DP2 Proposal. Demonstrating proof of feasibility is a requirement for a DP2 award. The small business concern must submit a Phase I Feasibility Proposal to be considered for selection to submit a Full DP2 Proposal.
>
> STEP TWO: If selected, the cognizant SYSCOM Program Office will contact the small business concern directly to provide instructions on how to submit a Full DP2 Proposal.

DoN SBIR reserves the right to make no awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposing small business concerns must read the topic requirements carefully. The Government is not responsible for expenditures by the proposing small business concern prior to award of a contract. For 25.1 topics designated as DP2, DoN will accept only Phase I Feasibility Proposals (described below).

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following section details requirements for submitting a compliant DoN SBIR DP2 Proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposing small business concerns are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.)

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

Eligibility. Each proposing small business concern must:

- Have demonstrated feasibility of Phase I-type R&D work
- Have submitted a Phase I Feasibility Proposal for evaluation
- Meet Offeror Eligibility and Performance Requirements as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA
- Comply with primary employment requirements of the principal investigator (PI) during the Phase II award including, employment with the small business concern at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the PI's time is spent in the employ of the small business concern
- Register in the System for Award Management (SAM) as defined in the Certifications and Registrations section of the DoD SBIR/STTR Program BAA. To register, visit https://sam.gov/

Proposal Volumes. The following seven volumes are required.

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

- **Technical Volume (Volume 2).**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - A submitting small business concern MUST use the DP2 Phase I Feasibility proposal template for Volume 2. The DP2 Phase I Feasibility proposal template can be found at https://navysbir.com/links_forms.htm.

    This template is specific to DoN DP2 topics and meets DP2 submission requirements:
    - ☐ Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
    - ☐ Single column format, single-spaced typed lines
    - ☐ Standard 8 ½" x 11" paper
    - ☐ Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - ☐ No font size smaller than 10-point

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

- **Cost Volume (Volume 3).** The text fields related to costs for the proposed effort must be answered in the Cost Volume of the DoD Submission system (at https://www.dodsbirsttr.mil/submissions/), however, proposing small business concerns DO NOT need to download and complete the separate cost volume template when submitting the DoN SBIR Phase I Feasibility Proposal. Proposing small business concerns are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Snapshot of Proposed Phase II Effort portion of the Technical Volume (Volume 2). Please refer to Table 3 below for guidance on cost and period of performance. Costs for the Base and Option are to be separate and identified on the Proposal Cover Sheet and in the Order of Magnitude Cost Estimate Table in the Technical Volume (Volume 2).

Order of Magnitude Cost Estimate Table			
Line Item – Details	**Estimated Base Amount**	**Estimated Option Amount**	**Total Estimated Amount Base + Option**
Direct Labor (fully burdened) – Prime			
Subcontractors/Consultants			
Material			
Travel & ODC			
G&A			
FCCM			
Fee/Profit			
TABA (NTE $25K, included in total amount)			
Total Estimated Costs			

TABLE 3: COST & PERIOD OF PERFORMANCE

Topic Number	**Base**		**Option**		**Total (NTE)**
	Cost (NTE)	**POP (NTE)**	**Cost (NTE)**	**POP (NTE)**	
N251-D01 to N251-D03	$1,000,000	30 mos.	$300,000	12 mos.	$1,300,000
N251-D04 to N251-D05	$700,000	12 mos.	$1,300,000*	24 mos.*	$2,000,000*
N251-D06 to N251-D07	$1,000,000	24 mos.	$1,000,000	24 mos.	$2,000,000

* Step Two: for the Full Phase II submission, if selected, N251-D04 and ~~N251-D04~~ N251-D05 will require the Phase II Option 1 and Phase II Option 2 to be detailed separately:

- Phase II Option 1: Cost $700,000, Period of Performance 12 months
- Phase II Option 2: Cost $600,000, Period of Performance 12 months

- Additional information:
  - For Phase II a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator. **NOTE:** G&A, if proposed, will only be attributed to the proposing small business concern.

- Provide sufficient detail for subcontractor, material, and travel costs. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel.
- Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.
- The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3.

- **Company Commercialization Report (Volume 4)**. DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Proposal Preparation Instructions and Requirements 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:
  - **Majority Ownership in Part.** Proposing small business concerns which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DoN topics advertised within this BAA. Complete the certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

  - Additional information:
    - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at https://navysbir.com/links_forms.htm to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
      - Additional Cost Information to support the Cost Volume (Volume 3)
      - SBIR/STTR Funding Agreement Certification
      - Data Rights Assertion
      - Allocation of Rights between Prime and Subcontractor
      - Disclosure of Information (DFARS 252.204-7000)
      - Prior, Current, or Pending Support of Similar Proposals or Awards
      - Foreign Citizens
    - 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 Proposal Preparation Instructions and Requirements section of the DoD SBIR/STTR Program BAA for details.

- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7)**. 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 complete the Disclosures of Foreign Affiliations or Relationships to Foreign Countries webform in Volume 7 of the DSIP proposal submission. Please refer to the Proposal Preparation Instructions and Requirements section of the DoD SBIR/STTR Program BAA for details.

DP2 EVALUATION AND SELECTION

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

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

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

- **Technical Volume (Volume 2).** The DoN will evaluate and select Phase I Feasibility proposals using the evaluation criteria specified in the Method of Selectin and 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:

  — A submitting small business concern MUST use the DP2 Phase I Feasibility proposal template for Volume 2. The DP2 Phase I Feasibility proposal template can be found at https://navysbir.com/links_forms.htm.
  This template is specific to DoN DP2 topics and meets DP2 submission requirements:
    - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
    - Single column format, single-spaced typed lines
    - Standard 8 ½” x 11” paper
    - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - No font size smaller than 10-point, except as permitted in the instructions above.

- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will undergo a compliance review to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:

  — Must not exceed values for the Base and Option (refer to Table 3).

— Must meet minimum percentage of work; a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs.

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

- **Supporting Documents (Volume 5).** Supporting Documents (Volume 5) will not be considered in the selection process and will only undergo a compliance review to ensure the proposing small business concern has included items in accordance with the DP2 SUBMISSION INSTRUCTIONS section above.

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

- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7)**. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7) will be assessed as part of the Due Diligence Program to Assess Security Risks. Refer to the DoD SBIR/STTR Program BAA to ensure compliance with Volume 7 requirements.

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 Certifications and Registrations section of the DoD SBIR/STTR Program BAA for details on how DoD will assess security risks presented by small business concerns. The Due Diligence Program to Assess Security Risks will be implemented for all Phases.

Discretionary Technical and Business Assistance (TABA). The SBIR and STTR Policy Directive section 9(b) allows the DoN to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Proposing small business concerns may request, in their Cost Volume (Volume 3), to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase II TABA amount is up to $25,000 per award, 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). The amount proposed for TABA cannot include any profit/fee by the proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to $50,000 per project. A TABA Report, detailing the results and benefits of the service received, will be required annually by October 30.

Request for TABA funding will be reviewed by the DoN SBIR/STTR Program Management Office.

If the TABA request does not include the following items the TABA request will be denied.

- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform (to include the purpose and objective of the assistance)
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any indirect costs, profit, or fee by the SBIR proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA requests must be included in the proposal as follows:

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

Proposed values for TABA must NOT exceed:

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

If a proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern will be eliminated from participating in the Navy SBIR Transition Program (STP), the DoN Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DoN provides directly to awardees.

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

Disclosure of Information (DFARS 252.204-7000). In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this award, the proposing small business concern shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons (defined by National Security Decision Directive 189). A small business concern whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DoN Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DoN Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the Government Contracting Officer, noted in the contract.

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

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

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

System for Award Management (SAM). It is strongly encouraged that proposing small business concerns register in SAM, https:// sam.gov, by the Close date of this BAA, or verify their registrations are still active and will not expire within 60 days of BAA Close. Additionally, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal. A small business concern selected for an award MUST have an active SAM registration at the time of award or they will be considered ineligible.

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

Human Subjects, Animal Testing, and Recombinant DNA. If the use of human, animal, and recombinant DNA is included under a DP2 proposal, please carefully review the requirements at: https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

SELECTION, AWARD, AND POST-AWARD INFORMATION

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

Debriefs. Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the proposal of the proposing small business concerns within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

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

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

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

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

Contract Types. In addition to the negotiated contract award types listed in the section of the DoD SBIR/STTR Program BAA titled Additional Considerations, 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. 4021/10 U.S.C. 4022 and related implementing policies and regulations. The DoN may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Contract Deliverables. Contract deliverables are typically progress reports and final reports. Required contract deliverables must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

Transfer Between SBIR and STTR Programs. Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa.

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DoN will give Phase III status to any award that falls within the above-mentioned description. Consequently, DoN will assign SBIR/STTR Data Rights to any noncommercial technical data and noncommercial computer software delivered in Phase III that were developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DoN protect the rights of the SBIR/STTR firm.

VERSION 3

Navy SBIR 25.1
Direct to Phase II Topic Index

N251-D01	DIRECT TO PHASE II: Passive Acoustics Sonobuoys Intelligence and Machine Learning
N251-D02	DIRECT TO PHASE II: Heat Treatment and Microstructural Modeling & Simulation of High-Performance Gear and Bearing Steel Alloys
N251-D03	DIRECT TO PHASE II: Accelerator-Based Launcher for Shipboard Systems
N251-D04	DIRECT TO PHASE II: Mission Center Large Screen Display Modernization
N251-D05	DIRECT TO PHASE II: Guided Wave Technology for Tank Leak Detection
N251-D06	DIRECT TO PHASE II: Tiling Approach to Large Format Focal Plane Arrays
N251-D07	DIRECT TO PHASE II: Next-generation Design Tools for Accelerated Navy Shipbuilding *

*** N251-D07 NOTE: SEA AIR SPACE EXPOSITION SMALL BUSINESS SHOWCASE:** Small business concerns that are selected to submit a Full DP2 Proposal to topic N251-D07 will be invited to present their capabilities with leadership and attendees during the Navy Sea Air Space Exposition Small Business Showcase (SBS). Sea Air Space will be held April 6-9, 2025 in the Washington, DC area. Please review the Description section of topic N251-D07 for further information.

N251-D01 TITLE: DIRECT TO PHASE II: Passive Acoustics Sonobuoys Intelligence and Machine Learning

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

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

OBJECTIVE: Develop an efficient, robust, and automated system that can process passive acoustic signals, effectively reducing human intervention, reducing operator workload, and improving data analysis accuracy. Develop and demonstrate innovative technologies, including new techniques from other signal processing domains, to enable the Directional Frequency Analysis and Recording (DIFAR) sonobuoy and Airborne Anti-Submarine Warfare (ASW) systems to automatically and accurately detect, classify, track, and localize threats.

DESCRIPTION: The Air Anti-Submarine Warfare (ASW) Systems Program Office (PMA-264), in response to the evolving challenges posed by nation states with significant investment in undersea capability and capacity, wants to develop innovative technologies that advance air ASW systems to reliably detect, classify, track, and localize submarines and unmanned underwater vehicles (UUVs) via passive sensors. This SBIR effort is to be confined to the acoustic processor on an aircraft (manned or unmanned). This SBIR effort should not require any changes to the sonobuoy. The focus is to incorporate advanced technology solutions with integrated sensor data to speed up reaction times that support the acoustic operator and improve passive acoustic target detection, classification, tracking, and localization. Advanced technologies have demonstrated promise in other signal processing domains such as target discrimination, the development of matched filters or templates for never-before-seen targets, and incoherent aggregation of signatures. Techniques may include generating unique identifiable signatures by combining data from multiple receivers or receptions in highly dynamic, real-time environments—even on computationally limited assets—to aid in automated detection, classification, tracking, and localization. These techniques produce additional metadata surrounding a signature to aid or refine classification. Recognition accuracy, reliability, and speed of processing are all important performance goals. The automated and accurate detection, classification, tracking, and localization of targets will go a long way in maintaining ASW superiority in the theater.

Recent advances in artificial intelligence (AI) sensing of passive acoustic data have paved the way for further improvements that rely more on automated processing of data with human operator oversight. The goal is to increase automation in passive acoustic processing with sensor information on the platform and ensure that other relevant data is being leveraged to better inform decision-making (e.g., environmental data, historical data, and sensor fusion data). Solutions will need to show significant accuracy in the detection, classification, tracking, and localization of undersea contacts.

Although the topic chiefly requires a technical solution, it also is focused on developing and maturing the continuum of human-machine interaction. The envisioned solution would allow operators to be part of the process sometimes, with the capability providing them decision-support. While at other times allowing operators to be supervisors of the analysis, providing oversight and expertise. This topic requires a level of automation transparency with the operators to enable a human to quickly understand why the system is presenting the information including the basis of automated detection, classification, and localization. The importance of the human operator's ability to adapt to new information, answer questions about information, and truly analyze an ASW target's characteristics and behavior cannot be overstated. The proposed capability needs to support the warfighter in his or her job and be a power multiplier, while reducing operator workload.

Multiple passive sonobuoys can enable the rapid identification, classification, and localization of threats. In order to extend the current capabilities, efficient innovative techniques are needed. The proposed solution should be designed to significantly enhance the efficiency of detecting, classifying, tracking, and localizing underwater threats, outperforming current capabilities managed by human operators. The system aims to speed up the detection and classification processes, ensuring a high degree of accuracy and reliability. Throughout the development effort, the proposer will be required to provide clear and provable metrics that demonstrate performance improvements when compared to the average acoustic operator capability.

The proposed solution must meet ethics principles outlined by the Department of Defense (Responsible, Equitable, Traceable, Reliable, and Governable) and present a plan that will be accounted for and tracked throughout the effort. Additionally, the final solution will meet Risk Management Framework and Cyber Security.

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

Demonstrate the proof-of-concept techniques for advanced identification, data fusion, signal aggregation, and classification of targets in dynamic ASW scenarios. Demonstrate advanced passive sonar techniques that significantly improve target discrimination in tactical scenarios.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above.

PHASE II: Develop a working prototype that can incorporate the developed advanced passive sonar processing techniques. The prototype capability should be able to ingest synthetic data, as well as real-world training data. Demonstration of the prototype capability should include its capability to perform autonomously and independently, as well as with an operator working with the system.
Work in Phase II may become classified. Please see note in Description paragraph.

PHASE III DUAL USE APPLICATIONS: Refine the capability from the Phase II final demonstration and show consistent reliability in a known performance envelope. A Phase III capability must include and demonstrate a function to self-tune its own algorithm based on new data inputs. The Phase III system must integrate engineering and pass operationally representative testing on an air deployed system and support Navy-supported test scenarios within current acoustic warfare operator training and go through verification and validation testing, as well as effectiveness and usability testing. Transition completed technology to fleet or appropriate Navy platform.

Technology developed in this SBIR topic could be leveraged for other marine monitoring applications. This technology could include air-deployable search and rescue hardware; resource exploration sensor technology; and oceanographic survey instrumentation.

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3. Saffari, A.; Zahiri, S. H. and Khishe, M. “Automatic recognition of sonar targets using feature selection in micro-Doppler signature.” Defence Technology, 20, 2023, pp. 58-71. https://doi.org/10.1016/j.dt.2022.05.007
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6. Fischell, E. M. and Schmidt, H. “Multistatic acoustic characterization of seabed targets.” The Journal of the Acoustical Society of America, 142(3), 2017, pp. 1587-1596. https://asa.scitation.org/doi/10.1121/1.5002887
7. “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

KEYWORDS: Automation; Autonomy; Anti-Submarine Warfare; Machine Learning; Artificial Intelligence; Explainability

N251-D02 TITLE: DIRECT TO PHASE II: Heat Treatment and Microstructural Modeling & Simulation of High-Performance Gear and Bearing Steel Alloys

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

OBJECTIVE: Develop and validate advanced modeling and simulation tools for predicting the microstructural and material property response to raw material melt and heat treatment processing variables of aerospace gear and rolling element bearing steels.

DESCRIPTION: High-performance gear and bearing steel alloys such as X-53, Pyrowear53 (P53), and Pyrowear675 (P675) can be susceptible to several types of material defects such as inclusions, sub-optimal microstructures and undesirable carbide morphologies and chemistries due to the raw material melt and/or heat treatment processes (i.e., carburization). There have been multiple instances where such defects have escaped non-destructive inspection (NDI) quality assurance processes currently in place to preclude these from service, resulting in poor component reliability and catastrophic failure leading to multiple safety mishaps. Traditional methods to address the issue often involve large scale empirical testing to determine root cause and corrective action, which consumes large amounts of resources and time, prohibitive in the current state of warfighter operational tempo and supply chain challenges. Computer modeling and simulation (M&S) is a powerful method that can be applied to explore critical material process variables in a digital space, potentially allowing rapid iteration and ability to reduce the amount of empirical testing required to deliver a robust material solution. Although such M&S tools already exist, there has not been a dedicated effort to apply these to the subject steel alloys of interest and identified above. This SBIR topic is aimed at leveraging existing M&S tools available from small business entities to help address the forgoing material processing issues described above. The end-goal is to enable original equipment manufacturers (OEMs), suppliers, and end users to perform processing simulations, microstructure modeling, and material property predictions to computationally investigate material issues and optimize gear and bearing material performance for critical aerospace applications. There is also potential to leverage across to other alloys once the benefit is realized. Emphasis is on case carburized gear and bearing steel alloys such as Pyrowear675 (P675), X-53, and Pyrowear53 (P53). These alloys are currently used in safety critical components and sub-assemblies including aircraft gearboxes, transmissions and propulsion systems on multiple naval aviation platforms including the F-35, V-22, CH-53K, and H-1.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required to satisfy the requirements of Phase I:
Developed a physics-based computational model and simulation tool capable of performing heat treatment processing simulations, microstructural modeling, and resulting material property predictions. Demonstrated the feasibility of the existing M&S tool by validating simulated predictions with microstructural evaluation of applicable material coupons and specimen/component testing (if available). Examples of validation include, but are not limited to, residual stress measurement and case depth, dimensional/strain measurement through heat treat process, microstructural phase composition determination.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above.

PHASE II: Develop a computational model of one of the materials of interest above as a baseline, with potential expansion to other materials of interest. Explore variables in the digital space that can affect material microstructure, performance, hardenability, and overall fatigue properties. The software tool must be capable of modeling material microstructure in raw material form, account for variations in alloy element compositions including inclusion content and phase transformation, computationally investigate material response to post processing operations (i.e., forging, heat treat, and carburization operations). Anticipated tasks include the following:

1. Coordinate with a supply chain in a representative bearing or gear application to determine detailed material properties and refine modeling and simulation changes in properties that occur through raw material ingot formation, forging, and subsequent heat treatment operations prior to final machining of a component.
2. Investigate carburization response of selected material to heat treat variable processing inputs such as coarsening effects of carbides molybdenum carbide (MoC), chromium carbide (CrC), and other relevant carbides; grain growth, diffusion, and precipitation during carburization equilibrium microstructure and homogenization processes; evaluation of variable processing history to evaluate whether MoC dispersion or alternate microstructural features more significantly impact carburization response and determine methods of elimination.
3. Develop and/or upgrade of an existing modeling tool capable of predicting carbide formation including carbide size, distribution, and location within the microstructure. The modeling tool should be able to establish mitigation strategies for precipitation in areas other than prior austenite grain boundaries as an output.
4. Validate software predictions thru subscale coupon and component testing.

PHASE III DUAL USE APPLICATIONS: Integrate the Phase II developed M&S tool to OEM and suppliers of steel alloy gears and bearings manufacturing process, to optimize alloy melt and heat treatment processes to ultimately provide the Navy with microstructurally robust steel alloy components. Potential dual use applications include any aerospace/automotive/marine/industrial applications that require high performance alloys (e.g., powertrain transmissions systems, turbine engine subcomponents, and gas pipelines).

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KEYWORDS: Inclusions; Carbide Networks; Steel Alloys; Modeling and Simulation; Heat Treatment Modeling; Gears and Bearings

N251-D03 TITLE: DIRECT TO PHASE II: Accelerator-Based Launcher for Shipboard Systems

PLEASE NOTE TOPIC TITLE CHANGE

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

OBJECTIVE: Develop a shipboard Accelerator-Based Launch System to launch group 1-2 unmanned aerial vehicles (UAVs) distances of more than 70 km without using UAV fuel or energy. UAV payload could support intelligence, surveillance, and reconnaissance (ISR) or anti-submarine warfare (ASW) mission threads.

DESCRIPTION: Currently, the United States Navy utilizes traditional launching systems for unmanned aerial vehicles (UAVs) or Vertical Takeoff and Landing (VTOL) UAVs. These systems require a UAV to expense fuel immediately upon launch. The Naval Aviation Community is interested in an innovative air vehicle launching system having significantly higher end speeds to achieve a greater distance before a UAV begins to expense onboard fuel reserves. The Navy seeks to address the limitations of existing launching systems, which suffer from several drawbacks such as onboard fuel dependent launches and large footprints, limiting mission flexibility and ship capacity. With a system such as this, the UAV will have the ability to stay on aloft longer or increase payloads due to the increased fuel reserves. This could provide greater intelligence, surveillance, and reconnaissance (ISR) capabilities and force projection.
Deliverables:

- System Design: Design a shipboard accelerator-based launching system capable of releasing UAVs at speeds exceeding Mach 1. Achieve deployment distances greater than 70 km over ground and altitudes surpassing 40 km.
- Scaled Prototype: Construct a working scaled prototype that accurately models scaled exit velocities, distance over ground and altitude of the full-scale design.
- Air Vehicle Considerations: While the air vehicle doesn't have to currently exist, it can be derived from the launching system's launch forces. Aim for a UAV weight within the group 1-2 category (small to medium-sized), which can be scaled down for the prototype. If possible, a group 3 category weight is optional. Remember that the vehicle's weight directly affects the distance it can travel based on stored fuel capacity as well as duration on station.
- Size: This accelerator is expected to be adapted to work off of a sea-based platform. The ship or platform does not need to currently exist, but it would be preferred. The upper limit size restraint is no more than 294 m in length, 32 m beam and a draft of 12 m so that the vessel can traverse through the world's canals. If the vessel chosen is towed, the design must also incorporate the lead vessel into the mentioned dimensions to adequately be towed through canals.
- Support documentation: Provide documentation that demonstrates the scaled prototype will meet the full-scaled design if a full-scaled prototype was constructed.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required to satisfy the requirements of Phase I:
Proposers interested in submitting a Direct to Phase II proposal must provide documentation to substantiate that the scientific and technical merit and feasibility equivalent to a Phase I project has been met. Documentation can include data, reports, specific measurements, success criteria of a prototype, and so forth.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above.

PHASE II: Provide a detailed design and engineering analyses consistent with a Critical Design Review. Include a demonstration of the full-scale system operating in simulation. If a subscale prototype can be built, utilize that to validate model performance. Provide detailed cost estimate, and a plan for manufacturing the full-scale prototype.

PHASE III DUAL USE APPLICATIONS: Build and test a full-scale prototype at sea.
This SBIR topic may benefit the private sector by providing a ship-based launching platform for satellites and UAVs. Having a mobile platform will better alleviate air and sea traffic from the area based on time of day, sea conditions, orbit or launch angle is required.

REFERENCES:
1. Sayler, K. M. "Hypersonic Weapons: Background and Issues for Congress (R45811)." Congressional Research Service, February 9, 2024. https://crsreports.congress.gov/product/details?prodcode=R45811
2. Guertin, N. H. “Director Operational Test & Evaluation Report FY22.” Department of Defense, January 2023, p. 18. https://www.dote.osd.mil/portals/97/pub/reports/fy2022/fy22doteannualreport.pdf

KEYWORDS: Rotational Accelerator; Rotational Launcher; Launcher; Unmanned Aerial Vehicles; UAVs; Group 1, Group 2; Accelerator

N251-D04 TITLE: DIRECT TO PHASE II: Mission Center Large Screen Display Modernization

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

OBJECTIVE: Develop and demonstrate innovative technologies that upgrade the large screen display system in Ship's Mission Center (SMC) to improve mission viewing, introduce advanced mounting methodologies, and enhance viewing specifications to meet Navigation Electronic Chart Display and Information System – Navy (ECDIS-N) requirements.

DESCRIPTION: Improvement to the operational picture within the SMC is needed to modernize key capabilities by replacing the currently obsolete system. The Navy seeks an innovative large screen display with improved access for maintenance, improved operational availability (Ao) and minimal Mean-Time-To-Repair. The proposer should develop and demonstrate innovative technologies that upgrade the display system in the SMC to improve mission viewing, introduce advanced mounting methodologies, and enhance viewing specifications to meet Navigation Electronic Chart Display and Information System – Navy (ECDIS-N) requirements.

The Ship's display system requires an upgrade that will promote and support an efficient and rapidly responsive combat environment. The current configuration consists of four (4) projectors displaying an image on one (1) large display. Any proposed modular display should not exceed the dimensions of 280"x50" and must meet all environmental qualification requirements. Proposed technology must be capable of displaying high resolution content using computer inputs as well as a Jumbotron fine pixel pitch. Solutions must provide an acceptable viewing distance/range from 6ft to 30ft. The upgraded display system must be modular, facilitate ease of repair, and have a display and mounting structure no thicker than 6" from the bulkhead. Technology must fit within the existing interior of the SMC. Solution should utilize advanced mounting methodologies that incorporate shock and vibration mitigation. Any repairs should be quickly implemented to allow for continued operations and testing. Minimal training should be required for this process. The improved display should reduce maintenance and improve safety with a secured system by allowing for accessible maintenance. Ship integration of selected panel technology must incorporate Navy specific data inputs as determined by a review of existing system discrepancies and limitations. Develop display upgrades to bring available wall display technologies up to Navy standards for current Navy Combatant ships, starting with the DDG 1000 class. Supporting documents to be developed will include updates of drawing packages and Ship Change Documents submission. Leveraging existing commercial wall display technologies, potential solutions should advance system capabilities to meet or exceed all Navy ship specific requirements.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:
Display viewing area as large as feasible to fit within the SMC not to exceed 280" wide x 50" high.
Provide resolution appropriate for viewing distance/range from 6ft to 30ft.
Display must meet color, brightness, and resolution requirements of ECDIS-N and other conventional ship console displayed systems.
Display system must be modular, easy to repair, and hatchable at the lowest replaceable unit level.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DoN SBIR 25.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop and demonstrate innovative technologies that upgrade the large screen display system in the SMC to improve mission viewing, introduce advanced mounting methodologies, and enhance viewing specifications to meet ECDIS-N requirements. Continue to develop the large screen display prototype through specified analysis and qualification testing to Navy requirements. Utilize mock-ups and customized application testing to validate the prototype hardware performance and that the above requirements are met and propose necessary modifications.

Provide specific design and hardware plan for a DDG 1000 SMC large screen display to meet or exceed the threshold performance objectives. Manufacture a prototype display to scale appropriate for evaluation. Develop a qualification test plan to include environmental requirements. Ensure the system design accommodates all shipboard input formats and meets Navy cyber protection standards. Execute test plan to fully qualify display and mounting system for a DDG 1000 SMC. Work with a Program Office to develop a final packaging design that meets the platform’s Size, Weight, and Power (SWaP). Produce qualified first article at full scale suitable for installation in a DDG 1000 class ship. Demonstrate system performance in a military-relevant environment and ensure production readiness.

PHASE III DUAL USE APPLICATIONS: Support the DoD in transitioning large format displays to other operational environments. Commercial applications for such technology could include outdoor venues, cruise ships, fishing boats, golf courses, and sporting events.

REFERENCES:
1. Canedy, Chadwick L.; Bewley, William W.; Tomasulo, Stephanie; Kim, Chu Soo; Merritt, Charles D.; Vurgaftman, Igor; Meyer, Jerry, R.; Kim, Miijin; Rotter, Thomas J.; Balakrishnan, Ganesh and Golding, Terry D. "Mid-infrared interband cascade light emitting devices grown on off-axis silicon substrates." Opt. Express 29, 2021, pp. 35426-35441. https://doi.org/10.1364/OE.435825
2. Ermolaev, M., Lin, Y., Shterengas, L., Hosoda, T., Kipshidze, G., Suchalkin, S., & Belenky, G. “GaSb-Based Type-I Quantum Well 3–3.5-µm Cascade Light Emitting Diodes.” IEEE Photonics Technology Letters, 30(9), 8, 2018, pp. 69-872. https://doi.org/10.1109/LPT.2018.2822621
3. Brereton, Erin. “Universities Use Video Walls as Storytelling Tools.” EdTech, 20 Feb 2024. https://edtechmagazine.com/higher/article/2024/02/universities-use-video-walls-storytelling-tools
4. “Video Wall Installation - The Top 5 Questions we hear from our clients!” Casaplex, 11 June 2024. https://casaplex.com/video-walls/?gad_source=1&gclid=EAIaIQobChMItIa9jfzThgMVSYiuBR0liASCEAAYAiAAEgJaMPD_BwE

KEYWORDS: Screen Display; Navigation Electronic Chart Display and Information System – Navy (ECDIS-N); High Resolution; Modular; Mounting Technology; Secured System

N251-D05 TITLE: DIRECT TO PHASE II: Guided Wave Technology for Tank Leak Detection

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

OBJECTIVE: Develop a portable, user-friendly Non-Destructive Testing and Evaluation (NDT&E) technology that will provide objective and easy to interpret data to detect and locate leaks in shipboard tanks without opening the tank.

DESCRIPTION: The Navy is interested in the application of methods or tools that may be combined with tank air testing to locate leaks. The Navy requires development of an advanced and novel solution that will allow for initial assessment to be performed more efficiently than the current process of targeting areas of concern that may require more detailed x-ray (NDT&E) to be performed. Examples of these new technologies for consideration should include the field of ultrasonics (guided waves) for test and analysis and provide a solution that is cost effective in purchase, operation, repair, and training.

Structurally sound and leak free tanks are mandatory to support a fully operational Naval asset. Tank repairs and satisfactory tank tightness testing are prerequisites for timely completion of ship repair availabilities. Locating leaks in built-in tanks is challenging, costly, and consumes valuable availability of man-hours. Commercial ships are required to conduct tank tightness checks on tanks that are opened in a shipyard availability and following repairs in accordance with ABS rules. Similarly, Navy repair activities follow similar requirements in accordance with NAVSEA technical requirements. Tanks are verified tight through hydro-pneumatic or pneumatic pressure drop testing. Difficult to locate leaks in U.S. Navy surface ships are identified by entering a tank, visually inspecting it for suspect areas, cleaning the suspect areas, and performing magnetic particle testing to confirm the extent of the defect. Preparations in larger tanks may involve expensive staging to obtain safe access to suspect areas. The Navy requires a technology that can locate leaks prior to opening a tank to help direct visual and conventional NDT&E follow-up to a leak location to expediting repairs, save man-day costs, and contribute to on-time availability completion.

Built-in tanks on surface combatants, amphibious ships, carriers, and auxiliary ships are most susceptible to leaks due to weld cracks, corrosion thinning, and tank penetration stress concentrations. The Navy requires an NDT&E method or tool that will direct an NDT&E technician to a specific area in a tank where a leak is present without entering the tank. The ability to accurately determine a leak location will result in a significant decrease in inspection and repair man-hours and ultimately, expedite satisfactory tank close out leading to on-time availability completions. The method or tool must be portable, capable of operation with or without the availability of a power source, and provide automated results easily interpreted by shipyard trades that routinely test tanks for tightness. It is highly desirable that the tank leak locating method or tool provide leak locating utility during pre-availability and early availability periods. The developed solution can be used in statically and dynamically assessing the integrity of naval vessel storage tanks.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type feasibility effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements for identifying leaks in built-in tanks using a novel NDT&E solution.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DoN SBIR 25.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop and deliver an advanced, portable, NDT&E solution (hardware/software/firmware) using guided wave technology (ultrasonics) for use by shipyard or regional maintenance center personnel in assessing liquid stage tanks (fuel, water, lube oil, etc.). Produce a prototype to be used to determine and locate leaks and material defects in tanks without opening the tank plus applicable technical data and training.

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology for Navy use. Provide and field an NDT&E system based on unique, cutting-edge technology that will be used for non-invasively and accurately locating leaks in tanks on naval vessels. Provide Navy personnel with training on how to utilize the system for the collection of data. Work with Navy personnel in conducting analysis until such time as they intend to assume that role.

In a manner like shipboard tank assessments, this same novel NDT&E system can be employed on large, above ground storage tanks (AST), common to both military and civilian petrochemical storage, to identify and locate AST bottom plate leaks and assess AST bottom plate integrity.
This technology would apply to commercial ship inspections.

REFERENCES:

1. Hay, Thomas R., Ph.D., P.E. “A Review of Non-destructive Testing Methods for Aboveground Storage Tank Floor Inspection.” TechKnowServ, February 2019. https://www.techknowserv.com/post/a-review-of-non-destructive-testing-methods-for-aboveground-storage-tank-floor-inspection
2. “Naval Ships’ Technical Manual Chapter 631, Preservation of Ships in Service – General, S9086-VD-STM-101 Revision 3.”
3. Fyu, Feng; Zhou, Xinyue; Ding, Zheng; Qiao, Xinglong and Song, Dan, “Application Research of Ultrasonic-Guided Wave Technology in Pipeline Corrosion Defect Detection: A Review.” Multidisciplinary Digital Publishing Institute – Coatings 2024. https://www.researchgate.net/publication/379061512_Application_Research_of_Ultrasonic-Guided_Wave_Technology_in_Pipeline_Corrosion_Defect_Detection_A_Review

KEYWORDS: Guided Wave Analysis; Leak Detection; Non-Destructive Testing & Evaluation; Ultrasonic Sensors; Tanks; Microelectronics

N251-D06 TITLE: DIRECT TO PHASE II: Tiling Approach to Large Format Focal Plane Arrays

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

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

OBJECTIVE: Develop and demonstrate a focal plane array (FPA) tiling technique that permits small, high-yield FPA and/or read-out integrated circuits (ROIC) chiplets to be assembled into a high-performing, large format FPA having appropriate flatness (or curvature) and uniformity to produce high-quality, wide field-of-view (FOV) imagery with improved manufacturing cost and yield.

DESCRIPTION: FPAs are routinely used in military imaging systems operating in the infrared (IR) spectral bands. Achieving high resolution and wide FOV simultaneously results in competing objectives as high resolution requires many pixels on target, while widening FOV inherently leads to increasing pixel sparsity. FPA technology development is therefore driven to two extremes: smaller pixels to increase resolution and larger array sizes to increase FOV. However, due to the lack of lattice compatibility between crystalline Si-based ROIC and epitaxially grown IR detector materials, the sensing layer and ROIC are currently assembled using indium-based bump-bonding techniques, which become more difficult as pixel size is decreased and array size increased. FPA advancement is further challenged by decreasing ROIC yield with increasing ROIC size due to the exponential increase in fabrication defects with ROIC area. While alternatives to bump-bonding may be found, the ROIC yield challenge continues to impede large FPA development because a multitude of Silicon (Si) wafers must be sacrificed to achieve a few ROICs that meet performance requirements.

To improve ROIC yield, tiling approaches in which high yielding small format ROICs or FPAs are assembled into larger arrays have been suggested for over a decade, but tiling remains largely a concept. The active area of existing ROIC designs is surrounded by peripheral electronics that provide address logic and detector bias voltages. To enable tiling, the peripheral electronics must be relocated to permit high fill-factor assembly, thereby avoiding image artifacts arising from inter-tile gaps. The tiled array must also be highly planar to remain within the depth of focus of the image collection optic. These requirements can potentially be met by 3D electronics integration, which should in principle be easy as the connection involves only Si-based analog and digital layers. The purpose of this Direct-to-Phase-II topic is to develop and demonstrate a prototype process for low-cost, large MWIR FPA and ROIC fabrication with tiling.

PHASE I: For a Direct-to-Phase II topic, the Government expects that the small business has accomplished the following:

- Demonstrated experience in FPA fabrication.
- Developed ROIC designs that enable 2- and/or 4-sided tiling of ROICs or FPAs, such that peripheral electronics have been relocated.
- Developed a tiling technique that enables 2- and/or 4-sided tiling of ROICs or FPAs with sufficient precision to permit inter-tile gaps of < 1 pixel to be routinely achieved.
- Developed techniques to synchronize tile-based images to form full-frame images.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DoN SBIR 25.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: The Phase II effort, including the Base and Option periods, should fabricate a fully functional tiled FPA consisting of at least 4 tiles, either in a 2x2 2D tile array or a 1x4 1D tile array mounted on a precision interposer. The preferred detector type is the high operating temperature (HOT) mid-wave infrared (MWIR) strained-layer superlattice (SLS) detector. Individual tiles should consist of NKxMK (for example 2048 x 2048) arrays of 5 micrometer (um) pixels, where N and M are selected to produce maximum tiled FPA yield. It is anticipated that peripheral electronics will be direct-bonded to form a multi-layer 3D integrated stack consisting of the detector layer, analog electronics layer, mixed signal layer, and precision interposer layer, although other designs, such as 1D tile arrays where all peripheral electronics are located on 2 sides, are also of interest. The tiling process can involve assembly of complete FPA tiles on an interposer or the assembly of ROIC tiles followed by bonding of a single, full-size, detector array. The tiled FPA will be fabricated from selected, defect-free individual tiles, as some defective tile yield is expected even for these smaller ROIC units. Importantly, the sensor chip assembly should be thoroughly and quantitatively characterized at ambient and operating temperature for operability, noise, gap widths, planarity, and be ready for camera integration in separate, subsequent testing.) Phase II deliverable will be a prototype camera core (tiled sensor chip assembly) packaged in a test dewar with appropriate optics and control electronics. A final report will include relative design and data package, Manufacturing Readiness Level (MRL) assessment for large format focal plane array producibility, and user’s manual for the prototype camera. The Seminal Transition Event will include an imaging demonstration and will occur at the conclusion of Phase II.

PHASE III DUAL USE APPLICATIONS: Large format FPA arrays are in demand across the Services. Within the Navy, the Shipboard Passive Electro-Optic and Infrared (SPEIR) Program of Record (PoR) has a requirement for wide FOV, high-resolution MWIR sensors for surface ships to which this technology is expected to transition. Successful completion of Phase II is expected to result in Phase III funding to scale up the tiled FPA size, improve manufacturability, and pursue other optimizations. Extensive field testing will be performed in Phase III in relevant environments to demonstrate capability. Successful demonstration of tile-based large array format sensors would benefit and improve camera technologies for the commercial digital photography and computer vision, astrophotography/astronomy, and autonomous navigation markets.

REFERENCES:

1. Fillion, R.; Wojnarowski, R.; Kapusta, C.; Saia, R.; Kwiatkowski. K. and J. Lyke, J. “Advanced 3-D stacked technology.” Proceedings of 5th Electronics Packaging Technology Conference, EPTC 2003, Article number 127148, pp. 13 – 18. https://ieeexplore.ieee.org/document/1271482

2. Renault, S.; Berger, F.; Franiatte, R.; Mermin, D. and De Brugiere, B.G. “Packaging of a 25-Tiles Device on Large Dimension AlN Ceramic Substrate Keeping Low Dead Areas and Tight Planarity.” 2023 IEEE CPMT Symposium Japan, ICSJ 2023, pp. 69–72. https://journals.scholarsportal.info/details/24758418/v2023inone/69_poa2doldaatp.xml

KEYWORDS: Focal Plane Array (FPA); Tiling; Chiplet; Readout Integrated Circuit (ROIC), Optical Detector Array; Mid-Wave Infrared (MWIR); Infrared; IR

N251-D07 TITLE: DIRECT TO PHASE II: Next-generation Design Tools for Accelerated Navy Shipbuilding

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

OBJECTIVE: Develop next-generation software design tools for Navy vessels, with a focus on medium or large autonomous surface vessels, that will enable dramatically faster design, construction, and outfitting times.

DESCRIPTION: The U.S. commercial shipbuilding industry is not competitive in the world market and has become a key vulnerability in the U.S. defense industrial base [Ref 1]. U.S. shipbuilding capacity has contracted drastically over the past decades; however, the Navy's shipbuilding budget has increased over the past several years, creating significant challenges in the U.S.'s capacity to meet that demand [Ref 2]. Increasing output quickly and efficiently involves addressing several areas such as shipyard modernization, rebuilding the workforce, and strategic economic development [Ref 2]. In addition, and the focus of this SBIR topic, is the development of new design tools for Navy ships or combatant craft (defined for the purposes of this topic as smaller vessels up to 200 ft long).

The intent of this topic is a substantial increase in the capability of design tools over today's state-of-the-art, directed toward dramatically faster design and construction (including fabrication, outfitting, and testing) times, with a focus on medium or large autonomous surface vessels. It is anticipated that the starting TRL of this effort will be TRL 2-3. The Navy today uses several tools, such as CREATE-SHIPS, which is a set of physics-based engineering tools developed by DoD [Refs 3,4,5] and includes, for example, Rapid Ship Design Environment (RSDE) for concept design, Integrated Hydrodynamics Design Environment (IHDE), and Integrated Structural Design Environment (ISDE). The Navy also uses Leading Edge Architecture for Prototyping Systems (LEAPS) [Ref 6] for a common database, Smart Ship Systems Design (S3D) [Ref 7], etc. Great progress has been made over the past few years in the development of new design tools, such as tools for simulation and virtual testing, digital twins, tools that help understand the cost and schedule impacts of requirements, visualization tools such as virtual reality, etc. Today, we are seeing tremendous advances in artificial intelligence/machine learning (AI/ML) approaches and increasing availability of large datasets. Ship requirements evolve rapidly and increasing complexity requires greater design space exploration. AI/ML approaches have potential to enable this design space exploration. Further, multi-domain optimization techniques continue to be developed, providing additional ability to explore design space [Ref 8].

Questions to consider include (1) Can a ship design be optimized for producibility, using a much larger number of parameters than possible today? And (2) Furthermore, might the entire construction be optimized, early in the design phase, including fabrication, outfitting, and testing, rather than just optimizing the structure? Moreover, quantum computing is maturing rapidly, which might allow huge numbers of possible alternatives to be examined quickly and efficiently. Computational fluid dynamic (CFD) capability has also progressed substantially [Ref 9] so can CFD and other methods be used to enable simulation capability for virtual testing of the hydrodynamic performance of early-stage designs? Virtual testing may also be beneficial for structure, control systems, topside signatures, shock damage, underwater explosion, and chemical/biological/radiation/nuclear (CBRN) defense. Digital twins of shipboard systems or subsystems might be used to optimize producibility so could a digital twin of the entire manufacturing process (construction, outfitting, testing) be used to optimize the process and foresee bottlenecks or rate-limiting steps?

Capabilities for design space exploration, design optimization, understanding cost and schedule earlier in the design process and understanding cost and schedule impact of changed requirements will all play a role in increasing the U.S. shipbuilding capacity.

SEA AIR SPACE EXPOSITION SMALL BUSINESS SHOWCASE: Small business concerns that are selected to submit a Full DP2 Proposal to topic N251-D07 will be invited to present their capabilities with leadership and attendees during the Navy Sea Air Space Exposition Small Business Showcase (SBS). As Sea Air Space occurs after the selections for consideration of award for Full DP2 Proposals, no information presented by the small business concerns at Sea Air Space will be considered evaluative. Small business concerns that submit a proposal to topic N251-D07 will be invited to attend the Small Business Showcase. Information on registration for the Small Business Showcase will be sent via email to the contacts listed on the proposal coversheet after the close of this BAA. Sea Air Space will be held April 6-9, 2025 in the Washington, DC area. Though there is no registration fee to participate in the Small Business Showcase activity at Sea Air Space, all travel, lodging, and other related costs for Sea Air Space are the responsibility of the small business concern.

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

- Proposals must show that the Offeror understands the current state of the art in ship design tools including the ones mentioned above, explain how the proposed approach will advance the state of the art and explain the return on investment.
- Proposals must describe in detail the Offeror's concept for next-generation ship/craft design tools. The proposal should clearly explain the rationale for the selection of the proposed concept for next-generation ship or craft design tools and how it will enable faster design and construction times. This rationale must be clearly supported by, for example, analysis, testing in simulation, and/or small scale-model testing. The rationale must include a discussion of how the proposed approach addresses and significantly accelerates a rate-limiting step in the design process.
- Proposal must clearly define the scope of the proposed effort, which is anticipated to be a subset of that discussed in the Description section, and show that the proposed scope is commensurate with the available resources and project duration.
- Approaches to next-generation ship/craft design tools that are adapted from non-maritime systems are of interest. In this case, the proposal would need to demonstrate understanding of the differences between design of the non-maritime system and a ship and how these differences will be addressed in the SBIR Phase II.
- Approaches that leverage previous lower-TRL research in this area are of interest and partnering with a university engaged in this research will be beneficial.
- The proposal must describe the approach to testing and validation of the next-generation design tool(s). The proposal must provide a clear explanation of the feasibility of the proposed testing methodology.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 25.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Using results from the Phase I-type effort, develop, demonstrate, and validate prototype next-generation ship design tool(s) that develop next-generation design tools for Navy ships that will enable faster ship design and construction (including fabrication, outfitting, and testing) times.
Address, at a minimum:

1) Development of the algorithm, process, etc. that the next-generation design tool will be based on.
2) Testing to support development of the next-generation design tools(s).
3) Testing to confirm and validate the function of the next-generation design tools(s). This testing will confirm the ability of the design tool(s) to reduce ship design and construction time. The validation phase will elucidate the exit TRL of the next-generation design tool(s) resulting from this project.
4) Clearly define the scope of the proposed effort, which is anticipated to be a subset of that described in the Description above and show that the proposed scope is commensurate with the available resources and project duration.
5) Description of how the software is architected to address cyber security issues and the approach for doing so.

Provide deliverables that include the next-generation design tool software, a report containing robust documentation of the software data acquired during this project (including algorithms, architecture, interfaces, build instructions, necessary software components and environment to build the next-generation design tool software, and a software user manual); and test methodology, metrics, and results.

Note: Teams that are structured to facilitate knowledge transfer of previous research results to this project, for example a small business-university team, are strongly encouraged.

The Phase II period of performance is anticipated to be four years; 24 month Base, 24 month Option, if exercised.

PHASE III DUAL USE APPLICATIONS: Given successful completion of the Phase II project and subject to availability of funding, the expected transition of next-generation ship design tools resulting from this Phase II SBIR is expected to be into the acquisition program. To enable successful commercialization, Phase III is expected to address integration, via interfaces defined by the Navy, of the next-generation ship design tool(s) product resulting from this Phase II SBIR into a larger architecture, cyber security compliant next-generation ship design tool, as well as additional rigorous testing in higher fidelity environments. Such a set of design tools might also be used to design commercial or civilian ships.

REFERENCES:

1. “U.S. Commercial Shipbuilding in a Global Context.” Congressional Research Service, November 15, 2023. https://crsreports.congress.gov/product/pdf/IF/IF12534
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3. Post, Douglass E. and Kendall, Richard P. "Creating and Using Virtual Prototyping Software - Principles and Practices." Addison-Wesley, 2022. https://www.amazon.com/Creating-Using-Virtual-Prototyping-Software-ebook/dp/B09HK5V97V
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9. Park, S. et al. "6DoF CFD Analysis for High-Speed Small Craft in Free Running Conditions, Ships and Offshore Structures." Ships and Offshore Structures, 1-21. https://doi.org/10.1080/17445302.2024.2393478

KEYWORDS: ship design tools; shipbuilding; multi-objective optimization; digital twin; computational fluid dynamics; autonomous surface vessels

DEPARTMENT OF THE AIR FORCE
25.1 SMALL BUSINESS INNOVATION RESEARCH (SBIR)
PHASE I
PROPOSAL SUBMISSION INSTRUCTIONS

The Air Force intends these Phase I proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Offerors must ensure proposals meet all requirements of the SBIR Program 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.

- Full component-specific instructions and topic descriptions are available on DSIP at https://www.dodsbirsttr.mil/submissions/solicitation-documents/active-solicitations. 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 DAF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, “25.1 Address Change”.

Points of Contact:

General information related to the AF SBIR/STTR program and proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us. 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 25.1 BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
    - Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

General information related to the AF Small Business Program can be found at the AF Small Business website, http://www.airforcesmallbiz.af.mil/. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

PHASE I PROPOSAL SUBMISSION

The DoD SBIR 25.1 Broad Agency Announcement, https://www.dodsbirsttr.mil/submissions/login, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic’s requirements.

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
Volume 7: Disclosures of Foreign Affiliations or Relationships to Foreign Countries

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 25.1 SBIR BAA. In addition to the requirements found in the 25.1 SBIR 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 university or other consultants in the project's planning and/or research stages may be appropriate. If so, describe in detail and include information in the Cost Volume. The proposed total of consultant fees, facility lease/usage fees, and other subcontract or purchase agreements may not exceed **one-third of the total contract price** or cost (do not include profit in the calculation), unless otherwise approved in writing by the CO. The SBIR funded work percentage calculation considers both direct and indirect costs after removal of the SBC's proposed profit. Support subcontract costs with copies of executed agreements. The documents must adequately describe the work to be performed. At a minimum, include a Statement of Work (SOW) with a corresponding detailed Cost Volume for each planned subcontract.

f. **Special Tooling, Special Test Equipment, and Material**: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness to the work proposed. Special tooling and special test equipment purchases must, in the CO's opinion, be advantageous to the Government and relate directly to the effort. These toolings or equipment should not be of a type that an offeror would otherwise possess in the normal course of business. These may include items such as innovative instrumentation and/or automatic test equipment.

g. **Consultants**: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

NOTE: If no exceptions are taken to an offeror's proposal, the Government may award a contract without negotiations. Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. If there are questions regarding the award document, contact the Phase I CO identified on the cover page. The Government reserves the right to reopen negotiations later if the CO determines doing so to be necessary.

COMPANY COMMERCIALIZATION REPORT (VOLUME 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR 25.1 BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

SUPPORTING DOCUMENTS VOLUME (VOLUME 5)

The following documents may be required if applicable to your proposal:

1. DD Form 2345: For proposals submitted under export-controlled topics, either International Traffic in Arms or Export Administration Regulations (ITAR/EAR), a copy of the certified DD Form 2345, Militarily Critical Technical Data Agreement, or evidence of application submission must be included. The form, instructions, and FAQs may be found at the United States/Canada Joint Certification Program website, http://www.dla.mil/HQ/InformationOperations/Offers/Products/LogisticsApplications/JCP/DD2345Ins tructions.aspx. DD Form 2345 approval will be required if proposal if selected for award.
2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 25.1 BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)

Note that the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

DISCLOSURES OF FOREIGN AFFILIATIONS OR RELATIONSHIPS TO FOREIGN COUNTRIES (VOLUME 7)

Small business concerns must complete the Disclosures of Foreign Affiliations or Relationships to Foreign Countries webform in Volume 7 of the DSIP proposal submission. Please be aware that the Disclosures of Foreign Affiliations or Relationships to Foreign Countries WILL NOT be accepted as a PDF Supporting Document in Volume 5 of the DSIP proposal submission. Do not upload any previous versions of this form to Volume 5. For additional details, please refer to the DoD SBIR Program BAA.

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 25.1 BAA. DAF is seeking varying technical/scientific approaches and/or varying and new technologies that would be responsive to the problem statement(s) and area(s) of interest in the topic. Multiple procurements are planned and anticipated to be awarded as a result of the topic, each proposal is considered a separate procurement and will be evaluated on its own merit, and that the Government may award all, some, or none of the proposals. Any per-award or per-topic funding caps are budgetary estimates only, and more or less funding may become available. Funding decisions are made with complete disregard to the other awards under the same topic.

In accordance with 15 USC 638(vv) (Section 4 of the SBIR and STTR Extension Act of 2022), and the Deputy Secretary of Defense Memorandum; Subject: Defense Small Business Innovation Research and Small Business Technology Transfer Due Diligence Program dated May 13, 2024, 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 DAF Topics.

PERFORMANCE OF WORK REQUIREMENTS AND LOCATION OF WORK

For Phase I, a minimum of two-thirds of the research or analytical effort must be performed by the Awardee. The DAF measures percentage of work by both direct and indirect costs, not including profit. Occasionally, the DAF will consider deviations from this performance of work requirement. **Requests for Performance of Work deviations must be made twice: prior to submission during the topic open period and as part of the initial proposal submission.** For requests prior to the initial proposal submission, the DAF will consider the request and approve or disapprove requesting applicants to proceed with DSIP submission. Upon proposal receipt, the DAF will again consider such requests for approval for the resultant award.

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 SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Air Force SBIR/STTR Contracting Officer Daniel J. Brewer, Daniel.Brewer.13@us.af.mil.

AIR FORCE SUBMISSION OF FINAL REPORTS

All Final Reports will be submitted to the awarding DAF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

PHASE II PROPOSAL SUBMISSIONS

DAF organizations may request Phase II proposals while 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 DAF SBIR/STTR One Help Desk. Phase II dollar values, performance periods, and proposal content will be specified in the Phase II request for proposal.

NOTE: The DAF primarily makes SBIR Phase I and II awards as Firm-Fixed-Price contracts. However, awardees are strongly urged to work toward a Defense Contract Audit Agency (DCAA)-approved accounting system. If the company intends to continue work with the DoD, an approved accounting system will allow for competition in a broader array of acquisition opportunities, including award of Cost-Reimbursement types of contracts. Please address questions to the Phase II CO, if selected for award.

All proposals must be submitted electronically via DSIP by the date indicated in the Phase II proposal instructions. Note: Only ONE Phase II proposal may be submitted for each Phase I award.

AIR FORCE SBIR/STTR PROGRAM MANAGEMENT IMPROVEMENTS

The DAF reserves the right to modify the Phase II submission requirements. Should the requirements change, all Phase I awardees will be notified. The DAF also reserves the right to change any administrative procedures that will improve management of the DAF SBIR/STTR Program at any time.

DAF Phase I Topic Index

Topic Number	Topic Name	Proposal Maximum PoP*	Proposal Maximum Value**	Technical Volume (Volume 2) Page Limitation***
AF251-0001	Reliable and Explainable Data-driven Methods for ELINT Signal Detection/Classification	6 Months	$140,000.00	20 Pages/Slides
AF251-0002	High Assurance Containerization and Orchestration	6 Months	$140,000.00	20 Pages/Slides
AF251-0003	Advanced Battery Technologies for Directed Energy Weapon Systems	6 Months	$140,000.00	20 Pages/Slides
AF251-0004	LLM for Assessment of Cognitive Warfare Effectiveness in Competition	6 Months	$140,000.00	20 Pages/Slides
AF251-0005	Comprehensive Framework for Test & Evaluation of Digital Twins	6 Months	$140,000.00	20 Pages/Slides
AF251-0006	TH-1H Helicopter Health Usage and Monitoring System (HUMS)	6 Months	$140,000.00	20 Pages/Slides
AF251-0007	Inspection of Bonded Composite Structures Through Fairing Materials	6 Months	$140,000.00	20 Pages/Slides
AF251-0008	High-Temperature Co-fired Ceramic Heat Flux Sensor	6 Months	$140,000.00	20 Pages/Slides
AF251-0009	Miniature Visible-Band Video Camera for Afterburner Probes, Hypersonic Propulsion Systems, and Combustion Driven Test Facilities	6 Months	$140,000.00	20 Pages/Slides
AF251-0010	Non-intrusive, Very-High-Speed (100 kHz), Time-Resolved Velocity and Temperature (Rotational and Vibrational) Measurements in Large-Scale Hypersonic Wind Tunnels	6 Months	$140,000.00	20 Pages/Slides
AF251-0011	High-Capacity Internal Balance	6 Months	$140,000.00	20 Pages/Slides

*Proposals in excess of this duration will not be considered for award.
**Proposals in excess of this amount will not be considered for award.
***Pages/slides in excess of this number will not be considered during proposal evaluations.

TOPIC NUMBER: AF251-0001

TITLE: Reliable and Explainable Data-driven Methods for ELINT Signal Detection/Classification

TECHNOLOGY AREAS: Sensors; Electronics; Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: To develop data-driven signal processing methods that produce reliable results in a wide variety of ELINT scenarios and whose operation is easily interpretable. This methodology will be used to produce robust algorithms that are designed from training data and whose assumptions for good performance can be quantified and verified.

DESCRIPTION: The traditional approach to the design of ELINT algorithms relies on the assumption of having explicit signal and clutter models for the data to be processed [1]. Such models are predicated on the availability of probability density functions for the signal(s) and clutter. With the advent of larger dimension data sets, more agile waveforms, and more complex clutter environments, this task is becoming increasingly more challenging. An alternative approach is to base the design on training data and machine learning techniques [2]. However, typical approaches such as neural networks and other machine learning methods have been applied “blindly” without much theory. As a result, when results do not agree with those obtained with the training data, no methods are available to discern the source of the problem [3]. It is therefore desired to make use of training data in the design, but to use techniques whose underlying assumptions are known and therefore, can alert the user to potential poor performance in advance of deployment. Note that this training data should not necessarily be raw data but could be spectrogram or other time-frequency data [4,5], which as feature data is more attuned to the discrimination problem at hand. As an example, two-sample approaches, in which training data spectrograms and test data spectrograms that are compared with a meaningful metric, may be viable. The problem of detection/classification can be viewed as a question of the degree of matching between the training data and the test data for a given hypothesis. As such, it falls within the framework of a “two-sample” problem. The two-sample problem is well established and researched endeavor and therefore there is much theory available to approach this inference problem. Some attempts in this direction can be found in [6]. In this way, the existing theory can be leveraged to guide the user as to the appropriate use of an algorithm, and furthermore if poor algorithm performance if observed, the reasons will become known to the user, being provided by nonvalid assumptions. This will benefit the overall system mission by improvements of system signal processing performance by utilizing the most reliable approaches for various scenarios. These scenarios may include airborne radar, passive radar, illuminators of opportunity, as well as others.

PHASE I: Propose methods that can be trained using realistic data. Use synthetic data sets to demonstrate effectiveness. Baseline approaches based on a probability density function model as well as one derived from machine learning methods should be used for performance comparisons.

PHASE II: Further refine and develop the algorithms for ELINT tasks. Conduct high fidelity demonstration/validation of algorithm performance, based on finer grained simulations. Develop a baseline embedded computing approach for meeting tactical timeline requirements for chosen applications. Quantify performance gains relative to conventional algorithms for detection and classification.

PHASE III DUAL USE APPLICATIONS: Military applications may include improved detection, localization, and tracking of various emitters in diverse military scenarios, having potential applicability across the entire DOD ISR enterprise. Commercial applications may include fields such as law enforcement, medical, and automotive.

REFERENCES:

1. R.G. Wiley, "ELINT, The Interception and Analysis of Radar Signals", Artech House, Boston, 2006.

2. U.K. Majumder, Erik P. Blasch, David A. Garren, "Deep Learning for Radar and Communications Automatic Target Recognition", Artech House, 2020

3. S. Letgus, et al, "Towards Explainable Artificial Intelligence for Regression Models", in IEEE Signal Processing Magazine, July 2022.

4. D. L. Stevens, S. A. Schuckers, "Detection and Parameter Extraction of Low Probability of Intercept Radar Signals using the Hough Transform", Global Journal of Researches in Engineering: J General Engineering, 2015

5. A. Orduyilmar, et al, "Machine learning-based waveform classification for cognitive EW", Signal, Image and Video Processing, 2021.

6. A. Gretton, et al, "A kernel method for the two-sample-problem", Advances in Neural Information Processing Systems 19 (NIPS 2006)

KEYWORDS: ELINT; machine learning; robust statistics; Time-Frequency Distributions; data-driven signal processing methods

TOPIC NUMBER: AF251-0002

TITLE: High Assurance Containerization and Orchestration

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Develop high assurance containerization and orchestration capabilities for assuring security, resiliency and readiness of various Air Force and Space Force capability deployments. Deployments should target specific use-cases involving cross domain solutions, microservices in critical aircraft flight control systems, and multi-domain connectivity; deployments should also be compatible with the broader context including cloud, IoT, and Edge computing.

DESCRIPTION: Containers and container orchestration technology are becoming more popular due to the performance benefits, portability, and the ability to leverage them in many different environments/architectures. However, security remains the barrier to widespread adoption in operational environments. The container threat model is headlined with the lack of high assurance and weak security isolation properties.

Design and develop an architecture for high assurance container and container orchestration capabilities. The challenge is for the architecture to integrate well with existing containerization technologies (e.g. Docker, Kubernetes, etc.) and be applicable to both cloud computing and IoT environments while providing high assurance through the following essential security properties: data separation, authorized information flow, assured sanitization, damage limitation, and attestation. Results must show a clear mitigation for the following risks associated with containerization without relying on security or trust of pre-existing containerized applications: cross-tenant attacks (failed isolation), data breach, access control violation, large tech stack, and container-host overload (DOS related). In other words, the architecture must not need to trust container applications in order to provide high assurance to the host and API nodes.

PHASE I: Define and develop initial architecture concept for high assurance containerization and orchestration capabilities. Target cloud and IoT environments with high assurance guarantees to protect applications such as cross domain solutions, aircraft flight control systems, and multi-domain connectivity. Include high-level capabilities design and description for a prototype that would be built in Phase 2.

PHASE II: Based on initial architecture concept, high-level capabilities prototype design and description, develop a detailed framework and architecture design for a high assurance containerization and orchestration ecosystem. Develop and demonstrate a high assurance prototype that can be applied to both cloud and IoT environments and fit well within existing technology stacks. Testing requirements include performance evaluation using micro and large-scale distributed benchmark suites and security guarantees and requirements validation. Demonstrate capabilities against set of test scenarios.

PHASE III DUAL USE APPLICATIONS: The goal for Phase III is to utilize containerization capabilities developed in Phase 2 beyond the DoD. The expected Phase III entry is at TRL6 with an ending at TRL9. The Phase III effort would bring the developed technology to the following DoD and commercial markets/applications: automotive, satellites, space systems, cloud deployment. Success and transition of containerization capabilities depends on communication/interoperability with multiple sectors.

REFERENCES:

1. SCONE: Secure Linux Containers with Intel SGX - https://www.usenix.org/system/files/conference/osdi16/osdi16-arnautov.pdf;

2. A review of native container security for running applications - https://www.sciencedirect.com/science/article/pii/S187705092031704X;

3. DoD Enterprise DevSecOps Strategy Guide - https://dl.dod.cyber.mil/wp-content/uploads/devsecops/pdf/DoDEnterpriseDevSecOpsStrategyGuide.pdf;

4. Container Security: Issues, Challenges, and The Road Ahead - https://ieeexplore.ieee.org/document/8693491;

5. vCDS: A Virtualized Cross Domain Solution Architecture - https://ieeexplore.ieee.org/document/9652903

KEYWORDS: Secure Containerization; High Assurance Containerization; Secure Container Orchestration; High Assurance Container Orchestration; Assured Container Isolation; Cross Domain Solution; Microservice Architecture;

TOPIC NUMBER: AF251-0003

TITLE: Advanced Battery Technologies for Directed Energy Weapon Systems

TECHNOLOGY AREAS: Weapons; Electronics; Materials

OBJECTIVE:

Purpose: To research and develop enhanced battery technology for Directed Energy weapons.

Motivation: Directed Energy weapons promise light-speed, unlimited magazine, low cost-per-shot defense of United States assets. Strategic directives outlined in the 2022 National Defense Strategy, along with recent calls from operational leaders, underscore the urgent need to accelerate the research and deployment of Directed Energy weapon systems [1,2]. Addressing this imperative requires focused exploration into the power subsystem.

Main Goals: Research novel electrochemistries, cell additives, or cell geometries to develop cell prototypes which advance one or more of the following: key: Characteristic [system-level goal]
(1) Energy Density [200 Wh/kg], Power Density [9 kW/kg, 12 kW/L]
(2) Discharge Rate [35C]
(3) Operating Temperature Range [-60 to 80 C]
(4) Non-flammable

Subgoals:
(1) Domestic Supply Chain
(2) Cycle life [greater than 1000 cycles]
(3) Reduced Cost (materials and manufacturing technique)

Deliverables:
Functional Electrochemical Cell, Voltage vs. capacity curves at various charge/discharge rates (up to 35C), temperatures, depths of discharge, and cycle numbers; safety tests

DESCRIPTION: Recent research has demonstrated the potential to improve battery performance along the four goals listed above. An electrochemical cell consists of three components: cathode, anode, and electrolyte. By modifying one or more of these components or the overall cell geometry, electrochemical performance can be improved. SBIR funding recipients would be expected to innovate on the cathode, anode, electrolyte, cell geometry, or cell additives and produce functional electrochemical cells with better performance along one or more of the goals without degrading performance in the other goal areas. Later, they would be expected to assemble multiple cells into a functional battery pack which meets system-level requirements for a Directed Energy weapon. I now detail possible avenues of research which can be pursued for each cell component. General Patton said, "Never tell people how to do things. Tell them what to do and they will surprise you with their ingenuity" [3]. The purpose of these examples is not to dictate to the businesses the approaches they must take, but to inform the SBIR awarding body that there is significant promise in this field and high likelihood of achieving the stated goals.

Cathode: One can modify a cathode's chemical composition or its physical structure to affect performance in an intercalation battery. Transitioning from traditional materials like $LiCoO_2$ or $LiFePO_4$ to more advanced options such as NMC, LiS, or zeta-V_2O_5, batteries achieves higher energy densities and discharge rates [4, 5, 6]. Changing the physical structure of the cathode, such as increasing porosity or reducing particle size, can also facilitate faster ion diffusion and electron transport, thereby improving power density and discharge rate capabilities. These modifications not only expand the operating temperature range but also reduce flammability risks associated with traditional cathode materials.

Anode: There is also possibility for improvement and innovation at the anode site. For example, the adoption of silicon anodes over carbon. Silicon's high theoretical specific capacity surpasses that of carbon, enabling increased energy density. However, challenges such as volume expansion during lithiation/delithiation cycles and poor cycling stability have limited silicon's widespread adoption [7]. Nanosizing silicon particles helps mitigate these drawbacks by accommodating volume changes and improving electrode stability, thereby contributing to increased power density and discharge rate capabilities while expanding the operating temperature range.

Electrolyte: Electrolyte optimization is crucial for achieving safer and more efficient battery operation. Introducing inorganic electrolytes, such as solid-state electrolytes or ionic liquids, offers improved thermal stability and reduced flammability compared to conventional organic electrolytes [8]. Furthermore, incorporating shear-thickening additives into the electrolyte formulation enhances safety by preventing thermal runaway in the event of mechanical abuse.

PHASE I: Technical Objectives:
(1) Identify a novel electrochemical material or approach which has demonstrated potential to improve over the state-of-the-art in one or more of the goal areas.
(2) Produce a prototype electrochemical cell design and measure voltage vs. capacity at various temperatures, charge rates, and cycle numbers up to and within the goal parameters.

Technical Outcomes:
(1) The electrochemical cell demonstrates increases in energy/power density, operating temperature range, discharge rate, and/or safety.

Program Outcomes:
(1) Establish plans, including the work breakdown structure, 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) Identify modifications to be made on the Phase I prototype cell to optimize electrochemical performance.
(2) Produce a battery pack consisting of an array of cells to demonstrate system-level performance consistent with the operation of a Directed Energy Weapon. Perform experiments to determine if the cells show improvements over the existing state-of-the-art under more rigorous electrochemical testing and function in all temperature ranges and safety tests.

Technical Outcomes:
(1) The battery pack demonstrates increases in energy/power density, operating temperature range, discharge rate, and/or safety.

Program Outcomes:
(1) A rechargeable battery demonstrates viability as the power source for a high-power Directed Energy weapon

PHASE III DUAL USE APPLICATIONS: Entry Criteria: TRL-5

Technical Objectives: Given the size, weight, and power requirements for a laser system produce a battery which meets the system-level power demands of a Directed Energy weapon.

Technical Outcomes: Power subsystem demonstration in a relevant environment.

Program Outcomes: Successful integration of the power system into a Directed Energy weapon.

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8. Fundamentals of inorganic solid-state electrolytes for batteries, Nature Materials, Volume 18, 2019

KEYWORDS: Directed Energy, Power Subsystem, Battery, Electrochemical Cell

TOPIC NUMBER: AF251-0004

TITLE: LLM for Assessment of Cognitive Warfare Effectiveness in Competition

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The objective is to develop, demonstrate, and transition LLM-enabled software for the assessment, characterization, and forecasting of cognitive warfare and information operations impacts on groups, communities, or populations. This capability will include a user interface that permits a customer to provide prompts and inquiries that run analyses, present assessments, and generate potential courses of action or expected outcomes. The software is to pull quantitative and qualitative data on visual, auditory, or textual information from multiple vectors of media to support sense-making and decision-making for operations in the information environment. An important aspect of this effort is in developing the ability present an emic (1st person) perspective of the target populations, with a focus on sentiment analysis correlated to regional events, actors, and messages that can code contextualized emotions and stances/opinions based on the language found in the data. Thus, a psychographic model of a local population can be crafted, visualized, and depicted in time and space.

DESCRIPTION: Competing in the information environment is highly challenging given the large amount of information that must be analyzed to ascertain whether opportunities or threats exist at a particular time and in a particular informational space. Concurrent with this is the constant need for data sharing to better coordinate efforts across diverse entities. Forecasting, detecting, and measuring the effectiveness of information maneuvers or employed cognitive warfare tactics is difficult. All of this is complicated by the high speed at which information flows, outpacing the human's capacity for processing and planning. To maintain situational awareness and support sense-making or forecasting in order to achieve information mastery, something beyond mere analytics is needed. Something akin to an automated information "wingman" might fill that gap, which can provide multiple perspectives, including the "emic" (1st person) perspective grounded in social science, and a multi-scale (person, culture, region, country) lens to contextualize and assess information maneuvers. This solution will contrast sharply with many current approaches that integrate scraping software and AI-enabled technology that present information and assessments from the "etic" (who, what, where) perspective that focus on the "facts" or events and not the subjective character of a people. New analytics, modeling, and visualization capabilities can assist planners, information operators, and intelligence analysts with influence campaign planning, strategic communication, and assessments. This capability will support military operations during conflict and in deterrence efforts or strategic competition.

Uses of generated group, community, or population psychographic models can include operations, activities, and investments supporting real-world combatant commander objectives, or can include notional data and simulations for wargaming and the development of tactics, techniques, and procedures related to cognitive warfare. These generated models could be depicted in a variety of ways using AI data-visualization techniques (e.g. chatbot directed analysis) as well as AI-simulation techniques.

By understanding the contextualized sentiments and emic perspectives of a target audience, military (or market) intervention strategies can be better devised. Ideally, the provided approaches will include multiple parameters to control for and integrate various knowledge topics, discrete events, varying community or network sizes, different languages/cultures, and diverse actors and influencers in the information environment. Approaches solely focused on disinformation do not align with this topic, and though this could be a component, this capability would concern reaction and response to legitimate events and potentially actionable activities done in response to them. No government furnished materials, equipment, data, or facilities will be provided.

PHASE I: Develop and demonstrate an LLM, AI-enabled software (analytic algorithms, models, visualizations) that pulls quantitative and qualitative data from visual, auditory, or textual information via multiple vectors of media to support sense-making and decision-making for operations in the information environment. Specifically, one that provides the ability to present an emic (1st person) perspective of target populations, with a focus on contextualized sentiment analysis correlated to regional events, actors, and messages that codes emotions and stances/opinion/viewpoints related to them based on the language found in the data. Information characterization should include multi-media visual (images, memes, videos), auditory (voice chat, audio recording, music), or textual (articles, tweets) content. A proof of concept demonstration would include a software capable of collection, analysis, and assessment of real or synthetic data, integrating multiple media vectors and multiple types of informational content to characterize a multi-facet population model. The demonstration of disaggregated sentiment detection/collection, encoded with key language indicators and bounded by regional area is key to this phase, using notional or real-world data. A feasibility study is to be conducted, comprising the use of research tools (e.g. MTurk) in a pilot experiment that can be presented to operational customers, validating the models and evaluating if the perception of the user interface during demonstration affects performance. A lexicon of indicators is to be delivered, embedded into the UI or as a separate product to ensure that analysts assess its content in the most accurate and consistent way. Other deliverables include a dataset, report outlining the assessment/modeling technique, algorithms, generative AI approach, and visualization software or dashboard that showcases the population model with various streams of information. Customers for the capability should be identified during this phase.

PHASE II: Companies selected for Phase II will apply the knowledge gained in Phase I to mature and integrate analytics and to further develop the interface, capabilities, and components needed to make the technologies transition to military customers and the open market. It will expand and develop the model to cope with real-time information flows and evolving information tactics. Deliverables are collection, assessment/modeling, and visualization software with the integration of an artificial general intelligence that uses regional media outlets and / or social media of visual, audio, or text-based data to characterize the information environment. Deliverables also include a final report with full documentation of algorithms and LLMs for detection/collection, modeling, and depiction software. An additional deliverable is a comprehensive software test dataset (synthetic or real-world) to be used to demonstrate the software/visualization to customers.

PHASE III DUAL USE APPLICATIONS: Phase III selectees will apply the knowledge gained in Phase II to further develop and complete the interface, capabilities and components needed to make the technologies transition to military customers and the open market. It will expand and develop the model to cope with real-time information flows and evolving information tactics. Efforts will culminate in an LLM/AI-powered software with the ability to collect varied and real-world information types across multiple vectors of media in a dynamic environment that can assess and generate a psychographic model of a population based on contextualized sentiment analysis. It will present a user interface that is either traditional or virtual, that permits a customer to provide inquires and prompts to direct the software towards focused analysis. Lastly, it will demonstrate the capability for users to visualize maneuvers, make recommendations on what language might alter current sentiments, and/or forecast impacts of potential courses of action and events on target audiences.

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KEYWORDS: social media; analytics; news sources; visualization; modeling; large language models; forecasting; classification; assessment; encoding; influence; characterization; communities; networks; information maneuvers; influence campaigns; information operations; cognitive warfare; artificial intelligence; wargaming; immersive simulation; great power competition; gray zone; sentiment; recent events; psychological operations; social psychology; sociology; culture; prediction; emotions; opinions; geography

TOPIC NUMBER: AF251-0005

TITLE: Comprehensive Framework for Test & Evaluation of Digital Twins

TECHNOLOGY AREAS: Sensors; Electronics; Information Systems; Human Systems

OBJECTIVE: The advent of digital twins and AI/ML presents a significant opportunity for the US Air Force to substantially improve Flight Test efficiency, viz. reduce both cost and time required for Test and Evaluation (T&E) of AF assets/capabilities. While significant effort and investments are made to create digital twins (DTs), there is no comprehensive framework to validate the completeness and accuracy of DTs. The purpose of this proposal is to address the need for such a capability.

DESCRIPTION: Digital twins have emerged as powerful tools for simulating and analyzing the behavior of physical systems in aerospace and manufacturing applications (Madni et al., 2019). DTs represent a potential driver of efficiency in the physical T&E process- but only if the DT faithfully represents the functionality of the physical asset to be tested. Thus, it is incumbent upon the test community to ensure DT accuracy (Schluse et al., 2018). Along with details of data collection and analyses, validation of a DT's fidelity to the test item must be a part of any test plan.

OSD Critical test areas:
Successful development of a comprehensive, scalable framework for the verification and validation of a DT include:
1. Model-Based System Engineering (MBSE)- support improved model development.
2. Integrated Networks of Systems- demonstratable correct operation of integrated network systems
3. Artificial Intelligence/Machine Learning- application of these tools to advance OSD capability in system as well as DT development and test. Plainly, the framework proposed in this SIBR is essential if the US is to remain ahead of adversary use of AI in weapon development and innovation (Kana, 2020).

We invite proposals from eligible vendors to
1. Create a comprehensive and scalable framework that test and evaluate the real-world applicability of digital twins, and
2. Demonstrate that such a framework can be applied to various Air Force digital twin applications.

The framework should evaluate whether the digital twin can capture and characterize physical system behavior, interactions, and dependencies, necessary for defensible T&E results (e.g. Lin et al., 2021).

APPROACH:
Up to the contractor, MBSE is suggested, but not required.

PHASE I: In Phase I, companies will develop a proof of concept and feasibility study that provide the conceptual design of a comprehensive test framework for digital twins. The conceptual design should include supporting literature for technical feasibility, showcase the technology's application opportunities to a broad base of DTs. At the end of Phase I, the company will be required to provide a concept demonstration of their technology to demonstrate a high probability that continued design and development will result in a Phase II mature product.

PHASE II: In Phase II, a fully functional T&E platform should be developed that incorporates a framework that can be customized for analyzing digital twins. This analysis should demonstrate the completeness and accuracy of the digital twin. This means a scalable and comprehensive framework that results in defensible evidence of the accuracy of the digital twin output compared to flight test data.

PHASE III DUAL USE APPLICATIONS: Complete the development of the technology developed in Phase II and produce prototypes to support further development and commercialization. Deliverables for Phase III include a market analysis report, a detailed business plan, a deployment and distribution plan, and documentation outlining potential adaptation and expansion opportunities.

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KEYWORDS: Artificial Intelligence/Machine Learning, Network Command, Control and Communications

TOPIC NUMBER: AF251-0006

TITLE: TH-1H Helicopter Health Usage and Monitoring System (HUMS)

TECHNOLOGY AREAS: Air Platform; Sensors; Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The HUMS must be custom configured for the TH-1H dynamic and structural components. Where feasible, the system will utilize the TH-1H's data bus and any HUMS will be designed to best capture and interface the TH-1H. The solution could be a combination of commercial of the shelf (COTS), newly designed/developed software/hardware, and/or other technologies that best capture the necessary data to comply with the need for live flight data and critical system and vibration data. Data will be recorded to a CVFDR system, recording as many parameters as technically and financially feasible IAW AFI 63-133. Additionally, HUMS should allow real time display of data with common interface to media viewing device for real-time on wing troubleshooting/analysis, also accommodate immediate on-ground download and analysis of crew reported vibrations to rapidly identify if a vibration is actually present. System software will identify which sensor(s) or component(s) is causing vibrations and default will be in inches-per-second (ips) for Rotary fleet standardization. System software will be open architecture modifiable by AETC/58 MXG using/owning agency Vibration Program Management Office. VPMO will have full rights to software for alarm/software tailoring and analysis for health of the fleet feedback.

DESCRIPTION: Adding a HUMS system enables the TH-1H aircraft to be in compliance with mandatory AFI guidance, cost savings through mishap prevention, cost savings through reduced maintenance troubleshooting, reduction in unscheduled maintenance, and part-utilization efficiencies. Undetected anomalous vibrations have led to catastrophic failures of systems in-flight leading to increased maintenance downtime, serious mishaps, and loss of aircraft. Data from continuous monitoring serves as a diagnostic aid for time-consuming troubleshooting procedures, parts/system condition assessment, and engineering dispositions. A HUMS enables pinpointing many problems immediately and can monitor the degradation of items to allow for scheduling part inspection, overhauls, or replacement. The emphasis for an AF organically maintained HUMS system will minimize long term sustainment costs of the system, software, and the data analysis capabilities of the HUMS system going forward. Current HUMS systems on similarly sized helicopters include an integrated Cockpit Voice and Flight Data Recorder (CVFDR) which enables compliance with AFI 63-101 and AFI 63-133 aiding future mishap investigations. The HUMS will be able to perform rotor track and balance; assess engine, gearbox and drive-train health (full-time vibration monitoring); and provide data to enable structural usage and fatigue life tracking, and maintenance trending. The HUMS will allow continuous monitoring of critical systems/structure and record flight usage data enabling cross-referencing along a common time stamp/history.

PHASE I: PHASE I: Each PHASE I submission will consist of system installation on at least 1(EA) assigned TH-1H aircraft, with follow-on testing of system and supporting software for effectiveness. Goal is to have a minimum of two-three Phase I submissions, in order to properly compete for effectiveness.

PHASE II: PHASE II: Following Phase I, assuming positive results, the vendor(s) will pursue a Phase II, in which it will Test and Evaluate system improvements, as well as operational results additional subset of the TH-1H fleet, laying the groundwork for rollout of the system/software to other DoD platforms in the future. Planned Phase II product improvements for testing:

• Integration with Cockpit Voice Flight Data Recorder (CVFDR), crash resistant recording per DAF customer requirement.
• Cybersecurity protocols (on wireless data transfer and cloud-based application hosting).
• Integration with Mx tracking software (lowers load associated with multiple systems).

PHASE III DUAL USE APPLICATIONS: PHASE III: Following Phase II, assuming positive results, the vendor will pursue Phase III operational metrics for testing on multiple assigned TH-1H aircraft (up to full fleet of 28):

• Reduction in Unscheduled Maintenance
• Improvement in Operational Readiness
• Change in Total Cost of Ownership

REFERENCES:

1. INTEGRATED LIFE CYCLE MANAGEMENT (AFI 63-101);

2. AFI 63-140;

3. MIL-STD-1530 assessing various forms of Aircraft Integrity requirements.

KEYWORDS: Health Usage and Monitoring; HUMS; TH-1H; Rotary; vibration monitoring; H-1;

TOPIC NUMBER: AF251-0007

TITLE: Inspection of Bonded Composite Structures Through Fairing Materials

TECHNOLOGY AREAS: 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 section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a nondestructive inspection (NDI) solution to detect delaminations and disbonding in complex composite bonded structures through fairing materials (or compounds) applied to the outer mold line (OML).

DESCRIPTION: Future aircraft systems will use advanced composite bonded structure concepts that require recurring inspection and maintenance throughout the system lifecycle. After production, much of the underlying support structure is inaccessible; therefore, structural inspections will need to be performed from the outer mold line (OML) using state-of-the-art NDI tools where inspection access is limited to a single side. Many of these structural concepts use bonding processes to assemble graphite epoxy outer mold line (OML) skins to graphite epoxy composite stiffening structures. Skins may range in thickness from 0.100 inch to 0.75 inch thick while bondline thicknesses may range on the order of 0.030 inch to 0.100 inch thick. Of concern are delaminations in the skin and disbonds within the bondline. Methods such as low frequency (less than 1.5 MHz), pulse-echo ultrasonic has demonstrated some success for thicker laminates (greater than 0.150 inch thick) and bare surfaces (i.e. no fairing materials present). Inspection through fairing materials, using conventional ultrasonics, is challenging as the void content prevents efficient ultrasound transmission.

To address this challenge, an advanced NDI solution is required to enable inspection of composite skins, adhesive bondlines and the diverse underlying structures by inspecting through these fairing materials.

PHASE I: Develop and execute a proof-of-concept and demonstrate the ability to detect 1-inch diameter disbonds between a composite laminate skin and bonded stiffener. In this phase, the stiffener can be simulated using a composite laminate. Two configurations shall be explored in this initial phase:

1) 0.150 inch thick OML laminate adhesively bonded to an 0.150 inch thick inner mold line (IML) laminate. Bondline thicknesses between 0.030 – 0.050 inch shall be evaluated. Fairing material thicknesses, applied to the OML surface, shall be representative such as between 0.030 inch and 0.150 inch.

2) 0.250 inch thick OML laminate adhesively bonded to an 0.150 inch thick IML laminate. Bondline thicknesses between 0.030 – 0.050 inch shall be evaluated. Fairing material thicknesses, applied to the OML surface, shall be between 0.030 inch and 0.150 inch.

3) Bondline disbonds may be simulated using flat-bottom holes drilled from the IML surface or other appropriate methods that simulate disbonds at these interfaces. Simulated disbonds shall cover a range of sized from 0.5 to 1.5 inches in diameter, in 0.25 inch increments.

PHASE II: Develop, mature and demonstrate a functional prototype capability enabling detection of composite delaminations and bondline disbonds for OML laminate thicknesses (ranging from 0.100 inch to 0.75 inch thick) and possessing bondline thicknesses from 0.030 inch to 0.100 inch. Fairing material shall be representative and shall be applied to the OML surface per specifications and geometries. The capability to reliably detect 0.5 inch diameter disbonds within the OML laminate and/or bondline is the goal and distinguish the disbond depth location. Bondline disbonds may be simulated using flat-bottom holes drilled from the IML surface or other appropriate methods that simulate disbonds at these interfaces. Simulated disbonds shall cover a range of sizes from 0.5 to 1.5 inch diameter in 0.25 inch increments. The capability to scan large areas and generate a 2D map of inspection of results (i.e. C-scan) shall be developed and demonstrated.

PHASE III DUAL USE APPLICATIONS: Through interaction with composite aircraft maintenance and engineering users, define and document the system functional requirements and mature the design and capability to address a specific aircraft program office's needs. Design and execute a probability of detection study to validate the detection capability through a range of fairing materials thickness and structural stack-ups/configurations as defined by the customer. Inspection through OML laminate porosity up to 1.5 % shall also be addressed in the final system design and demonstrated in a field level environment.

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https://www.sciencedirect.com/science/article/abs/pii/S2214785322074296;

3. Nondestructive evaluation of thick-section composites and sandwich structures: A review;

4. Structural Integrity and Durabilty of Advanced Composites,
https://www.sciencedirect.com/science/book/9780081001370

KEYWORDS: NDI; Inspection; Bondline Failures; OML; aerodynamic; pulse-echo; composite

TOPIC NUMBER: AF251-0008

TITLE: High-Temperature Co-fired Ceramic Heat Flux Sensor

TECHNOLOGY AREAS: Weapons; Sensors; Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop 0-1500 °F co-fired ceramic heat flux sensor as an alternative to 0-500 °F sensors.

DESCRIPTION: Schmidt-Boelter heat flux gauges are commonly used in aerospace testing to measure heat transfer at the surface of a test article, which is essential for the safety and performance of various components in in-flight systems. This gauge is often employed in testing and analyzing thermal protection systems, heat exchangers, and other areas where precise temperature readings are vital during dynamic operating conditions, such as ascent, re-entry, or extreme environments. Featuring a thin, thermocouple-like sensor that closely contacts the surface, the Schmidt-Boelter gauge provides accurate measurements of solid surfaces. Its rapid response time is precious in aerospace, where temperature fluctuations can occur swiftly due to changes in speed and atmospheric conditions. Additionally, these gauges are designed to withstand the harsh conditions typical of aerospace environments, ensuring reliable performance even in extreme temperatures and pressures. Their low thermal mass effectively captures transient heat transfer phenomena, making them indispensable in the analysis and optimization of thermal management systems. Overall, Schmidt-Boelter gauges are essential in aerospace engineering, offering precision and responsiveness for maintaining the integrity and functionality of aircraft and spacecraft components.

Due to their current manufacturing limitations, small size, and intricate nature, these sensors are handcrafted one at a time, limiting their size, sensor-to-sensor accuracy and repeatability, and flexibility in applications that could be achieved with an automated process. Additionally, the current design limits the maximum usable temperature to 500 °F. Further complicating the process, a sensor installed in a test article cannot typically be removed without destruction.

Advanced ceramics manufacturing technology allows microelectronics features to be mass-produced at a micron scale. For these sensors, ceramics manufacturing processes could provide the consistency, performance, and temperature tolerance required for high-temperature co-fired device production. The ceramic refractory composite sintered at elevated temperatures in a carefully controlled atmosphere can provide a rugged substrate for selective metallization, precision drilling, and wire bonding needed for electrical connection of dissimilar metals.

An advanced technique methodology is needed to revolutionize the manufacturing and operational capabilities of Schmidt-Boelter heat flux gauges by developing an automated production process that leverages the latest ceramics manufacturing techniques. The extended goals are:

- Temperature Enhancement: Increase the maximum usable temperature of the sensor from 500 °F to at least 1500 °F, utilizing bi-metallic thermopile designs and advanced ceramic refractory composites that can withstand extreme thermal environments.

- Automated Production: Transition from handcrafted sensor production to a fully automated manufacturing process. This will involve integrating precision ceramics manufacturing techniques to enable the mass production of heat flux gauges, significantly reducing production time and costs while maintaining high-quality standards.
- Consistency and Accuracy: Improve part-to-part consistency and sensor-to-sensor accuracy through uniform processing techniques, ensuring reliable measurements in diverse aerospace applications. This will foster greater confidence in test results and allow for more precise engineering decisions.
- Scalability and Flexibility: Develop a scalable manufacturing model that can accommodate various designs and specifications, allowing for customization to meet specific measurement needs across a wide range of aerospace testing scenarios.
- Enhanced Functionality: Explore and evaluate other innovative technologies alongside ceramics manufacturing that could further improve performance, durability, and functional range of heat flux sensors. This includes investigating alternative materials and designs that could complement the bi-metallic thermopile approach.

These objectives aim to not only enhance the capability and reliability of Schmidt-Boelter heat flux gauges but also to set new standards in aerospace testing instrumentation, driving advancements in thermal management and energy efficiency. This will ultimately contribute to safer and more efficient aerospace systems, supporting the industry's ongoing evolution toward more sophisticated and resilient technologies.

PHASE I: The Phase 1 effort should choose the optimum manufacturing process, design of sensing elements, manufacture of prototype sensing elements, testing of prototypes, and generation of a batch production plan that meets the sensor requirement specifications. The result of the Phase 1 effort will be a path forward for manufacturing and functionally testing complete sensors in batch quantities.

PHASE II: The Phase II should fully develop the manufacturing process, manufacture batches of sensing elements, bonding to a sensor base, lead attachment, and calibration of sensors. In-situ demonstration testing in a relevant environment at the University of Tennessee Space Institute Propulsion Research Facility (operated by the Air Force) will provide performance characteristics and survivability data in comparison to current sensors.

PHASE III DUAL USE APPLICATIONS: Phase III will involve detailed sensor characterization, applications optimization, manufacturing refinement to allow full-out marketing.

REFERENCES:

1. How The Schmidt-Boelter Gage Really Works, C.T. Kidd et al, 1995.

2. Design Guidelines, AdTech Ceramics Inc., Chattanooga TN, AdTech Ceramics.com

KEYWORDS: Heat flux; Schmidt-Boelter; ceramic sensor

TOPIC NUMBER: AF251-0009

TITLE: Miniature Visible-Band Video Camera for Afterburner Probes, Hypersonic Propulsion Systems, and Combustion Driven Test Facilities

TECHNOLOGY AREAS: Ground Sea; Sensors; Electronics; Air Platform

OBJECTIVE: To develop a miniature visual-video camera technology with the advanced form factor and optical performance for embedding into small, water-cooled probes for evaluating and monitoring turbine engine augmentor performance, hypersonic propulsion systems, and combustion driven test facilities.

DESCRIPTION: AEDC develops and implements multi-purpose probes that are inserted into the hot, high speed, exhaust streams of gas turbine engines and hypersonic systems in order to measure pressure, temperature, velocity, species concentrations, and other performance characteristics. In particular, development of camera viewing probes has allowed unprecedented optical access to the turbine engine augmentors but current needs far exceed the capability of available visual (400-700 nm) camera technologies. Camera technologies are unavailable that meet the requirements for size, form factor, optical quality and frame rates for embedding into probes used in combustion system performance evaluation, health monitoring and diagnosis. Camera technologies are required that meet the specifications below:

Design Characteristic Threshold Objective Stretch Goals

Number of pixels 1280 x 960 1600 X 1200 2048 X 2048
Frame Rate 60 fps global shutter 100 fps, global shutter 1000 fps, global shutter
Form factor Cylindrical Cylindrical Cylindrical
Outer Diameter 0.25 inches 0.125 inches 0.10 inches
Length 2.0 inches 1.5 inches 1.5 inches
Performance Life 1000 hours at relevant 1000 hours at relevant 1000 hours at relevant
conditions conditions conditions
Video Interface Proprietary Interface Network Camera Interface Network Camera Interface
Synchronization None Two cameras synchronization Multiple camera synchronization
Remote Operation Local Computer Operation over remote link Operation over remote
link Ethernet link link Ethernet link
Lens Fixed Lens Variable Focal Length or Remotely Focused & Zoomed Lenses
Interchangeable Fixed Lenses

Innovative development techniques will be required to achieve the required form factor, size, and camera performance. The innovative camera technologies will replace existing small diameter NTSC cameras that do not meet these specifications. The camera technology must be remotely controlled over an Ethernet or equivalent data link. Since the cameras will be embedded into probes inserted into the extremely harsh environment of augmented engine exhaust flows and hypersonic flows, the camera must be rugged and robust (vibrationally insensitive for internal probe temperatures up to 160 ºF). Remote manual adjustments over shutter speeds and gains must also be available.

PHASE I: Develop a proof of principal camera technology design capable of satisfying all objective requirements. A laboratory demonstration that the prototype components meet the vibrational and temperature requirements for extended periods of time (2 hours) is desirable.

PHASE II: Develop and a prototype camera system satisfying all objective requirements and demonstrate the camera performance in a relevant environment for 100 hours, or until failure. Sequentially produce and evaluate four more working prototype systems incorporating lessons learned into the following prototype system to achieve a sufficiently robust and reliable camera technology that meets all objective requirements and/or stretch goals.

PHASE III DUAL USE APPLICATIONS: Formalize the production process and design the appropriate machinery/infrastructure to support full-scale commercial production.

REFERENCES:

1. Hiers, R. S. Jr. and Hiers, R. S. III, “Development of High Temperature Image Probes for Viewing Turbine Engine Augmentors,” AIAA-2002-2912, 22nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, St. Louis, Missouri, 24 - 27 June 2002.

2. Hiers, R. S. III and Hiers, R. S. Jr., “Development of Exit-Plane Probes for Turbine Engine Condition Monitoring,” AIAA-2002-4304, 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, Indianapolis, Indiana, 7-10 July 2002.

3. Beitel, G. R., Jalbert, P. A., Plemmons, D., Hiers, R. S., and Catalano, D. R., “Development of Embedded Diagnostics for Internal Flow-Field Measurements in Gas Turbine Engines,” AIAA 2004-6865, AIAA/USAF Developmental Test & Evaluation Summit, Woodland Hills, California, 16-18 November 2004.

KEYWORDS: viewing probes; turbine engines; diagnostics; augmentors

TOPIC NUMBER: AF251-0010

TITLE: Non-intrusive, Very-High-Speed (100 kHz), Time-Resolved Velocity and Temperature (Rotational and Vibrational) Measurements in Large-Scale Hypersonic Wind Tunnels

TECHNOLOGY AREAS: Sensors; Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and validate very high-speed, non-intrusive, time-resolved instrument for velocity measurements at rates up to 100 kHz and rotational/vibrational temperature measurements at rates as fast as possible using the laser and camera system supplied for the velocity measurement. The diagnostic must be capable of measurements throughout the entire run period in the new AEDC Tunnel 9 Mach 14, and the existing Mach 18 and VKF hypersonic ground test facilities.

DESCRIPTION: The AEDC Hypervelocity Tunnel 9 is a key facility for providing critical high Mach number data in support of the development of the nation's hypersonic flight vehicles. Tunnel 9 provides Mach 7, 8, 10, 14, and 18 capabilities and, in the near future, new state-of-the-art Mach 8 and Mach 14 facilities. Forces, moments, and surface quantities to support the validation of CFD models are routinely measured in the hypersonic facilities. However, these measurements are not sufficient to provide a complete understanding of the hypersonic flow physics needed to produce accurate modelling. The characterization of a hypersonic wind tunnel flow requires a knowledge of its freestream turbulence, which includes vorticity, entropy, and acoustic fluctuations. Traditionally, the characterization of free stream fluctuations (tunnel noise) in large scale hypersonic wind tunnels has been limited to high frequency Pitot pressure measurements. Such measurements are performed behind a normal shock which distorts the spectral content and the magnitude of the fluctuations as a function of the probe tip geometry (1). The accuracy of this method is dependent on the accuracy of the tunnel noise measurements at high frequencies.

A non-intrusive measurement of the freestream velocity and temperature (both translational and vibrational) is needed to characterize the turbulence in the hypersonic wind tunnel flow fields. The vibrational nonequilibrium processes occurring in expanding hypersonic flow fields result in the freezing of the vibrational energy at a much higher "temperature" than the translational temperature. This is a very important quantity to measure because this vibrational energy is not converted to kinetic energy due to the reduction of collisions during the expansion process. This results in lower free stream translational velocities as well as changes to other freestream quantities. These measurements are needed to determine the true Mach number of the flow field.

The velocity and vibrational and rotational temperatures were recently measured as part of the AEDC Tunnel 9 Mach 18 nozzle development using the FLEET (Femtosecond Laser Electronic Excitation Tagging) and the Hybrid CARS (Coherent Anti-Stokes Raman Spectroscopy) techniques, respectively (2). These techniques were also demonstrated in the AEDC Tunnel 9 in the existing Mach 14 facility (3, 4). The measurements were performed at a rate of 1 kHz, which was state-of-the-art at the time. The results were very helpful in the initial design of the Mach 18 facility (5). However, to provide a much better statistical sample, a much faster data rate, up to 100 kHz is required for velocity and as fast as possible for CARS are required.

A measurement technique that can discriminate between the disturbance modes (vorticity, entropy and acoustic) is highly desirable for the soon to be deployed Mach 14 facility and the existing Mach 18 facility. Particle Image Velocimetry (PIV) and Laser Doppler Velocimetry (LDV) are not acceptable due to the high stagnation temperature of the flow and the impracticality of seeding the core flow. Approaches such as Rayleigh scattering, interferometry, and schlieren methods show promise, but have yet to be successfully applied for turbulence measurements in large scale hypersonic T&E facilities. The goal of this effort is to develop and demonstrate an instrument suitable for non-intrusive turbulence measurements at rates up to 100 kHz in large-scale hypersonic wind tunnels. Previously measurements have been made at rates of 1 kHz which was state-of-the-art at the time of its implementation. However, the requested 100 kHz rate (continuous, not burst mode) is needed to achieve the desired requirements. An instrument suite would also be acceptable, considering the multimodal nature of the freestream disturbances in hypersonic wind tunnels.

Typical test conditions for the USAF AEDC Hypervelocity Wind Tunnel 9 are: Mach number 8 to 18, run time 0.25 to 5 seconds, stagnation temperature up to 1850 K, static temperature 40 to 200 K, static pressure 3.5 to 10,000 Pa, static density 0.0003 to 0.56 kg/m3, and velocity 1370 to 2070 m/s. It is desired that the velocity and temperatures are measured throughout the entire run time at a rate near 100 kHz. Test section optical access is typically gained through two thick (50 mm) BK7 glass windows located 1.5 to 2 m apart, but smaller diameter (thinner) inserts with other optical materials can be implemented. Additionally, 75 mm diameter ports are available at the exit of the Mach 18 nozzle and the future new Mach 14 nozzle. The test gas is nitrogen. Hypersonic wind tunnel facilities also produce low-frequency vibrations during testing which must be tolerated by the proposed instrument. While this solicitation does not require “global” data, multiple point measurements are required to obtain turbulence length scale and convection velocity magnitudes and directions. Finally, it is very important that the instrument be able to reject the sidewall boundary-layer located over the test cell windows.

PHASE I: Demonstrate the feasibility of a non-intrusive instrument capable of high-speed flow velocity measurements at rates near 100 kHz and CARS measurements as fast as possible using the existing velocity hardware. The demonstration needs to be done in a supersonic or hypersonic wind tunnel facility.

PHASE II: Develop and demonstrate the prototype system in the AEDC Tunnel 9 (or other large scale hypersonic wind tunnel with relevant properties). Deliver the prototype system hardware and software (including data reduction software and operational manuals) to AEDC Tunnel 9.

PHASE III DUAL USE APPLICATIONS: The instrument can be marketed for non-intrusive velocimetry and temperature measurements in high-speed wind tunnels.

REFERENCES:

1. R. S. Chaudhry, G. V. Candler. Recovery of Freestream Acoustic Disturbances from Stagnation Pressure Spectrum in Hypersonic Flow, AIAA Paper 2016-2059.

2. Dogariu, A., et al, Velocity and temperature measurements in Mach 18 nitrogen flow at Tunnel 9”, AIAA SCITECH Forum, January 2021.

3. Dogariu, A., et al, Hypersonic Flow Velocity Measurements Using FLEET, CLEO: Applications and Technology 2018, Combustion and Hypersonic Flow Diagnostics, San Jose, CA, May 2018.

4. Dogariu, A., et al, Single shot temperature measurements using Coherent Anti-Stokes Raman Scattering in Mach 14 flow at the hypervelocity AEDC Tunnel 9, AIAA Paper2019-1089, AIAA SCITECH Forum, 07-11 January, 2019, San Diego, CA.

5. J.J. Korte et al, Tunnel No. 9 Hypervelocity Freestream Conditions for Vibrational Frozen Flow, AEDC-TR-21-H-2.

KEYWORDS: turbulence; hypersonic; instrumentation; non-intrusive; seedless; wind-tunnel

TOPIC NUMBER: AF251-0011

TITLE: High-Capacity Internal Balance

TECHNOLOGY AREAS: Sensors; 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 section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop the capability to design internal balances that increase the load capacity of internal balances while maintaining the form factor, sensitivity, measurement uncertainty, and an adequate safety factor.

DESCRIPTION: Current internal strain gage balance technology has reached the limit of strength and sensitivity within the required form factors. A new step in measurement technology is required to increase the load capacity of internal balance measurements while maintaining the form factor, sensitivity, measurement uncertainty, and an adequate safety factor. The balance must maintain a 2.5-inch diameter or comparable form factor and be compatible with current tunnel installation hardware. The balance should be designed to the resolved loads described here within 0.1% measurement uncertainty (Normal Force: 10,000 lb, Pitching Moment: 32,500 in-lb, Side Force: 5,000 lb, Yawing Moment: 16,250 in-lb, Rolling Moment: 24,000 in-lb, Axial Force: 850 lb). The internal balance needs to support aerodynamic models in a high load and dynamic wind tunnel environment. The safety of the facility and related systems requires a minimum safety factor of 3 on yield or 4 on ultimate on all components and areas of concentrated stress. Fatigue life is also a concern, and the design should strive for maximum life span using cyclic loadings at the intended loads stated. The operating range is 60-140 °F with pressures between 10 and 4,000 psfa and the balance should be insensitive to environmental changes, or able to be calibrated over this range. The design methodologies of this high-capacity internal balance will be used to update balance designs of all shapes and capacity ranges.

PHASE I: Provide a preliminary design and stress analysis that proves the feasibility of the increased load capacity with the appropriate safety factor. Highlight areas of high stress concentration and hardware limitations and provide detailed plans to mitigate any limiting factors. Instrumentation details and data system requirements should be investigated and reported. Provide estimates of the other balance metrics to show that the proposed the internal balance concept will be capable of meeting test requirements.

PHASE II: Develop a prototype internal balance that meets the design criteria described. Deliver and demonstrate the prototype internal balance and perform a preliminary set of loadings and calibrations to validate acceptable performance and uncertainty requirements as outlined in Phase I. Provide a detailed stress analysis and documentation of the health monitor requirements to maintain safe operation within the capability of the internal balance.

PHASE III DUAL USE APPLICATIONS: Use the design methodologies and technology developed and present possible applications to other balance designs, sizes, environments and load ranges for other facility applications.

REFERENCES:

1. Calibration and Use of Internal Strain Gage Balances with Applications to Wind Tunnel Testing (AIAA R-091A-2020) https://doi.org/10.2514/4.106019.001;

2. Wind Tunnel Balances (Klaus Hufnagel), https://doi.org/10.1007/978-3-030-97766-5

KEYWORDS: 6-component balance; internal balance; high-capacity

VERSION 2

DEPARTMENT OF AIR FORCE (DAF)
25.1 SMALL BUSINESS INNOVATION RESEARCH (SBIR)
DIRECT-TO-PHASE-II (D2P2)
PROPOSAL SUBMISSION INSTRUCTIONS

The DAF intends these proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Firms must ensure proposals meet all requirements of the SBIR Program BAA posted on the DoD 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.

- Full component-specific instructions and topic descriptions are available on DSIP at https://www.dodsbirsttr.mil/submissions/solicitation-documents/active-solicitations. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the DAF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "25.1 Address Change".

Points of Contact:

- For 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.**
- For 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 25.1 SBIR BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
  Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

General information related to the AF Small Business Program can be found at the AF Small Business website, http://www.airforcesmallbiz.af.mil/. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

DIRECT TO PHASE II

15 U.S.C. §638 (cc), as amended by the SBIR AND STTR EXTENSION ACT OF 2022, allows DoD to make a SBIR Phase II award to a small business concern with respect to a project, without regard to whether the small business concern was provided an award under Phase I of an SBIR program with respect to such project. DAF is conducting a "Direct to Phase II" implementation of

this authority for these 25.1 SBIR topics and does not guarantee D2P2 opportunities will be offered in future solicitations. Each eligible topic requires documentation to determine whether the feasibility requirement described in the Phase I section of the topic has been met.

DIRECT TO PHASE II PROPOSAL SUBMISSION

The DoD SBIR 25.1 Broad Agency Announcement, https://www.dodsbirsttr.mil/submissions/login, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic's requirements.

The complete proposal must be submitted electronically through DSIP. Ensure the complete technical volume and additional cost volume information is included in this sole submission. The preferred submission format is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. **VIRUS-CHECK ALL SUBMISSIONS.**

INTRODUCTION: D2P2 proposals must follow the steps outlined below:

1. Applicants must create a Cover Sheet in DSIP; follow the Cover Sheet instructions provided in the DoD SBIR 25.1 BAA.Applicants must provide documentation satisfying the Phase I feasibility requirement* to be included in the Phase II proposal. Applicants must demonstrate completion of research and development through means other than the SBIR/STTR Programs to establish the feasibility of the proposed Phase II effort based on the criteria outlined in the topic description.
2. Applicants must submit D2P2 proposals using the instructions below.

*NOTE: DAF will not consider the applicant's D2P2 proposal if the applicant fails to demonstrate technical merit and feasibility have been established. It will also not be considered if it fails to demonstrate the feasibility effort was substantially performed by the applicant and/or the principal investigator (PI). Refer to the topics' Phase I descriptions for minimum requirements needed to demonstrate feasibility. Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.

DIRECT TO PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

A. Proposal Requirements. A Direct To Phase II proposal shall provide sufficient information to persuade the AF the proposed technology advancement represents an innovative solution to the scientific or engineering problem worthy of support under the stated criteria.

B. Proprietary Information. Information constituting a trade secret, commercial/financial information, confidential personal information, or data affecting National Security must be clearly marked. It shall be treated in confidence to the extent permitted by law. Be advised, in the event of proposal selection, the Work Plan will be incorporated into the resulting contract by reference. Therefore, DO NOT INCLUDE PROPRIETARY INFORMATION in the work plan. See the DoD BAA regarding proprietary information marking.

C. General Content. Proposals should be direct, concise, and informative. Type shall be no smaller than 11-point on standard 8 ½ X 11 paper, with one-inch margins and pages consecutivelynumbered. Applicants are discouraged from including promotional and non-programmatic items. If included, such material will count toward the page limit.

DIRECT TO PHASE II PROPOSAL FORMAT

Complete proposals must include all of the following:
Volume 1: DoD Proposal Cover Sheet
Note: If selected for funding, the proposal's technical abstract and discussion of anticipated benefits will be publicly released. Therefore, do not include proprietary information in this section.
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents, e.g. DoD Form 2345 (if applicable), Militarily Critical Data Agreement (if applicable); etc.
Volume 6: Fraud, Waste, and Abuse Training Completion
Volume 7: Disclosures of Foreign Affiliations or Relationships to Foreign Countries

Phase II proposals require a comprehensive, detailed description of the proposed effort. AF D2P2 efforts are to be proposed in accordance with the information in these instructions. Commercial and military potential of the technology under development is extremely important. Proposals emphasizing dual-use applications and commercial exploitation of resulting technologies are sought.

All D2P2 research or research and development (R/R&D) must be performed by the small business and its team members in the United States, as defined in the DoD SBIR 25.1 BAA. The Principal Investigator's (PI's) primary employment must be with the small business concern at the time of awardand during the entire period of performance. Primary employment means more than one-half the PI's time is spent in the small business' employ. This precludes full-time employment with another entity. Only one principal investigator/project manager can be designated to a proposal at any given time.

Knowingly and willfully making false, fictitious, or fraudulent statements or representations may be a felony under18 U.S.C. Section 1001, punishable by a fine up to $250,000, up to five years in prison, or both.

Please note the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete. The DAF recommends completing submission early, as site traffic is heavy prior to solicitation close, causing system lag. **Do not wait until the last minute.** The AF will not be responsible for proposals not completely submitted prior to the deadline due to system inaccessibility unless advised by DoD. The DAF will not accept alternative means of submission outside of DSIP.

DOD PROPOSAL COVER SHEET (VOLUME 1)

Complete the proposal Cover Sheet in accordance with the instructions provided via DSIP. The technical abstract should include a brief description of the program objective(s), a description of the effort, anticipated benefits and commercial applications of the proposed research, and a list of keywords/terms. The technical abstract of each successful proposal will be submitted to the Office of the Secretary of Defense (OSD) for publication and, therefore, must not contain proprietary or classified information.

TECHNICAL VOLUME (VOLUME 2)

The technical proposal includes all items listed below in the order provided. Refer to topic index for page limitations. Pages in excess of this count will not be considered by the Government in evaluations.

(1) **Table of Contents:** A table of contents should be located immediately after the Cover Sheet.

(2) **Glossary:** Include a glossary of acronyms and abbreviations used in the proposal.

(3) **Milestone Identification:** Include a program schedule with all key milestones identified.

(4) **Identification and Significance of the Problem or Opportunity:** Briefly reference thespecific technical problem/opportunity to be pursued under this effort.

(5) **Phase II Technical Objectives:** Detail the specific objectives of the Phase II work and describe the technical approach and methods to be used in meeting these objects. The proposal should also include an assessment of the potential commercial application for eachobjective.

(6) **Work Plan:** The work plan shall be a separate and distinct part of the proposal package, using a page break to divide it from the technical proposal. It must contain a summary description of the technical methodology and task description in broad enough detail to provide contractual flexibility. The following is the recommended format for the work plan; begin this section on a new page. **DO NOT include proprietary information.**

a) 1.0 – Objective: This section is intended to provide a brief overview of thespecialty area. It should explain the purpose and expected outcome.
b) 2.0 – Scope: This section should provide a concise description of the work to beaccomplished, including the technology area to be investigated, goals, and majormilestones. The key elements of this section are task development and deliverables, i.e., the anticipated end result and/or the effort's product. This section must also be consistent with the information in Section 4.0 below.
c) 3.0 – Background: The applicant shall identify appropriate specifications, standards, andother documents applicable to the effort. This section includes information or explanation for, and/or constraints to, understanding requirements. It may include relationships to previous, current, and/or future operations. It may also include techniques previously determined ineffective.
d) 4.0 – Task/Technical Requirements: The detailed individual task descriptions must be developed in an orderly progression with sufficient detail to establish overall program requirements and goals. The work effort must be segregated into major tasks and identified in separately numbered paragraphs.

Each numbered major task should delineate the work to be performed by subtask. The work plan MUST contain every task to be accomplished in definite, realistic, and clearlystated terms. Use "shall" whenever the work plan expresses a binding provision. Use "should" or "may" to express a declaration or purpose. Use "will" when no contractor requirement is involved, i.e., "... power will be supplied by the Government."

(7) **Deliverables:** Include a section clearly describing the specific sample/prototype hardware/ software to be delivered, as well as data deliverables, schedules, and quantities. Be aware of the possible requirement for unique item identification IAW DFARS 252.211-7003, ItemIdentification and Valuation, for hardware. If hardware/ software will be developed but not delivered, provide an explanation. At a minimum, the following reports will be required under ALL Phase II contracts.

a) Scientific and Technical Reports: Rights in technical data, including software, developed under the terms of any contract resulting from a SBIR Announcement generally remain with the contractor. The Government obtains SBIR/STTR data rights in all data developed or generated under the SBIR/STTR contract for a period of 20 years, commencing at contract award. Upon expiration of the 20-year SBIR/STTR license, the Government has Government purpose rights to the SBIR data.

i. Final Report: The first page of the final report will be a single-page project summary, identifying the work's purpose, providing a brief description of the effort accomplished, and listing potential result applications. The summary may be published by DoD. Therefore, it must not contain any proprietary or classified information. The

remainder of the report should contain details of project objectives met, work completed, results obtained, and technical feasibility estimates.

ii. Status Reports: Status reports are due quarterly at a minimum.

b) Additional Reporting: AF may require additional reporting documentation including:

i. Software documentation and users' manuals;
ii. Engineering drawings;
iii. Operation and maintenance documentation
iv. Safety hazard analysis when the project will result in partial ortotal development and delivery of hardware; and
v. Updates to the commercialization results.

(8) **Related Work:** Describe significant activities directly related to the proposed effort, including any previous programs conducted by the Principal Investigator, proposing firm, consultants, or others, and their application to the proposed project. Derscribe how these activities interface with the proposed project and discuss any planned coordination with outside sources. Also list any applicant-identified subject matter experts, regardless of affiliation, providing comments regarding the applicant's knowledge of the state-of-the-art in the specific approach proposed. 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)
c. Date of completion

(9) Commercialization Potential:

a) The DoD requires a commercialization plan be submitted with the Phase II proposal,specifically addressing the following questions:
   i. What is the first planned product to incorporate the proposed technology?
   ii. Who are the probable customers, and what is the estimated market size?
   iii. How much money is needed to bring this technology to market and how will it be raised?
   iv. Does your firm have the necessary marketing expertise and, if not, how will your firm compensate?
   v. Who are the probable competitors, and what price/quality advantage is anticipated by your firm.

b) The commercialization strategy plan should briefly describe the commercialization potential for the proposed project's anticipated results, as well as plans to exploit it. Commercial potential is evidenced by:

   i. The existence of private sector or non-SBIR/STTR Governmentalfunding sources demonstrating commitment to Phase II efforts/results.
   ii. The existence of Phase III follow-on commitments for the research subject.
   iii. The presence of other indicators of commercial technology potential,including the firm's commercialization strategy.

c) If awarded a D2P2, the awardee will be required to update periodically the commercialization results of the project via SBA. These updates will be required at completion of the effort, and subsequently when the contractor submits a new SBIR/STTR proposal to DoD. Firms not submitting a new proposal to DoD will be requested to provide updates annually after the D2P2 completion.
d) Note, the "Commercialization Plan" and the "Company Commercialization Report" are distinct documents. The Company Commercialization Report (CCR) comprises Volume 4 as separately indicated in these instructions.

(10)**Relationship with Future R/R&D Efforts**:
   a) State the anticipated results of the proposed approach, specifically addressing plans for Phase III, if any.
   b) Discuss the significance of the D2P2 effort in providing a basis for the Phase III R/R&D effort, if planned.

D. **Key Personnel:** In the technical volume, identify all key personnel involved in the project. Include information directly related to education, experience, and citizenship. Atechnical resume for the Principal Investigator, including publications, if any, must also be included. Concise technical resumes for subcontractors and consultants, if any, are also useful. Identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For these individuals, in addition to technical resumes, please provide countries of origin, type of visas or work permits held, and identify the tasks they are anticipated to perform.

Foreign Nationals (also known as Foreign Persons) means any person who is NOT:
a. a citizen or national of the United States; or

b. a lawful permanent resident; or
c. a protected individual as defined by 8 U.S.C. § 1324b

ALL applicants proposing to use foreign nationals MUST follow the DoD 25.1 BAA and disclose this information regardless of whether the topic is subject to ITAR restrictions.

When the topic area is subject to export control, these individuals, if permitted to participate, are limited to work in the public domain. Further, tasks assigned must not becapable of assimilation into an understanding of the project's overall objectives. This prevents foreign citizens from acting in key positions, such as Principal Investigator, Senior Engineer, etc. Additional information may be requested during negotiations in order to verify foreign citizens' eligibility to perform on a contract awarded under this BAA.

The following will apply to all projects with military or dual-use applications developing beyond fundamental research (basic and applied research ordinarily published and sharedbroadly within the scientific community):

(1) The Contractor shall comply with all U. S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, andthe Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data,and software, or for the provision of technical assistance.
(2) The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where thework is to be performed on-site at any Government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies,including technical data or software.
(3) The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.
(4) The Contractor shall be responsible for ensuring that these provisions apply to its subcontractors.

E. **Facilities/Equipment:** Describe instrumentation and physical facilities necessary and available to carry out the D2P2 effort. Justify equipment to be purchased (detail in cost proposal). State whether proposed performance locations meet environmental laws and regulations of Federal, state, and local Governments for, but not limited to, airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulkwaste disposal practices, and handling and storage of toxic and hazardous materials.

F. **Consultants/Subcontractors**: Private companies, consultants, or universities may be involved in the project. All should be described in detail and included in the cost proposal. In accordance with the Small Business Administration (SBA) SBIR Policy Directive, a minimum of 50% of the R/R&D must be performed by the proposing firm, unless otherwise approved in writing by the Contracting Officer. These requests can only be made upon proposal submission. Signed copies of all consultant or subcontractor letters of intent must be attached to the proposal. These letters should briefly state the contribution or expertise being provided. Include statements of work and detailed cost proposals. Include information regarding consultant or subcontractor unique qualifications. Subcontract copies and supporting documents do not count against the Phase II page limit. Identify any subcontract/consultant foreign citizens per E above.

G. **Prior, Current, or Pending Support of Similar Proposals or Awards:** WARNING: While it is permissible, with proper notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work forconsideration under numerous Federal program solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. Any potential for this situation must be disclosed to the solicitation agency(ies) before award. If a proposal submitted in response to this BAA is substantially the same as another proposal previously, currently, or in the process of being funded by another Federal agency/DoD Component or the DAF, the applicant must so indicate on the Cover Sheet and provide the following:

a) The name and address of the Federal agency(ies) or DoD Component(s) towhich proposals were or will be submitted, or from which an awarded is expected or has been received;
b) The proposal submission or award dates;
c) The proposal title;
d) The PI's name and title for each proposal submitted or award received; and
e) Solicitation(s) title, number, and date under which the proposal was or will besubmitted, or under which an award is expected or has been received.
f) If award was received, provide the contract number.
g) Specify the applicable topics for each SBIR proposal submitted or award received.

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

COST VOLUME (VOLUME 3)

A detailed cost proposal must be submitted. Cost proposal information will be treated as proprietary. Proposed costs must be provided by both individual cost element and contractor fiscal year (FY) in sufficient detail to determine the basis for estimates, as well as the purpose, necessity, and reasonableness of each. This information will expedite award if the proposal is selected. Generally, Firm-Fixed-Price contracts are appropriate for Phase II awards. In accordance with the SBA SBIR/STTR Policy Directive, Phase II contracts must include profit or fee.

Cost proposal attachments do not count toward proposal page limitations. The cost proposalincludes:

a) **Direct Labor:** Identify key personnel by name, if possible, and labor category, if not. Direct labor hours, labor overhead, and/or fringe benefits, and actual hourly rates for each individual are also necessary for the CO to determine whether these hours, fringe rates, and hourly rates are fair and reasonable.

b) **<u>Direct Cost Materials</u>:** Costs for materials, parts, and supplies must be justified and supported. Provide an itemized list of types, quantities, prices, and, where appropriate, purpose. If computer or software purchases are planned, detailed information such as manufacturer, price quotes, proposed use, and support for theneed will be required.

c) **<u>Other Direct Costs:</u>** This includes specialized services such as machining or milling, special test/analysis, and costs for temporary use/lease of specialized facilities/ equipment. Provide usage (hours) expected, rates, and sources, as well as brief discussion concerning the purpose and justification. Proposals including leased hardware must include an adequate lease versus purchase rationale.

d) **<u>Special Tooling, Special Test Equipment, and Material</u>:** 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 applicant would otherwise possess in the normal course of business. These may include such items as innovative instrumentation and/or automatic test equipment.

e) **<u>Subcontracts:</u>** Subcontract costs must be supported with copies of subcontract agreements. Agreement documents must adequately describe the work to be performed and cost bases. The agreement document should include a SOW, assignedpersonnel, hours and rates, materials (if any), and proposed travel (if any). A letter from the subcontractor agreeing to perform a task or tasks at a fixed price is not considered sufficient. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-half of the total contract price, unless otherwise approved in writing by the Contracting Officer.

The prime contractor must accomplish price analysis, including reasonableness, of the proposed subcontractor costs. If based on comparison with prior efforts, identify the basis upon which the prior prices were determined reasonable. If price analysis techniques are inadequate or the FAR requires subcontractor cost or pricing data submission, provide a cost analysis. Cost analysis includes but is not limited to, consideration of materials, labor, travel, other direct costs, and proposed profit rates.

f) **<u>Consultants</u>:** For each consultant, provide a separate agreement letter briefly stating the service to be provided, hours required, and hourly rate, as well as ashort, concise resume.

g) **<u>Travel</u>:** Each effort should include, at a minimum, a kickoff or interim meeting. Travel costs must be justified as required for the effort. Include destinations, numberof trips, number of travelers per trip, airfare, per diem, lodging, ground transportation, etc. Per Diem and lodging rates may be found in the Joint Travel Regulation (JTR),Volume 2, www.defensetravel.dod.mil.

h) **<u>Indirect Costs</u>:** Indicate proposed rates' bases, e.g., budgeted/actual rates per

FY, etc. The proposal should identify the specific rates used and allocation bases to which they are applied. Do not propose composite rates; proposed rates and applications per FY throughout the anticipated performance period are required.

i) **Non-SBIR Governmental/Private Investment:** Non-SBIR Governmental and/or private investment is allowed. However, it is not required, nor will it be a proposal evaluation factor.

NOTE: If no exceptions are taken to an applicant's proposal, the Government may award a contract without exchanges. Therefore, the applicant's initial proposal should contain the applicant's best terms from a cost or price and technical standpoint. If there are questions regarding the award document, contact the Phase I CO identified on the cover page. The Government reserves the right to reopen exchanges later if the CO determines doing so to be necessary.

COMPANY COMMERCIALIZATION REPORT (VOLUME 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR 25.1 BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

SUPPORTING DOCUMENTS VOLUME (VOLUME 5)

The following documents may be required if applicable to your proposal:

1. DD Form 2345: For proposals submitted under export-controlled topics either International Traffic in Arms or Export Administration Regulations (ITAR/EAR), a copy of the certified DD Form 2345, Militarily Critical Technical Data Agreement, or evidence of application submission must be included. The form, instructions, and FAQs may be found at the United States/Canada Joint Certification Program website, http://www.dla.mil/HQ/InformationOperations/Offers/Products/LogisticsApplications/JCP/DD2315Ins tructions.aspx. DD Form 2315 approval will be required if proposal if selected for award.
2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 25.1 BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

Feasibility Documentation (required for all proposal submissions, contained within Volume 5, not subject to page limitations)

1. D2P2 proposals require a comprehensive, detailed effort description. Proposals should demonstrate sufficient technical progress or problem-solving results to warrant more extensive RDT&E. Developing technologies with commercial and military potential is extremely important. Particularly, AF is seeking proposals emphasizing technologies' dual-use applications and commercialization.
2. * NOTE: The applicant shall provide information to enable the agency to make the 15 U.S.C. 638(cc) determination of scientific and technical feasibility and merit. Applicants are required to provide information demonstrating scientific and technical merit and feasibility has been established. The DAF will not review the Phase II proposals if it is determined the applicant 1) fails to demonstrate technical merit and feasibility are established or 2) the feasibility documentation does not support substantial performance by the applicant and/or the PI. Refer to the Phase I description within the topic to review the minimum requirements needed to demonstrate scientific and technical feasibility. **Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.**
3. If appropriate, include a reference or works cited list as the last page.
4. Feasibility efforts detailed must have been substantially performed by the applicant and/or the

PI. If technology in the feasibility documentation is subject to intellectual property (IP) rights, the applicant must provide IP rights assertions. Additionally, applicants shall provide a short summary for each item asserted with less than unlimited rights describing restriction's nature and intellectual property intended for use in the proposed research. Please see DoD SBIR 25.1 BAA for technical data rights information.

5. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated.

FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)

Note that the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

DISCLOSURES OF FOREIGN AFFILIATIONS OR RELATIONSHIPS TO FOREIGN COUNTRIES (VOLUME 7)

Small business concerns must complete the Disclosures of Foreign Affiliations or Relationships to Foreign Countries webform in Volume 7 of the DSIP proposal submission. Please be aware that the Disclosures of Foreign Affiliations or Relationships to Foreign Countries WILL NOT be accepted as a PDF Supporting Document in Volume 5 of the DSIP proposal submission. Do not upload any previous versions of this form to Volume 5. For additional details, please refer to the DoD Program BAA.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DAF does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals submitted in response to DAF topics should not include TABA.

METHOD OF SELECTION AND EVALUATION CRITERIA

D2P2 proposals are evaluated on a competitive basis by subject matter expert scientists, engineers, or other technical personnel. Throughout evaluation, selection, and award, confidential proposal and evaluation information will be protected to the greatest extent possible. D2P2 proposals will be disqualified and not evaluated if the Phase I equivalency documentation does not establish the proposed technical approach's feasibility and technical merit.

Proposals will be evaluated for overall merit in accordance with the criteria outlined in the 25.1 BAA Section 6.0. 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 15 USC 638(vv) (Section 4 of the SBIR and STTR Extension Act of 2022), and the Deputy Secretary of Defense Memorandum; Subject: Defense Small Business Innovation Research and Small Business Technology Transfer Due Diligence Program dated May 13, 2024, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may choose to either 1) create a plan to mitigate the risk(s) or 2) DAF may decide not to select the proposal for award based upon a totality of the review.

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 REQUIREMENTS AND LOCATION OF WORK

For Phase I, a minimum of two-thirds of the research or analytical effort must be performed by the Awardee. The DAF measures percentage of work by both direct and indirect costs, not including profit. Occasionally, the DAF will consider deviations from this performance of work requirement. **Requests for Performance of Work deviations must be made twice: prior to submission during the topic open period and as part of the initial proposal submission.** For requests prior to the initial proposal submission, the DAF will consider the request and approve or disapprove requesting applicants to proceed with DSIP submission. Upon proposal receipt, the DAF will again consider such requests for approval for the resultant award.

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 APEX, Peerless Technologies, Engineering Services Network, HPC- COM, Mile Two, REI Systems, MacB (an Alion company), Montech, Oasis, Astrion/Oasis, and Infinite Management Solutions. In addition, only Government employees and technical personnel from Federally Funded Research and Development Centers (FFRDCs) MITRE and Aerospace Corporations working under contract to provide technical support to AF Life Cycle Management Center and Space Force may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. **Contact the AF SBIR/STTR Contracting Officer (Daniel.Brewer.13@us.af.mil) with concerns about any of these contractors**.

PROPOSAL STATUS AND FEEDBACK

The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Cover Sheet will be notified by e-mail regarding proposal selection or non-selection. Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the Proposal Number and Topic Number referenced.

Automated feedback will be provided for proposals designated Not Selected. Additional feedback may be provided at the sole discretion of the DAF.

IMPORTANT: Proposals submitted to the DAF are received and evaluated by different organizations, handled by topic. Each organization operates within its own schedule for proposal evaluation and selection. Updates and notification timeframes will vary. If contacted regarding a proposal submission, it is not necessary to request information regarding additional submissions. Separate notifications are provided for each proposal.

The Air Force anticipates that all proposals will be evaluated and selections finalized within approximately 90 calendar days of solicitation close. Please refrain from contacting the BAA CO for proposal status before that time.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Air Force SBIR/STTR Contracting Officer Daniel J. Brewer, Daniel.Brewer.13@us.af.mil.

AIR FORCE SUBMISSION OF FINAL REPORTS

All Final Reports will be submitted to the awarding DAF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

DAF Direct-to-Phase-II Topic Index

Topic Number	Topic Title	Proposal Maximum Dollar Amount*	Proposal PoP Maximum**	Technical Volume (Volume 2) Page Limit***
AF251-D001	III-Nitride-Based Quantum Sensors	$1,400,000.00	24	35
AF251-D002	High Operating Temperature Dynamic Range MWIR Infrared Imagers	$1,400,000.00	24	35
AF251-D003	Advancement of CryoUltrasonic Testing for Inspection of Aerospace Components	$1,400,000.00	24	35
AF251-D004	Small unmanned aerial system low-level command system	$1,400,000.00	24	35
AF251-D005	Novel Focal Plane Array to Enable Agile Autonomous Flight Control	$1,400,000.00	24	35
AF251-D006	Advanced Manufacturing of Cryocoolers for Infrared IR sensors	$1,400,000.00	24	35
AF251-D007	Limited-Life Probabilistic Performance Prediction of Metallic Materials	$1,400,000.00	24	35
AF251-D008	Multi-Agent Simultaneous Segmentation and Scheduling (MASSS)	$1,400,000.00	24	35
AF251-D009	Autonomous Robotic Coating Process Planning for Complex Geometries	$1,400,000.00	24	35
AF251-D010	Large Scale Thermoplastic Processing	$1,400,000.00	24	35
AF251-D011	Intelligent Diagnostics for Radomes	$1,400,000.00	24	35
AF251-D012	Enhanced Sensor for Characterizing Radome Health	$1,400,000.00	24	35
AF251-D013	Conformable Robotic Masking for Aircraft Painting Operations	$1,400,000.00	24	35
AF251-D014	Collaborative Robotic Systems for Efficient Confined Space Inspections	$1,400,000.00	24	35

AF251-D015	Field Level Fuels/Propellant Analysis in a Case	$1,400,000.00	24	35
AF251-D016	Deep Neural Networks for Reliability Modeling	$1,400,000.00	24	15
AF251-D017	Integrated Radio and High Sound Reduction Hearing Protection	$1,400,000.00	24	35
AF251-D018	AgilePod16V2 Compatible Optical Nose End-cone and High-Resolution EO/IR Attritable Deployment Sensor for Modular Capability – AgilePod ConeHEADs	$1,400,000.00	24	35
AF251-D019	B61-12 Tail Kit Assembly Modular Avionics Retrofit	$1,400,000.00	24	15
AF251-D020	Design of a Planar Array Antenna for Electric Magnetic Pulse (EMP) and High Power Microwave (HPM) Testing	$1,800,000.00	24	15
AF251-D021	Long Kill Chain via Secure Private Clouds	$1,400,000.00	24	35
AF251-D022	Multispectral False Alarm Mitigation	$1,800,000.00	15	35
AF251-D023	Optical Fence Line (OFL)	$1,800,000.00	15	35
AF251-D024	Data Informed Software Enabled Weapons Mission Applications	$1,400,000.00	24	35
AF251-D025	Spatial Tracking for Enhanced Automated Manufacturing - Extended Reality (STEAM-XR)	$1,400,000.00	24	35
AF251-D026	Scaled Silicon Carbide on Insulator for Quantum Applications	$1,400,000.00	24	35
AF251-D027	Rapid and Affordable Propulsion Manufacturing Technologies for Munitions	$1,400,000.00	24	35

*Proposals in excess of this amount will not be considered for award.
**Proposals in excess of this duration will not be considered for award.
***Pages/slides in excess of this number will not be considered during proposal evaluations.

TOPIC NUMBER: AF251-D001

TITLE: III-Nitride-Based Quantum Sensors

TECHNOLOGY AREAS: Sensors; Materials; Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a novel platform for quantum optical sensing using the III-Nitrides Materials system.

DESCRIPTION: Novel quantum sensors offer the opportunity to measure a variety of properties with unprecedented precision and sensitivity. This includes sensors that potentially can measure temperature, acceleration, and magnetic fields with extreme accuracy. Quantum sensors based on optical systems (i.e., with an optical qubit) offer the unique capability of miniaturization, integration with existing systems, stability, and scalability. However, current quantum systems based on e.g., diamond and SiC have, despite decades long investments, not found widespread application for quantum sensing applications. Optical defects in these materials, such as nitrogen-vacancy (NV) centers in diamond and silicon vacancies (VSi) in SiC, have been extensively studied for their potential use in quantum technologies. While they have shown promise in various applications, there are still significant challenges that need to be addressed before they can be used effectively in quantum sensing. This includes control of the impurity incorporation, integration on the system level, and stable room temperature operation.

III-Nitrides such as GaN, AlN, and AlGaN have been long investigated for optical and electrical devices. Recent theoretical and experimental works from various groups points to the potential of achieving single photon sources and optical qubits in bulk III-Nitrides. The published data indicates that these materials offer the potential to achieve qubits with room temperature stability. Moreover, III-Nitrides boast a well-established materials toolbox that facilitates rapid scaling and seamless integration with other similar-material devices, paving the way for a comprehensive photonic platform. In order to leverage III-Nitride based technology for quantum sensing applications qubits need to be established and integrated with appropriate photonic circuitry.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Prior work expected to be completed in a "Phase-I type" effort, in order to qualify for this D2P2, requires demonstrated feasibility which should include work and results in the following areas:

"Phase I-type" efforts should include growth and fabrication results to show feasibility of high performance and high quality films with low rms surface roughness and minimal unintentional defects. Performers should have requisite experience building constituent elements of the platform such as waveguides and sources. Early laboratory or field demos showcasing individual components for sensing capabilities are expected.

PHASE II: Phase II will focus and the development and result in the demonstration of a new platform that allows for the development of quantum sensors. This platform should be based on the III-Nitrides materials system and operate in the UV-visible range of the spectrum. All needed parts for the quantum optical system and quantum sensor should be demonstrated which could include an integrated photonic circuit with all necessary elements (e.g., waveguides, cavities, up/ down converting elements, excitation, detection…). Eventually, the integrated circuit should be combined with a viable III-Nitride based qubit.

PHASE III DUAL USE APPLICATIONS: Phase III awardees can expect that the developed platform will be used to demonstrate a quantum sensor (e.g., accelerometer, magnetometer, gravity gradiometer) for targeted military applications. Scalability and reliability of the quantum sensor should be demonstrated, and commercialization should be pursued.

REFERENCES:

1. Castelletto, S., & Boretti, A. (2020). Silicon carbide color centers for quantum applications. Journal of Physics: Photonics, 2(2), 022001.

2. Varley, J. B., Janotti, A., & Van de Walle, C. G. (2016). Defects in AlN as candidates for solid-state qubits. Physical Review B, 93(16), 161201.

3. Berhane, A. M., Jeong, K. Y., Bodrog, Z., Fiedler, S., Schröder, T., Triviño, N. V., ... & Aharonovich, I. (2017). Bright room-temperature single-photon emission from defects in gallium nitride. Advanced Materials, 29(12), 1605092.

4. Rigler, M., Buh, J., Hoffmann, M. P., Kirste, R., Bobea, M., Mita, S., ... & Zgonik, M. (2015). Optical characterization of Al-and N-polar AlN waveguides for integrated optics. Applied Physics Express, 8(4), 042603.

5. Lu, T. J., Fanto, M., Choi, H., Thomas, P., Steidle, J., Mouradian, S., ... & Englund, D. (2018). Aluminum nitride integrated photonics platform for the ultraviolet to visible spectrum. Optics express, 26(9), 11147-11160.

KEYWORDS: Quantum sensing; precision; sensitivity; photon source; room temperature; qubit; nanophotonics

TOPIC NUMBER: AF251-D002

TITLE: High Operating Temperature Dynamic Range MWIR Infrared Imagers

TECHNOLOGY AREAS: Sensors; Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Development of high operating temperature (HOT), large-dynamic range mid-wave infrared (MWIR, 3-5 mm) focal plane arrays for imaging. Design, fabricate, and demonstrate high performance, mid-wavelength infrared (MWIR) detector operating at room temperature and integrate it to commercial ROICs.

DESCRIPTION: Photon sensors for the MWIR band of the electromagnetic spectrum require cooling below 180 K for low dark currents and high detectivity. The requirements of smaller gap for full band absorption, thicker absorber for large quantum efficiency, flatter bands for suppressed Auger generation/recombination, and low defect densities for longer Shockley-Read-Hall lifetimes are challenging to simultaneously achieve at elevated temperatures. Several studies including photon trapping and plasmonic structures-coupled detector designs were conducted to increase the operation temperature, but the improvements were limited to 200 K in this wavelength regime. However, detailed calculations continue to predict the possibility of background-limited and thermoelectrically (TE)-cooled operation even at the long wave infrared regime if the structures are fully depleted.

PHASE I: Recent advancements in the development of antimonide based Type II superlattice (T2SL) infrared detectors and focal plane arrays abound. Several studies including photon trapping and plasmonic structures-coupled detector designs were conducted to increase the operation temperature. As mercury cadmium telluride (HgCdTe) infrared detector technology continues to push boundaries to increase device operating temperature and achieve larger format arrays, addressing performance limitations in state-of-the-art p–n junction photodiodes becomes critical. Decades of research and development on HgCdTe material growth and fabrication techniques have resulted in the achievement of detectors with dark current limited by intrinsic Auger thermal generation processes, rather than by extrinsic dark current mechanisms such as surface conduction, Shockley–Read–Hall (SRH) centers, or trap-assisted tunneling when CdZnTe substrates are used. A currently favored alternative technology involves replacement of the expensive, not readily available, and relatively small-area CdZnTe wafers with Si wafers. Si wafers offer thermal matching to the Si readout integrated circuit (ROIC), together with thermal cycling reliability, mechanical strength, and large size over CdZnTe substrates.

As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Prior work expected to be completed in a "Phase-I type" effort, in order to qualify for this D2P2, requires demonstrated feasibility which should include work and results in the following areas:

For an applicant to demonstrate that its technology is at an appropriate level for a D2P2 award, the applicant should have experience developing numerical simulations and predictive calculations for– dark current (Id), quantum efficiency (η), responsivity (R), NEDT, and detectivity (D*)—at elevated operating temperatures for applications similar to the topic above. In addition, proposers need to have the requisite experience and facilities to perform electrical and optical measurements for detector performance characterization. Similar applications may include target identification and recognition, ISR, or other kinds of target detection and surveillance.

PHASE II: The awardee(s) will undertake physics based theoretical analysis with metrics for frame rate, dynamic range, resolution and sensitivity architecture with single element detectors. Awardee(s) will develop a road-map for realization of focal plane arrays and obtain experimental data on single element detectors coupled with read-out architectures. Awardee(s) will demonstrate a small format 4x4 fanout of the detector architecture (year 1 deliverable) that is scalable to a 320x256 focal plane array at the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Phase III awardee(s) can expect further scaling of performance metrics for dual use applications; and a design for performance approach for defense system in partnership with a defense contractor and a design for cost for commercial applications.

REFERENCES:

1. P.R.Guduru, A.J.R., and G.Ravichandran, Dynamic Shear Bands: An Investigation Using High Speed Optical and Infrared Diagnostics. Mechanics of Materials, 2001. 33: p. 371-402.

2. Rogalski, A., P. Martyniuk, and M. Kopytko. "Type-II superlattice photodetectors versus HgCdTe photodiodes." Progress in Quantum Electronics (2019): 100228.

3. T. Specht, Z.Taghipour, T.J. Ronningen, R.Fragasse, R. Tantawy, S. Smith, E. Fuller, W. Khalil, and S. Krishna. "Photodetector Architecture for Open Circuit Voltage Operation of MWIR InAsSb Detectors." IEEE Research and Applications of Photonics in Defense Conference (RAPID), pp. 1-4. IEEE, 2019.

KEYWORDS: high operating temperature focal plane arrays; photonic infrared detectors; type II superlattices; large dynamic range; mid wave infrared imagers; enhancing coupling

TOPIC NUMBER: AF251-D003

TITLE: Advancement of CryoUltrasonic Testing for Inspection of Aerospace Components

TECHNOLOGY AREAS: 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 section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The objective of this topic is to advance the readiness of CryoUltrasonics technology to enable nondestructive evaluation of complex-shaped components. End state performance should meet a ultrasonic testing frequency threshold of 2 Megahertz, and objective of 10 Megahertz, for representative aerospace components. Testing performance should be assessed using known features such as range of differently sized flat bottom holes (FBHs) to sizes as small as #1 (1/64 inch). At a minimum, the activity should demonstrate freezing, testing and analysis of at least two representative aerospace components in ice- or ice-based composites. One desired demonstration is to freeze disk-shaped components at least 24 inches in diameter (objective 36 inches in diameter), and as a separate demonstration, freeze-test-and-analyze components with complex internal geometry such as curved channels or vanes. An additional desire is to include representative components for testing ranging from lightweight-to-dense alloys (e.g., Aluminum, Titanium, and Nickel-based alloys) and composites.

DESCRIPTION: CryoUltrasonic testing is an emerging method for nondestructive evaluation of complex-shaped components of metallic alloys and high performance composites [1]. The method involves encasing the component in an ice- or ice-based composite to more closely match the acoustic properties of the component. Compared to conventional immersion ultrasound in water, this methodology provides both improved transmission of sound and reduced refraction at component-ice interfaces [1], allows for a larger critical angle at component-ice interfaces thus facilitating inspection of highly inclined and curved surfaces [1,2,3,4], has relative insensitivity to rough interfaces like those produced by metal Additive Manufacturing processes [3], and can transform the inspection article into a simple solid shape [1,2,3,4]. These attributes are beneficial for both conventional and Additively Manufactured components that cannot be easily inspected using mature nondestructive evaluation methods such as immersion ultrasound testing or x-ray Computed Tomography. However, the benefits of Cryo Ultrasonic inspection for structural components are not yet fully realized. It is desired to enhance this laboratory-based methodology to enable capability demonstration(s) on representative aerospace components with surrogate flaws as small as a 1 Flat Bottom Hole. In particular, innovative approaches are sought to reduce the total cycle time for preparation, testing and analysis to a few hours, while also enabling freezing of parts up to 36 inches in diameter while maintaining excellent acoustic properties.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant(s) to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. The applicant(s) is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-like” effort that includes demonstration of Cryo Ultrasonic Testing on sample(s) with surrogate or known defects that demonstrate feasibility for key processes in CryoUltrasonic workflow: freezing of the sample, ultrasonic testing (at frequencies of at least 2 megahertz or higher), and analysis demonstrating detection of the defect. The applicant(s) should have defined a clear, immediately actionable plan with the proposed solution. Letters of support from potential collaborators/stakeholders is encouraged.

PHASE II: Under the Phase II effort, the awardee(s)shall sufficiently develop the CryoUltrasonic Testing technology to provide capability demonstration(s) on representative aerospace components that contain surrogate defects as small as a 1 Flat Bottom Hole. Identification of issues and or business model modifications required to further improve product or process relevance to costs, availability, or safety, should be documented.

PHASE III DUAL USE APPLICATIONS: The awardee(s) will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES:

1. Simonetti, F., et al. "Cryo-ultrasonic NDE: Ice–cold ultrasonic waves for the detection of damage in complex-shaped engineering components." IEEE transactions on ultrasonics, ferroelectrics, and frequency control 65.4 (2018): 638-647.

2. Simonetti, F., and M. Fox. "Experimental methods for ultrasonic testing of complex-shaped parts encased in ice." NDT & E International 103 (2019): 1-11.

3. Simonetti, F., and M.D. Uchic. "Equiaxed Polycrystalline Ice for Ultrasonic Testing of Solids." Physical Review Applied 18.1 (2022): 014034.

4. Simonetti, F. "Cryo-ultrasonic testing of curved components." NDT & E International 137 (2023): 102835.

KEYWORDS: CryoUltrasonic Testing; Nondestructive Evaluation; Nondestructive Inspection; Phased Array Ultrasonic Testing

TOPIC NUMBER: AF251-D004

TITLE: Small unmanned aerial system low-level command system

TECHNOLOGY AREAS: Electronics; Air Platform; Information Systems

OBJECTIVE: The objective of this project is to develop a small unmanned aerial systems (sUAS) flight control system (FLCS) capable of supporting different dynamics through a model following algorithm (aka micro-VISTA), to support rate control input and output to control-surface actuators. The proposed effort is focused on developing the technology to provide an interface for lower-level commands (LLC) between autonomy algorithms and a sUAS simulating the dynamics of another aircraft. The UAS FLCS should permit the autonomy algorithms to use LLCs to fly the aircraft through the allowable flight envelope but should intercede to prevent loss of control in cases where the aircraft would exceed limits. Autonomy algorithms can be developed and testing using this capability with reduced risk and development time.

DESCRIPTION: Given the complexity of autonomous systems and the environment we expect to use them, it is impossible to set up a complete set of necessary development and test scenarios in open air using target platforms. Therefore, including Live, Virtual, and Constructive (LVC) simulation into flight test will be mandatory for testing before fielding autonomies. Being able to test autonomies through a build-up of lower-to-higher fidelity simulation environments will be critical to evaluate autonomies, not just to support autonomy development, but also to enable testing future autonomous systems. Specifically, having a simulation architecture where autonomy software can move seamlessly between simulation environments before getting onto the objective platform is necessary, i.e., laboratory to software-in-loop/hardware-in-loop (SIL/HIL) simulations, to flight through in-air surrogates such as sUAS or VISTA/Venom platforms.

So far, all autonomy test on surrogate platforms has used waypoint or Heading-Speed-Altitude (HSA) commands to an autopilot. Lower-level controls (e.g., roll, pitch, throttle) will be necessary to enable target platforms to perform complex intended behaviors that are either not easily performed or impossible to perform using waypoint or HSA commands, e.g., Beyond-Visual-Range (BVR), Basic Fighter Maneuvers (BFM). Although the 412TW VISTA platform is pioneering LLC interfacing that allows acceleration and roll-rate command inputs to F-16 flight controls there is currently no standard interface defined nor any option available for sUAS, thereby creating an expensive and sluggish gap between software testing and in-air testing. Being able to test complex intended behaviors on sUAS will reduce the overall cost to test autonomy as well as increase the tempo of flight test as sUAS are cheaper and easier to get up in the air.

LLC systems enable executing roll, pitch, and throttle commands on the aircraft. A sUAS LLC system would effectively allow a sUAS to perform complex in-air maneuvers that require acceleration and roll-rate commands. Several efforts have demonstrated this LLC capability, but only on larger platforms (i.e., F-16) using platform-specific FLCS and none have demonstrated LLCs on sUAS using COTS autopilots.

Model Following Algorithms (MFA) enable simulating the dynamics of another aircraft through a control augmentation process. An MFA on a sUAS would enable implementing multiple vehicle model types on that sUAS.

Initial evaluations of overall accuracy will be performed with the FLCS integrated on a sUAS test aircraft. Air data captured using the FLCS would be evaluated and compared to the commanded inputs. On subsequent test efforts, the FLCS system would be integrated into a Renegade sUAS aircraft for evaluations of suitability and utility on faster sUAS systems.

RESEARCH GOALS:

• Model Renegade sUAS for simulation and control law development

• Build FLCS to take various low-level commands inputs (e.g., rates, surface deflections) and generate servo commands
• MFA in FLCS to enable mimicking flight dynamics of other platforms with appropriate model
• Dynamic state control
• Auto-recovery from state-limit exceedance
• Interface control document (ICD) for FLCS interface

PHASE I: This is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made because of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Applicants are expected to provide a white paper providing a comprehensive feasibility assessment that outlines the technical viability of developing an LLC and MFA enabled FLCS interface for sUAS. This assessment should address the suitability of the FLCS for sending LLCs to sUAS and their potential integration into different sUAS platforms, while allowing for model following. Furthermore, Data Analysis is essential, and it is anticipated that the Applicants conduct a thorough analysis and provide meaningful conclusions about the accuracy, suitability, and utility of the interface as sUAS aircraft equipment. Lastly, it is expected that an integration of the FLCS will be demonstrated on a sUAS using a COTS autopilot. Additional processing may be used in the platform. The Applicants should then demonstrate its performance in real-flight scenarios.

PHASE II: The proposed effort is focused on maturing the technology to be able to provide roll, pitch, and throttle driven maneuvers to high performance aircraft in regimes near the upper speed limits of group 3 sUAS (Department of Defense, 2018). As a result, the Phase II Period of Performance objectives:
1) Create and verify aeromodel of Renegade sUAS.
2) Demonstrate a FLCS with simulated sUAS to include the Renegade sUAS.
3) Collect simulation test data to evaluate the FLCS against commanded inputs.
4) Integrate a FLCS into a Renegade sUAS with a COTS autopilot.
5) Collect flight test data using the Renegade aeromodel and sUAS model(s) used in #2 above.
6) Evaluate flight test data against commanded inputs.
7) Verify FLCS is permissive for agile maneuvers within the allowable flight envelope.
8) Verify FLCS can safely recover aircraft control during an envelope exceedance event.
9) Evaluate the suitability and utility of the FLCS for sUAS with a COTS autopilot.
10) Provide ICD of the FLCS.

PHASE III DUAL USE APPLICATIONS: Phase III would transition this type of system to be the primary means of enabling LLC and MFA for sUAS. Autonomy test would be able to significantly reduce overall cost and risk by using LLC and MFA enabled sUAS. The 416th Emerging Technologies Integrated Test Force is expected to be the primary government group to sustain this capability.

LLC and MFA enabled sUAS facilitate the integration and testing of autonomy algorithms and limits the risk, development time, and airworthiness approvals required for such assessments. These sUAS include the baseline autopilot capability and include interfaces to autonomy computers with a hardware architecture modeled after the 412 Test Wing X-62A VISTA. For both LLC and MFA enabled UAS and VISTA, the reliability and determinism of the baseline autopilot provides the foundation for airworthiness safety review assessments, airspace and range permissions, and risk assessments. Flight tests are no more dangerous than a routine operation since the experimental autonomy algorithm is prevented from exceeding the allowable flight envelope by the trusted and verified baseline autopilot recovery mechanism. Commercialization of LLC and MFA enabled sUAS can be extended to Phase III in which the system is integrated into the development cycle of novel autonomy algorithms with commercial and government teams. The system can be developed into a commercial product and retain government property rights for continued use and development.

REFERENCES:

1. Air Force Materiel Command. (2023). 2023 AFMC Strategic Plan.

2. Department of Defense. (2018). Guidance for the Domestic Use of Unmanned Aircraft Systems in U.S. National Airspace.

3. Department of the Air Force. (2022). Seven Operational Imperatives.

KEYWORDS: small unmanned aerial systems (sUAS); flight control system (FLCS); open air using target platforms; autonomous systems; simulation and control law development.

TOPIC NUMBER: AF251-D005

TITLE: Novel Focal Plane Array to Enable Agile Autonomous Flight Control

TECHNOLOGY AREAS: Sensors; Information Systems; Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Extend the mathematical tool set developed under the AF-funded Mode Sensing Hypothesis grant to accommodate focal plane array structures that will enable agile autonomous flying systems. Develop the FPA structures, building and testing prototypes. Incorporate structures on a flying airframe/spaceframe, demonstrating they can autonomously recognize need for flight mode change and execute the identified change.

DESCRIPTION: Next generation unmanned air-vehicle systems (UAS) require improved sensing approaches to enhance their autonomous capabilities for an array of operational applications. Current autonomous UAS operations employ several sensors and associated feedback loops that are responsive to changes in their observed state relative to the environment. This topic will explore and advance a faster / more responsive, more efficient, and adaptable approach in which bioprincipic methods will be employed to modify sensor structure, control effectors, and change dynamic modes, ultimately enhancing efficiency of autonomous flight operations. In the USAF-funded Mode Sensing Hypothesis grant, it was shown that for the fly Calliphora vicina, the directions associated with the matched filters associated with the optic flow patterns associated with the fly's flight, the control authority directions, and the directions associated with details of the airframe were aligned so as to maximize the sensed energy through the system. Contrary to other hypothesized relationships, such as maximizing control to correlate with maximum observability, which is how we engineer guided systems but is not the way Nature designs these systems. Thus the most efficient flight of the fly is among modes that maintain this relationship. It is desired to develop flying platforms that demonstrate that this is true across a variety of engineered flying vehicle designs. This topic solicits proposals to develop capabilities in the seeker (the analog to the compound eye) that will facilitate the system's recognizing, from the imaging sensor output, that a different vehicle configuration (sensors, control effectors, etc) would improve performance of the system. This is done in Calliphora optic lobe with the lobula plate tangential cells (LPTCs), which are matched filters for optic flow patterns across the animal's retina. The retina can apparently be read out in several ways which reflect different preprocessing architectures among the ommatidial outputs. It is desired to develop hardware and software to have engineered systems capable of doing this, enabling agile (going from state to state) autonomous control of the system through the details of how the imaging sensor sees the world. A secondary consideration is to not over-engineer the system: keep the approach simple and inexpensive.

PHASE I: For this Direct-to-Phase-II (D2P2) topic, there are no Phase I awards. To qualify for this D2P2, applicants must demonstrate feasibility, competency, and cite successful past performance in designing, building, testing, and demonstrating advanced focal plane arrays, with properties reflecting particular requirements, such as pixel inhomogeneity, pixel anisotropy, event-based sensing, identifying and tracking regions of interest, sensing expanded-beyond-the-traditional properties of the electromagnetic field such as multispectral sensing and sensing polarized light.

PHASE II: AFRL seeks a new and novel bioprincipic approach to autonomous UAS operations and relative position maintenance, employing new sensors and new, versatile versions of older sensors (in this topic specifically, sensor focal plane arrays) to enable making rapid autonomous decisions to improve the GN&C performance of the UAS across a variety of flight operations. For this Direct-to-Phase-II (D2P2) topic, the proposer should develop, implement, and prototype a novel advanced FPA with different implicit architectures, such as pixel inhomogeneity, pixel anisotropy, event-based sensing, identifying and tracking regions of interest, sensing expanded-beyond-the-traditional properties of the electromagnetic field such as multispectral sensing and sensing polarized light. The proposer should demonstrate functionality of the prototype in flight demonstrations on a suitable vehicle, using the general approach associated with the mode sensing hypothesis. The developed novel FPA structures will allow the sensor to prefilter the information, enabling autonomous decisions to be made to improve the performance of the space vehicle based on observations from the sensor suite. Improvements could include approaches to focal plane readout, changing the spectral or spatial or polarization properties sensed, or changing the control effectors (such as angle of thrust), etc, to improve the performance of the vehicle.

PHASE III DUAL USE APPLICATIONS: AFRL is building a program to incrementally demonstrate the principles engendered in the mode sensing hypothesis by developing various sensors to be incorporated in to the overall structure of a UAS or other airframe, demonstrating the validity of the approach. Successful completion of this effort will provide a critical component towards realizing a complete mode sensing capability, to be incorporated into the system as part of the final flight test demonstration. As this will result in a 6.2 level subsystem, In Phase 3 the government and vendor team will work with AFRL/RWT flight team to further mature the technology as a portion of a flight experiment. At that point, the system prototype will be demonstrated to appropriate AFLCMC program offices for consideration for the various tasks this mode sensing technology can address.

REFERENCES:

1. Krapp, H. G., G. K. Taylor and J. S. Humbert (2012). The mode-sensing hypothesis: matching sensors, actuators and flight dynamics. Frontiers in Sensing - From Biology to Engineering. F. G. Barth, J. A. C. Humphrey and M. V. Srinivasan, Springer: 101-114.

2. Theobald, J. C. (2017). "Optic flow induces spatial filtering in fruit flies." Current Biology 27 (March 20, 2017): R1–R2.

3. Barrows, G. L., T. M. Young, C. W. Neely, A. N. Leonard and J. S. Humbert (2012). Vision Based Hover in Place. 50th AIAA Aerospace Sciences Meeting.

4. Humbert, Krapp, …, Taylor, "Motion vision is tuned to maximize sensorimotor energy transfer in blowfly flight" submitted to Nature

5. Warrant, E. and G. Von der Emde, Eds. (2016). the Ecology of Animal Senses: Matched Filters for Economical Sensing, Springer.

KEYWORDS: Mode sensing; motion vision; insect flight; matched filter; sensor placement; mechanistic interpretability; observability; controllability

TOPIC NUMBER: AF251-D006

TITLE: Advanced Manufacturing of Cryocoolers for Infrared IR sensors

TECHNOLOGY AREAS: Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: This topic seeks to mature manufacturing processes for Infrared (IR) Cryogenic Coolers (cryocoolers). Ideal projects would improve the quality of the cryocooler and drive down cost through increased production, increased reliability, and development of a manufacturing process enhancement model capable of component/subcomponent design, predictive manufacturing processes and tracking of manufacturing process data.

DESCRIPTION: The Department of the Air Force and U.S. Space Force needs effective, reliable, low-cost IR cryocoolers to cool down infrared detectors down to cryogenic temperatures to perform within desired specifications. Cryocoolers are the components that provide the cryogenic cooling capability; currently they're designed by custom, fabricated, and qualified in low numbers at large costs (e.g. $3-5 million per unit). Currently cryocoolers are provided by large prime contractors or sourced via foreign suppliers. This effort should implement existing manufacturing processes to increase production and inspect the feasibility of cost reduction to less than $1 million per unit. It should also investigate advanced manufacturing techniques to further reduce costs to at most $250 thousand per unit and increase rate of production to at least 50 units per year. This should be done while meeting performance specifications of cooling, size, weight, power, meant-time-to-failure and vibration.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II effort. Therefore, a Phase I award is not required. The applicant is required to provide detail and documentation in the Direct to Phase II (D2P2) proposal which demonstrates accomplishments of a “Phase I- type” effort including a feasibility study. This includes determining the scientific and technical merit and feasibility of ideas appearing to have to have commercial and/or defense potential. The applicant must demonstrate that a prototype infrared cryocooler manufacturing capability exists or provide modeling capability to support a design. The applicant should have a clearly defined actionable plan with proposed solution and AF customer and should be able to describe how/if the capability can be used by other DoD or Government customers.

PHASE II: Eligibility for D2P2 is predicated on the applicant having performed a “Phase I-type” effort predominantly separate from the SBIR/STTR programs. Under the phase II effort, the applicant shall optimize previous designs of cryocoolers for manufacturing. The applicant shall sufficiently develop the technical approach and manufacturing processes to fabricate and test a small number of relevant prototypes. Relevant process steps shall be detailed including but not limited to assembly techniques, work instructions and build of materials. Identification of manufacturing/production issues and or business model modifications required to further improve process and product should also be documented. A successful phase II effort will utilize components and manufacturing processes that increase production yields and improve capabilities of companies to become suppliers of cryocoolers to DoD prime contractors.

Cryocoolers of interest will be able to meet the following objectives:
- Up to 2.5 Watts of cooling at 71 degrees Celsius
- Operating temperature -40 degrees Celsius to 71 degrees Celsius
- Noise, Root Mean Square less than or equal to 1 peak-to-peak voltage

PHASE III DUAL USE APPLICATIONS: Commercialize the new approach by supplying subcomponents to cryocooler integrators, by supplying equipment to cryocooler manufacturers, or by manufacturing cryocoolers in-house. Begin producing and delivering products, at a low rate, to customers. Fully qualify the product for the intended application(s). Assist in integrating the product into a demonstrator system

REFERENCES:

1. CREARE LLC, Low Temperature, Low Capacity Cryocooler Technology, NASA SBIR phase I, July 2023 – February 2024; https://www.sbir.gov/awards/204145

2. CREARE LLC, Low Cost Radiation-Hardened Cryocooler Control Electronics for Space Missions, NASA SBIR Phase II, June 2023 – June 2025; https://www.sbir.gov/awards/204151

3. WECOSO INC, Miniature 2-Stage 20k Cryocooler, NASA SBIR phase I, July 2023 – February; https://www.sbir.gov/awards/204238

4. QMAGIQ LLC, DEPOSITION OF MULTIPLE INFRARED SPECTRAL FILTERS DIRECTLY ON FOCAL PLANE ARRAY , NASA SBIR phase I June 2022 - Jan 2023; https://www.sbir.gov/awards/196178

5. TRITON SYSTEMS INC, High-Efficiency Modified Collins Cycle Cryocooler, NASA SBIR phase I Jul 2022 – jan 2023; https://www.sbir.gov/awards/196501

KEYWORDS: Cryocooler; Manufacturing; space

TOPIC NUMBER: AF251-D007

TITLE: Limited-Life Probabilistic Performance Prediction of Metallic Materials

TECHNOLOGY AREAS: Air Platform; Weapons; 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 section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: This topic seeks to advance the state-of-the-art in probabilistic fatigue life prediction tools for elevated-temperature, durability critical, and fracture critical metallic aerospace structural applications with limited-life design requirements.

DESCRIPTION: There has been increased interest at the Air Force Research Laboratory (AFRL) and industry for an advancement in models, data, and tools to allow improved metals probabilistic performance prediction for reduced-cost, limited-life components. Components may be designed within the reduced life trade space of elevated stress, temperature, and/or environmental degradation relative to traditional material capability limits. The goal of this effort is not to develop new materials performance models for elevated temperature materials. Rather, the goal is to advance the state-of-the-art in existing probabilistic fatigue life and/or damage tolerance prediction tools to include the relevant mechanisms that drive metals behavior in limited-life conditions. These driving mechanisms are expected to be application dependent and may include, but are not limited to crack-tip plasticity, oxidation, and time-dependent behavior (creep- or dwell-fatigue.) Additionally, influences from microstructure and microstructure scale features (porosity, inclusions, surface roughness) shall be considered in the life prediction approach. Titanium alloys and Ni-base super alloys are anticipated to be the choice for low-cost, limited-life elevated temperature applications and are the preferred materials. A product form requirement is not defined but is anticipated to include wrought or various additive manufacturing modalities. An expected outcome of this effort is the verification and experimental validation of the implemented models and tools, as well as demonstration through a relevant component provided with support of an OEM partner.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Air Force expects the applicant(s) to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The applicant should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Phase I type efforts include having demonstrated feasibility via prior development of fatigue life prediction tools for durability-critical or fracture-critical metallic structural components. Critically, a customer such as an aerospace OEM or Air Force office should be identified, and evidence of collaboration and a letter of support is highly recommended.

PHASE II: Under the Phase II effort, the awardee(s) shall sufficiently develop the technical approach and probabilistic life prediction software tool to conduct relevant demonstrations. Identification of predictive tool issues and/or business model modifications required to further improve the software relevance to the customer should be documented. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution. The successful Phase II effort will develop a probabilistic life prediction capability verified and validated for at least one alloy & product form for a particular component class as defined by an OEM collaborator, but two alloy / product forms are preferred. The limited-life application demonstration should be applied to a component design that is intended to survive for a fraction of the lifetime of an equivalent component in a conventional, long-life aerospace system. Demonstration will require more severe conditions of stress, temperature, and/or environment to survive for the reduced service life. Increases in at least two drivers (stress, temperature, dwell time, environment, …) should be included in the demonstration. At a minimum, experimental validation should be conducted on coupon specimens, and/or with existing data, however, subscale testing is recommended.

PHASE III DUAL USE APPLICATIONS: Phase III or Phase II enhancements shall include collaborative efforts with the customers to validate and support the verified workflows. Phase III shall provide businesses workflows that have been verified and validated to an acceptable degree, as deemed by the customer. Options for service contracts for continual support based on these efforts should also be provided. Expected Technology Readiness Level (TRL): 6

REFERENCES:

1. Sadeghi, E, et.al., A state-of-the-art review of fatigue performance of powder bed fusion-built alloy 718, Progress in Materials Science, vol 133, 2023.

KEYWORDS: Limited-life; life prediction; probabilistic; creep-fatigue; dwell-fatigue; oxidation; verification; validation

TOPIC NUMBER: AF251-D008

TITLE: Multi-Agent Simultaneous Segmentation and Scheduling (MASSS)

TECHNOLOGY AREAS: Space Platforms; Air Platform; Ground Sea

OBJECTIVE: This topic seeks to develop software that will allow an arbitrary number multiple mobile robotic manipulators to dynamically and intelligently team and cooperate for performing discrete tasks on a single asset.

DESCRIPTION: Multi-Agent Simultaneous Segmentation and Scheduling (MASSS) is a complex problem in robotics, that if solved, will facilitate collaborative task execution by multiple mobile robots with shared or overlapping work envelopes to reduce the cycle time for low-volume, high-mix, and/or high-variability manufacturing processes. The current commercial, off the shelf (COTS) state-of-the-art for multi-robot systems is preprogrammed, pre-choreographed motion solutions that cannot accommodate the variable, uncertain, and stochastic processes encountered in defense aerospace manufacturing and sustainment operations.

The motivation is the fact that cycle time is a cardinal performance metric in defense production, as it directly influences how quickly both the industrial and organic manufacturing bases can get materiel into the hands of the warfighter. Manufacturers and depots frequently deploy multiple human workers to collaboratively complete a given manufacturing process to reduce cycle time. A new class of agile, adaptive robots (e.g. scan-and-plan) is becoming available, but they are typically no faster, and often slower, than a single human worker. Without the ability to collaboratively work in parallel, the cycle time penalty they impose render applications that are otherwise ripe for robotic automaton as impractical.

The central technical challenge associated with MASSS is to solve the simultaneous segmentation and scheduling (S3) problem on a time scale that enables intelligent dynamic task reallocation in response to process variation during system operation. S3 in an optimization problem that simultaneously considers: 1) the distribution of actions in both physical and task space amongst multiple agents; 2) the order in which agent should perform its assigned actions; and 3) system constraints, including but not limited to those associated with collisions, manipulator kinematics, manufacturing process, and precedence.

The objective of this effort is to achieve the above goal for discrete manufacturing processes. Discrete processes are those that can be decomposed into a set of discrete robot poses and actions. Examples include de-fastening, hole making, and spot welding. In contrast, examples of continuous processes would include coating, de-coating, sanding, and blasting.

The high-level project objectives are:

1) Demonstrate in simulation that a step-change in discrete process cycle time is feasible by dynamically reallocating discrete tasks between multiple robots operating in a shared workspace.

2) Develop reusable methods, tools, frameworks, etc. that can be used or adapted to a multitude of discrete manufacturing processes and system components.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Air Force expects the applicant(s) to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. The feasibility study shall prove through prior research and development that the applicant has demonstrated mobile robotic manipulator technology with the following capabilities: (1) full 3 degree of freedom (DOF) base with a 6 DOF manipulator; (2) capability to accomplish aerospace-relevant discrete processing tasks; (3) localization, navigation, safety, and control systems needed for single-robot operation. Proof can be provided by direct demonstrations of any or all of the aforementioned capabilities, or through a combination of direct demonstrations and proposed modifications to an existing system to achieve the project goals. In the latter case, the applicant shall provide in-depth details on modifications necessary to achieve the desired capability. Modifications should utilize commercially available technologies.

PHASE II: Eligibility for D2P2 is predicated on the applicant having performed a “Phase I-like” effort predominantly separate from the SBIR Programs. Under the phase II effort, the applicant shall sufficiently develop the technology in order to conduct a small number of relevant demonstrations in simulation. The final prototype system shall be capable of (1) Simultaneously optimizing task allocation and scheduling between multiple mobile robotic manipulators; (2) Supporting an arbitrary number of mobile manipulators; (3) Adapting to the stochastic nature of manufacturing processes (e.g., variability in individual task cycle time, replacing broken or worn tooling, variability in robot repositioning/motion time, etc.); and (4) Displaying simulation results graphically and predicting total cycle time for a given number of mobile manipulators. The awardee(s) must identify technology hurdles they are expected to encounter during the development program, as well as potential solutions to mitigate risk to the program.

PHASE III DUAL USE APPLICATIONS: The awardee(s) will implement the MASSS software tools developed under the Phase II effort in hardware for multiple mobile manipulators and validate performance and achievement of objectives in pilot production at a USAF air logistics center. The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning the technology to various defense aerospace OEMs, their supply chain, and the Air Force and broader DoD organic industrial base. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

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2. Bui, H., Pierson, H.A., Nurre, S.G, and Sullivan, K.M. (2020) Tool Path Planning Optimization for Multi-Tool Additive Manufacturing. Procedia Manufacturing, 39, 457-464;

3. Jin, Y., Pierson, H.A. and Liao, H. (2019) Toolpath allocation and scheduling for concurrent fused filament fabrication with multiple extruders. IISE Transactions, 51(2), 192-208.

KEYWORDS: multi-robot collaboration; multi-robot optimization; multi-robot scheduling

TOPIC NUMBER: AF251-D009

TITLE: Autonomous Robotic Coating Process Planning for Complex Geometries

TECHNOLOGY AREAS: Ground Sea; Air Platform; Space Platforms

OBJECTIVE: This topic seeks to commercialize agile, autonomous robotic motion planning that achieves in-tolerance coating process results for arbitrarily sized, geometrically complex aerospace components (i.e., parts with concavities, holes, overhangs, etc.).

DESCRIPTION: Agile task planning is a critical limiting factor for integrating robotics into low-volume, high-variability manufacturing and sustainment environments which are essential to the DAF's mission. For topology-driven tasks such as spray painting, agile task planning means defining a tool trajectory that accomplishes the manufacturing process objective over the surface of a workpiece, e.g., applying a specified coating thickness. Recent progress in agile, semi-autonomous robotic path planning has shown great promise, with some specific applications achieving pilot production, but only for smooth, convex surface topologies. A substantial gap exists for more complex geometries, which as of now, must be programmed by a human expert. Additionally, the current state-of-the-art is limited to path planning, focusing on the motion of the tool, when what is really needed is process planning, focusing on the result of the robotic process vis-a-vis the manufacturing process objective. For example, a toolpath that yields excellent results for electrostatic powder coating, where overspray is merely inconvenient, may yield terrible results if applied to painting, where overspray can ruin a coating. The ubiquity of topology-driven manufacturing processes in the DAF manufacturing and sustainment enterprise, and the fact that most aircraft and engine components have non-convex and discontinuous surfaces, creates a critical need to close these gaps. Failure to do so will continue to severely limit the application of robotic automation in the DAF manufacturing and sustainment enterprise.

The objective is to develop collaborative robotic process planning systems that combine autonomous toolpath generation for complex geometries, manufacturing process simulation, and immersive user interaction in a manner that makes automation of batch-size-one operations practical. The vision is a system that automatically plans the process, presents the plan and simulation results to a human task expert, and provides an intuitive interface for the human to evaluate, modify, and ultimately approve the process plan.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Air Force expects the applicant(s) to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. The feasibility study shall prove through prior research and development that the applicant has demonstrated robotic scan and plan spray coating that adapts robotic motion and tool path to as-built geometry that deviates from nominal geometry. Proof can be provided by direct demonstrations of any or all of the aforementioned capabilities, or through a combination of direct demonstrations and proposed modifications to an existing system to achieve the project goals. In the latter case, the applicant shall provide in-depth details on modifications necessary to achieve the desired capability. Modifications should utilize commercially available technologies.

PHASE II: Under the Phase II effort, the awardee shall sufficiently develop the technology to the point where it can be physically demonstrated on aerospace relevant complex parts with aerospace relevant coating systems. The awardee(s) must identify technology hurdles they are expected to encounter during the development program, as well as potential solutions to mitigate risk to the program.

PHASE III DUAL USE APPLICATIONS: The awardee(s) will implement the technology developed under the Phase II effort in hardware for a defense aerospace relevant robotic coating application and validate performance and achievement of objectives in pilot production at a USAF air logistics center. Key to this demonstration is to illustrate the system's adaptivity to new geometries and variation in known geometries without programming and with minimal human input and expertise. The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning the technology to various defense aerospace OEMs, their supply chain, and the Air Force and broader DoD organic industrial base. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES:

1. Brown, S. and Pierson, H.A. (2020) Adaptive Path Planning of Novel Complex Parts for Industrial Spraying Operations. Production and Manufacturing Research, 8(1), 335-368.

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KEYWORDS: robotic coating; robotic painting; advanced robotics; adaptive robotics; robotic tool path planning

TOPIC NUMBER: AF251-D010

TITLE: Large Scale Thermoplastic Processing

TECHNOLOGY AREAS: Materials; Air Platform

OBJECTIVE: This topic seeks to demonstrate the capability to process thermoplastic components on large acreage aerospace structures.

DESCRIPTION: Thermoplastic composite materials can be consolidated into complex aerospace relevant shapes very quickly using press form or stamp forming processes. Many thermoplastic parts are flown on military and commercial aircraft today, however, these parts are typically small clips and brackets. This project will quickly identify, mature, and demonstrate a method to rapidly consolidate large aerospace components without the use of high temperature autoclave equipment. The contractor shall demonstrate the application of the technology on thermoplastic types PEEK, PEKK, or LM-PAEK or other government approved high temperature, high performance thermoplastic material for a large relevant aerospace part. The contractor shall validate that the consolidation process has resulted in a low void, high fiber volume part and will document cost, cycle time and weight savings compared to a traditional hand laid composite part processed in an autoclave. The proposed thermal solution should accommodate multiple part geometries and not be a stand-alone self heated tool that can only be used for a single geometry.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant(s) to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. The feasibility study shall demonstrate in their proposal that they have already achieved quality thermoplastic composite consolidation using their proposed process on a small or mid-size (up to 3 feet by 5 feet) part. The contractor shall also discuss in their Ph II proposal the ability to scale up processing size to efficiently process larger composite parts (larger than 4 feet by 6 feet). The process proposed should have the capacity to tightly control temperatures over the size of a large component to provide for efficient heating and temperature soak during the material recrystallization process.

The applicant(s) should have already demonstrated a non-autoclave technology that can rapidly process thermoplastic composite materials. The applicant(s) should have already demonstrated the ability to tightly control processing temperature for small and medium parts.

PHASE II: During the Phase II project, the awardee(s) shall demonstrate the capacity to process larger thermoplastic components which are at least approximately 4 feet by 6 feet on a relevant aerospace part.

The awardee(s) shall validate that the proposed process results in a high fiber volume (58 percent+), low void (greater than 1.5 percent) thermoplastic part. The awardee(s) shall demonstrate that the process has a high level of thermal control over the entire size of the part with the ability to tightly control the material recrystallization process and optimize thermoplastic material properties. The awardee(s) shall validate part quality by performing a limited number of appropriate tensile, compression and short beam shear tests using relevant ASTM standards. The awardee(s) shall document the part preparation and processing time using the proposed process and compare the overall cycle time, cost, and weight of the part compared to a hand lay-up thermoset part processing using autoclave technology. The awardee(s) shall document tooling costs and lead times for the proposed processing technology compared to traditional thermoset tooling.

PHASE III DUAL USE APPLICATIONS: The awardee(s) will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. The awardee(s) shall develop and demonstrate the ability to scale up their process for a variety of part geometries and sizes. The awardee(s) will work with relevant aircraft designers to meet their material performance requirements and demonstrate the applicability of the proposed process for large composite parts.

REFERENCES:

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KEYWORDS: Large scale thermoplastic processing

TOPIC NUMBER: AF251-D011

TITLE: Intelligent Diagnostics for Radomes

TECHNOLOGY AREAS: Ground Sea; Materials; Air Platform

OBJECTIVE: This topic seeks to develop second generation platform for supporting radome repair of multiple radomes, and demonstrate it on modern radome systems. Extend AI defect detection algorithms for advanced radome designs. Include the use of enhanced microwave probe technology that utilizes additional frequencies to improve defect sensitivity and accuracy.

DESCRIPTION: A next-generation robotic platform is needed for robotically scanning radomes. The Air Force wishes to utilize a new, modular design paradigm so that the scanning robot is a separate unit from the navigation platform. The awardee will construct a mobile platform that can be either manually repositioned (e.g. mobile cart) or connected to a separate navigation robot. The mobile platform will provide a stable base for the scanning robot so that automated navigation can be easily added at a later date. The awardee will also assemble hardware (robot arm, logic controllers, auxiliary sensors, interface computer, etc.) onto the common mobile platform; integrate AMMP end-of-arm tooling along with auxiliary and safety sensors; program adaptive path for selected radome, including adaptive capabilities to account for robot and/or radome positioning errors; include path capability for full area scans as well as concentrated scans for areas with identified defects; develop updated HMI software and back-end supporting software to ensure ease-of-use by technicians in the depot environment; include data outputs for communicating with ‘Big Data’ archive server, as well as repair processes and/or robots for utilizing data to repair ARDS identified defects. Finally, the awardee will harden software to meet Air Force cybersecurity requirements, as appropriate.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Air Force expects the applicant(s) to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. The feasibility study shall prove through prior research and development that the applicant has demonstrated mobile robotic manipulator technology with the following capabilities: (1) full 3 degree of freedom (DOF) base with a 6 DOF manipulator; (2) capability to accomplish aerospace-relevant discrete processing tasks; (3) localization, navigation, safety, and control systems needed for single-robot operation. Proof can be provided by direct demonstrations of any or all of the aforementioned capabilities, or through a combination of direct demonstrations and proposed modifications to an existing system.

PHASE II: Under the Phase II effort, the awardee(s) shall sufficiently develop the technology in order to conduct a small number of relevant demonstrations in simulation. The final prototype system shall be capable of (1) automated scanning of a selected radome (2) Program adaptive path for selected radome, including adaptive capabilities to account for robot and/or radome positioning errors and path capability for full area scans as well as concentrated scans for areas with identified defects (3) Develop an AI-based classification and regression algorithm for defect detection and thickness determination, and predictive modeling of radome viability for selected radome (4) Investigate methods for fast modeling of band-pass radomes that incorporate additional layer(s) of frequency selective surfaces. Develop strategies for modeling these layers as impedances that can capture their angle dependencies for use in future radome applications. The awardee(s) must identify technology hurdles they are expected to encounter during the development program, as well as potential solutions to mitigate risk to the program.

PHASE III DUAL USE APPLICATIONS: The awardee(s) will implement the software and hardware tools developed under previous efforts to validate performance and achievement of objectives in pilot production at a USAF air logistics center. The awardee(s) will pursue commercialization of the various technologies developed in Phase II for transitioning the technology to various defense aerospace OEMs, their supply chain, and the Air Force and broader DoD organic industrial base. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES:

1. Freeman, R.M., Schultz, J.W. (2021) Adaptive Radome Maintenance and Diagnostics with AMMP RF Sensor. TRN: AFRL-RX-WP-TR-2021-0173 (DTIC);

KEYWORDS: Virtual twin radome; radome tuning; machine learning radome repair; Defect Tolerance and Tuning Strategies for Complex Radomes; Machine learning for wave identification radomes

TOPIC NUMBER: AF251-D012

TITLE: Enhanced Sensor for Characterizing Radome Health

TECHNOLOGY AREAS: Sensors; Air Platform; Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Enhance sustainability of Air Force radomes by demonstrating an advanced sensor system to assess radome health and verify radome repairs that can also be mounted on a mobile collaborative robot for use in high-tempo depot or hangar environments.

DESCRIPTION: Radomes (such as aircraft nosecones) are critical components of all Air Force aircraft that protect key aircraft sensor systems while supporting aerodynamic flight. These radomes are subject to wear and tear during operational use and require periodic inspection and repairs to maintain their performance. Many Air Force aircraft radomes lack high-confidence assessment of their operational performance after repairs and refurbishment in Air Force depots, affecting mission readiness and prematurely reducing the effective lifetime of radomes in service. Efficient use of sustainment resources also require that radomes be inspected before they are repaired so that needed repairs are accurately determined and unnecessary repairs are avoided.

Between newer advanced aircraft and radar modernization programs, the complexity of Air Force radomes is ever increasing. Similarly, the demands on radome performance are also increasing in terms of both mechanical reliability and with respect to the radome's effect on the underlying sensors. Typical defects that can occur in a radome include delamination, crushed honeycomb, or water ingress that is trapped in honeycomb core layers. Additionally, repairs can sometimes inhibit the performance of radomes by changing the effective dielectric properties at the repair location. Thus, an advanced diagnostic sensor is needed that is sensitive to these types of defects and that can be directly related to the electromagnetic performance of the radome.

While the ability of the desired sensor to both detect defects and assess radome performance is key, it also must be able to do this in a compact package with minimal weight, power, and safety requirements. In the near-term this sensor is envisioned for use in the dynamic environment of a repair depot. Thus, it must be small and lightweight enough to be used as either a man-portable device or as end-of-arm tooling on a collaborative robot.

Collaborative robots are designed to be inherently safe, so the sensor should be capable of operation without fixed robot "cell" walls or light curtains and potentially on mobile cobot systems. Furthermore, it must be rugged enough to withstand use in an environment where dust, moisture, impact, electrostatic shock, or other hazards may be present, such as at a forward-operating base. vAdditionally, deployment of the sensor at forward-operating bases will require that measurements can be taken on aircraft, without removing the radome or exposing the antenna. vThe development of this technology will enhance existing sustainment operations by providing an increased ability to accurately and quickly diagnose radome health and operational performance.

PHASE I: For this Direct-to-Phase II topic, evaluators are expecting that the submittal firm have already demonstrated the ability to measure electromagnetic properties and detect some defects in fiberglass composites with portable COTS sensors.

PHASE II: Develop a working prototype to detect defects in radome structures with sensitivity that is greater than the current state-of-the-art, while simultaneously characterizing radome performance. Demonstrate the prototype as end-of-arm tooling on a collaborative robot and test on representative surfaces.

PHASE III DUAL USE APPLICATIONS: If the Phase II is successful in developing the technology, Air Logistics Complexes will purchase technology using organization (working capital) funds. The effort will refine hardware and software to increase accuracy and sensitivity. Achieve production-ready state for marketing to the Air Force, other related federal agencies, and private industry.

REFERENCES:

1. Walton, J.D. "Radome Engineering Handbook: Design and Principles." Marcel Dekker, Inc., New York, 1970 ;

2. Shavit, R. “Radome Electromagnetic Theory and Design.” Wiley-IEEE Press, 2018 https://onlinelibrary.wiley.com/doi/book/10.1002/9781119410850 ;

3. D. A. Heiser and R. B. Keyser, "Microwave measurements for antenna radome maintenance and replacement," 1998 Symposium on Antenna Technology and Applied Electromagnetics, Ottawa, ON, Canada, 1998, pp. 501-506 https://ieeexplore.ieee.org/document/7861713

KEYWORDS: Radome ; Microwave Probe ; Reflective Measurements

TOPIC NUMBER: AF251-D013

TITLE: Conformable Robotic Masking for Aircraft Painting Operations

TECHNOLOGY AREAS: Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Research, formulate, and develop conformable masking material (non-tape) and robotic applicator to eliminate labor intensive manual masking operation on complex geometries in various orientations minimizing paint bleed and rework, resulting in consistently high-quality intricate details and protective paint jobs without the need for harsh chemicals and additional processing steps.

DESCRIPTION: Painting and masking contribute to a military force's effectiveness, survivability, and mission success. Camouflage schemes on aircraft and vehicles make them less visible to enemies, while specific markings and paint jobs aid in friendly identification and prevent costly mistakes. Painting also acts as a protective layer, guarding against corrosion from harsh environments and extending the lifespan of valuable equipment. Additionally, specialized paints may be used to enhance functionality, like radar-absorbent coatings on aircraft. A paint operation of an aircraft can takes several weeks of labor by several skilled workers. Over 90% of this operation relates to masking. This involves meticulous preparation of the aircraft surface, followed by the application of tapes, paper, or films to protect designated areas from paint. Several skilled workers carefully cut and conform these materials to the aircraft's intricate shapes. Extensive masking necessitates significant personnel hours for application and removal, driving up labor costs. The time-intensive nature of masking creates bottlenecks that extend project timelines and delay critical aircraft deployments. Imperfect masking can also lead to paint overspray, uneven coverage, and improper thickness control, requiring rework and further extending schedules.

Modern aircraft and weapon systems have intricate curves, recessed panels, and hard-to-reach nooks and crannies that pose significant challenges for traditional masking methods. Automated tape masking systems struggle with conformability and accessibility. Tape simply cannot conform seamlessly to the aircraft's unique shapes without several splices. This inflexibility leads to gaps and uneven edges, compromising the quality of the paint application. Robots laying tape often struggle to reach confined spaces or navigate around protruding elements. These limitations leave areas exposed and vulnerable to paint overspray. The Air Force is seeking a solution that addresses these limitations. By embracing innovation and moving beyond traditional methods, the Air Force can unlock a transformative leap in aircraft painting operations.

The Air Force needs a truly innovative solution that transcends these limitations. This novel approach should streamline the masking process to achieve significant cost savings and faster turnaround times. It should also ensure consistently high-quality paint jobs through superior conformability, even on complex geometries. Finally, minimizing environmental impact by eliminating the need for harsh solvents used in traditional masking removal is crucial. This solution should offer superior conformability with a material that seamlessly adapts to complex shapes, eliminating the need for intricate taping techniques. The development of this sustainment technology is the key to unlocking substantial advancements in Air Force aircraft painting operations, leading to faster turnaround times, consistently high-quality paint jobs, properly marked assets, and proper corrosion protection.

PHASE I: For this Direct-to-Phase II topic, evaluators are expecting that the submittal firm demonstrate the ability to formulate masking material and robotically dispense conformable material on complex geometries in various orientations. Demonstrate the integration of robot system for precise deposition on aircraft components.

PHASE II: Develop masking material for acceptable adhesion to aircraft substrate and easy removal with residue without harsh chemicals or abrasive scraping. Develop and execute test plan to ensure the masking material does not damage existing paint or affect new paint adhesion. Develop working robotic prototype to precisely apply masking material on aircraft substrate to minimize over spray and allow intricate paint jobs on complex geometry. Significantly reduce paint operations times by eliminating manual application of masking.

PHASE III DUAL USE APPLICATIONS: If the Phase II is successful in developing the technology, the ALC will purchase technology using organization (working capital) funds. The effort will refine hardware and software to increase accuracy and reliability. Scale and achieve production-ready state for marketing to the Air Force, other related federal agencies, and private industry.

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1. Mather, et al. “WR-ALC Corrosion Control mission extends aircraft life”, 2021, February 5. Air Force Materiel Command. https://www.afmc.af.mil/News/Article-Display/Article/2496688/wr-alc-corrosion-control-mission-extends-aircraft-life/

2. Neha Yadav, Ralf Schledjewski, “Review of in-process defect monitoring for automated tape laying”, Composites Part A: Applied Science and Manufacturing, Volume 173, 2023, 107654, ISSN 1359-835X, https://doi.org/10.1016/j.compositesa.2023.107654. (https://www.sciencedirect.com/science/article/pii/S1359835X23002300)

3. Seegmiller, N. A., Bailiff, J. A., & Franks, R. K. (2009). “Precision Robotic Coating Application and Thickness Control Optimization for F-35 Final Finishes”. SAE International Journal of Aerospace, 2(1), 284–290. https://doi.org/10.4271/2009-01-3280

KEYWORDS: Automated Masking ; Masking Material Development ; Conformal Masking

TOPIC NUMBER: AF251-D014

TITLE: Collaborative Robotic Systems for Efficient Confined Space Inspections

TECHNOLOGY AREAS: Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Research, develop, and validate a collaborative robotic system that enables workers to perform inspections and potentially maintenance within hard to access and/or dangerous environments within aircraft wings or other confined spaces. This process should reduce the overall wing fuel tank inspection time while also minimizing the need for humans to enter confined spaces. The system must work in direct collaboration with its human operator, allowing for it to operate in a wide array of unstructured environments.

DESCRIPTION: Current inspection methods of aircraft wing fuel tanks are labor-intensive, requiring technicians to manually enter ventilated, yet cramped and hazardous spaces. The physical constraints of these spaces limit the availability of qualified personnel and extend maintenance timelines, impacting operational readiness. At the same time, they are under intense time pressure to carry out their work on complex systems which can further exacerbate labor shortages, quality, and availability. There is a large opportunity to minimize the need for humans to enter confined spaces, and ultimately to prevent entry all together, through the use of collaborative robotics. This, in turn, will shorten the time required for wing inspections while increasing worker safety.

Robotic systems have previously demonstrated potential for aircraft inspections in places like wings. Many of these systems, however, require extensive setup and training to operate. Furthermore, their designs require extensive support equipment within their bases or tethered nearby, limiting the places they can operate in and decreasing their total reach into a given system. Collaborative robots have shown promise in unstructured and dynamic environments like aircraft maintenance. Combining a human operator's ability to rapidly navigate most of the distance to an inspection site with a portable, reconfigurable robotic system that extends the operator’s reach will provide the adaptability needed to perform inspections in a wide range of unstructured environments in the depot and beyond.

An innovative robotic system is desirable that can navigate the complex internal structures of aircraft wings, performing comprehensive inspections while reducing the overall time needed for completion based on existing methods. This system should be able to be carried and operated by a single worker, allowing them to insert it with a camera or other desired sensor through a service port. It should move within the wing to inspect the inner cavities. The robotic platform should also be capable of rapid mounting to a surface, such as an access hatch door panel or other similar features, to perform inspections without the need for an operator.

PHASE I: For this topic, the Government expects that the Offeror has developed and validated a prototype that addresses, at a minimum, the ability to perform confined space inspections in a relative environment. Previous work submitted within the feasibility documentation must have been substantially performed by the Offeror and/or the Principal Investigator (PI).

PHASE II: Develop working prototype of the collaborative robotic system to be used by a single human operator to collect visual inspection information within a wing that can withstand an aircraft maintenance environment. Obtain a TRL 7 based on Air Force standards and ready to test in an operational environment.

PHASE III DUAL USE APPLICATIONS: If the Phase II is successful in developing the technology, the ALC will purchase technology using organization (working capital) funds. The scope should be to refine hardware and software to increase usability and reliability. Achieve production-ready state for marketing to the Air Force, other related federal agencies, and private industries involved in all manners of production or manufacturing.

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KEYWORDS: Collaborative Snake-Like Robot; Confined Space Robotics

TOPIC NUMBER: AF251-D015

TITLE: Field Level Fuels/Propellant Analysis in a Case

TECHNOLOGY AREAS: Sensors; Materials

OBJECTIVE: The objective of this topic is to develop a fully integrated self-contained field portable fuels/propellant test and analysis system housed within a single person portable case targeted at being no larger than 24" X 18" X 8" and capable of analyzing a single jet fuel, diesel fuel, or rocket/missile propellant sample in real time to determine a comprehensive range of defined specification chemical properties, including fuel cleanliness and free water. The primary focus for this capability would be in support of Agile Combat Employment (ACE) operations including on-site jet fuel/propellant production and/or desulfurization, with secondary support capabilities for rocket/missile propellant analysis. The portable system would also be required to be supported via an approved ASTM International test method or conformance to an existing approved ASTM test method.

DESCRIPTION: As part of future fuel/propellant support related ACE operations, the ability to produce sustainable aviation fuel/propellant (for both jet/diesel fuel/propellant applications) on-site or to process locally available high sulfur fuel inventories into an ultra low sulfur diesel (ULSD) fuel alternative at expeditionary or isolated locations will be a reality. Producing or processing of any fuel/propellant at expeditionary locations will require the ability to perform suitability for use analysis on the fuel/propellant product to ensure that it meets all fuel/propellant quality assurance requirements. Failure to ensure suitability for use of a produced or processed fuel/propellant could compromise safety of flight standards and potentially cause ground support equipment or vehicle engine failures.

Current Air Force deployable fuels/propellant quality control testing kits or systems are limited in fuel/propellant property testing capabilities, and are unable to perform the level of suitability for use conformance testing required, to support aviation, space, or ground operations. Current practice requires fuel/propellant samples be collected and sent to a regional laboratory where suitability for use conformance analysis would be performed on the sample. This process can demand 2-10 days depending on location, transportation, international customs, and lab technician availability. Delays dramatically impact ACE operations regarding either fuels/propellant production or fuel desulfurization at expeditionary locations.

To address this logistics support gap, a fully integrated self-contained field portable fuels/propellant test and analysis system housed within a single person portable case no larger than 24" X 18" X 8" capable of analyzing a single jet/propellant or diesel fuel sample in real time to determine a comprehensive range of defined suitable for use chemical properties, including fuel cleanliness and free water, is needed. For fuels/propellant quality assurance acceptance, the system would be required to be supported by either a new or existing ASTM International test method.

Fuel/propellant suitable for use chemical property determination would need to be made through a combination of direct measurement or property extrapolation via chemometric or chemical property characterization modeling leveraging alternative test methods including multivariate spectroscopy, optical imaging, and cascading lasers.

To be able to meet the fuels/propellant analysis objective of this topic, the following fuel/propellant chemical properties ideally would need to be measured to be able to ensure product suitability for use of any produced fuel/propellant or processed fuel.

- Total Acid Number
- Total Sulfur Content
- Mercaptan Sulfur Content
- Cetane Number / Derived Cetane Number

- Cetane Index
- Distillation Fractions (IBP, T10, T50, , T90, FBP, Residue, Loss)
- Viscosity @ 40°C
- Density @15°C
- Aromatics Content
- FAME Content
- Freezing Point
- Flash Point
- Smoke Point
- Cloud Point
- Hydrogen Content
- Net Heat of Combustion
- Viscosity @-20°C
- Micro-Separometer (MSEP) Rating
- Copper Strip Corrosion
- (Thermal) Oxidation Stability
- Fuels System Icing Inhibitor Content
- Electrical Conductivity
- Existent Gum Content
- Fuel Cleanliness; Particulate Matter/Particle Count
- Fuel Cleanliness; Free Water Content
- Fuel Lubricity
- Carbon Residue
- Ash Content

The system needs to be able to be operated by a minimally trained fuels laboratory technician and contain all required training manuals or incorporated computer based training capabilities. The system would need to either be self calibrating or have the ability for the operator to be able to perform calibration using available standards. The system needs to be capable of being stored and operated in conditions ranging from -25 degrees F to +135 degrees F and have the ability to operate on AC, rechargeable battery or a 12-DC volt sources with the use of Commercial-Off-The-Shelf (COTS) to the fullest extent possible. The system would minimize to the greatest extent possible any hazardous waste and require minimum consumables. The integrated system must be able to operate in a hazardous environment meeting all National Fire Protection Association (NFPA) or ATmosphere EXplosibles (ATEX) requirements for the operating environment. The system would need to be ruggedized and be able to meet testing requirements of MIL-STD-810.

The topic is expected to deliver the number of fully functioning prototypes meeting a Technology Readiness Level (TRL) of 8 required to fully support any and all ASTM International test method development and Inter-Laboratory-Study (ILS) testing requirements to meet the topic's objective.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have;

• Identified the prime potential Department of the Air Force end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified;
• Described integration cost and feasibility with current mission-specific products;
• Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a "Phase I-like" effort predominantly separate from the SBIR Programs. Under the Phase II effort, the offeror shall sufficiently develop the technical approach, product, and process in order to be able to perform a full suitable for use sample analysis for identified fuel/propellant properties and report results, develop an ASTM test method, conduct operational field trials under various environmental conditions, and perform required testing in support of an initial ASTM ILS. Identification of manufacturing/production issues and or business model modifications required to further improve product or processes relevance to improved sustainment costs, availability, or safety, should be documented. These Phase II awards are intended to provide a path to field a TRL 8 instrument with ASTM accreditation via an approved ASTM test method or conformance to an existing ASTM test method and commercialization. The successful Phase II effort will build on integration of emerging analytical and artificial intelligent technologies including but not limited to Raman spectroscopy, Near Infrared spectroscopy, Fourier Transform Infrared spectroscopy, Ultra-Violet spectroscopy, Electrochemical Impedance spectroscopy, optical imaging, laser light obscuration, cascading lasers, multivariate spectroscopy calibration modeling, and chemometric/chemical property characterization modeling to demonstrate integrated functionality towards a portable fuels analysis system capable of performing fuel/propellant suitable for use conformance testing within the defined form, fit, and function requirements of this effort. The system must be capable of establishing performance-based qualification of vibrational spectroscopic analyzer systems intended to be used to predict the test result of a fuel property that would be produced by a Primary Test Method (PTM) if the same fuel is tested by the PTM. A methodology must be developed to establish the lower/upper prediction limits associated with the Predicted Primary Test Method Result (PPTMR) with a specified degree of confidence that would contain the PTM result (if tested by the PTM). The prediction limits must be able to be used to estimate the confidence that fuel released using the analyzer system based on a PPTMR that meets PTM-based specification limits will meet PTM-based specification limits when tested by a PTM. The Phase II awardee will build on the current state of the art to advance the Technology Readiness Level to deliver a fully integrated system capable of meeting the objective requirements for the defined fuels properties. The awardee will coordinate with the Department of the Air Force technical point of contact (TPOC) via regular information exchange meetings and technical reports. The final deliverable will consist of delivering the number of fully functioning prototypes meeting a Technology Readiness Level (TRL) of 8 required to fully support any and all ASTM International test method development and Inter-Laboratory-Study (ILS) testing requirements and an ASTM test method. Performance parameters to consider are:
Performance in a field environment,
Time required for analysis of the fuel,
Cost to analyze the fuel,
Accuracy / Precision of the analysis,
Safety for the operator to conduct the analysis.
Calibration, How? Who? Where? Cost?
Repair ability, How? Who? Where?
Mean time between failures (MTBF):
Transportability/drop ability: How does the devices handle transportation and accidental dropping?
The prototypes should be a TRL 8 or greater per Department of Defense Technology Readiness

Assessment (TRA) Guidebook, June 2023, and Technology Readiness Assessment Guide: Best Practices for Evaluating the Readiness of Technology for Use in Acquisition Programs and Projects, January 2020.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES:

1. Department of Defense To Prototype Use of Synthetic Fuels for Contested Environments; https://www.diu.mil/latest/department-of-defense-to-prototype-use-of-synthetic-fuels-for-contested;

2. Deployable Fuel Desulfurization; https://udayton.edu/udri/_resources/docs/deployable-fuel-desulfurization-capabilities.pdf;

3. ASTM D8340 Standard Practice for Performance-Based Qualification of Spectroscopic Analyzer System; https://www.astm.org/d8340-22.html

4. ASTM D7778 Standard Guide for Conducting an Interlaboratory Study to Determine the Precision of a Test Method; https://www.astm.org/d7778-15r22e01.html;

5. Navy Fuel Composition and Screening Tool (FCAST) v3; https://apps.dtic.mil/sti/tr/pdf/AD1071161.pdf;

6. Sustainable Aviation Fuel Prescreening Tools and Procedures; https://www.sciencedirect.com/science/article/pii/S0016236120330003;

7. A Structured Framework for Predicting Sustainable Aviation Fuel Properties using Liquid-Phase FTIR and Machine Learning; https://arxiv.org/html/2408.01530v1;

8. Predicting the physical and chemical properties of sustainable aviation fuels using elastic-net-regularized linear models based on extended-wavelength FTIR spectra; https://www.sciencedirect.com/science/article/abs/pii/S0016236123021713?via%3Dihub;

9. Learning to predict sustainable aviation fuel properties: A deep uncertainty quantification viewpoint; https://www.sciencedirect.com/science/article/abs/pii/S0016236123021221;

10. Evaluating the Predictive Powers of Spectroscopy and Chromatography for Fuel Quality Assessment; https://pubs.acs.org/doi/abs/10.1021/ef050347t:

11. The Development of Advanced Sensor Technologies to Measure Critical Navy Mobility Fuel Properties; https://apps.dtic.mil/sti/pdfs/ADA444116.pdf;

12. Rapid Fuel Quality Surveillance through Chemometric Modeling of Near-Infrared Spectra; https://apps.dtic.mil/sti/pdfs/ADA509785.pdf;

13. Evaluation of Portable Near Infrared Fuel Analysis Spectrometer; https://apps.dtic.mil/sti/pdfs/ADA535021.pdf;

14. Near Infrared Fuel Analyzer Temperature Evaluation; https://apps.dtic.mil/sti/pdfs/ADA562356.pdf;

15. Laboratory Evaluation of Light Obscuration Particle Counters used to Establish use Limits for Aviation Fuels; https://apps.dtic.mil/sti/pdfs/AD1001615.pdf

16. Monitoring Of Free Water And Particulate Contamination Of F-24 Fuel, https://apps.dtic.mil/sti/pdfs/AD1023712.pdf;

17. Using Spectroscopy to Measure Quality Parameters for Jet Fuel; https://www.azom.com/article.aspx?ArticleID

KEYWORDS: portable fuels analysis; portable propellant analysis; deployed jet fuel analysis; chemometric fuel modeling; portable jet fuel testing; aviation turbine fuel; diesel fuel; missile propellant, multivariate spectroscopy; jet fuel property characterization modeling; sustainable aviation fuel; sustainable missile propellant, ground fuel; suitability for use conformance testing

VERSION 2

TOPIC NUMBER: AF251-D016

TITLE: Deep Neural Networks for Reliability Modeling

TECHNOLOGY AREAS: Weapons; Nuclear

OBJECTIVE: The classic abduction/action/prediction models so prevalent in today's reliability and causality models take relatively long to process and are compute intensive. Explore the benefits of implementing Deep Neural Networks in the defense industry to tackle inaccurate reliability predictions. At completion of this SBIR, the prediction model should be able to make reliability predictions that will be validated during the next year of reliability data collection and be less memory and intensive by orders of magnitude over abduction/action/prediction modeling. By utilizing cutting-edge methods for analyzing complex data patterns, organizations can identify key factors contributing to reliability issues and make data-driven decisions to enhance overall system performance. Leveraging the power of deep learning algorithms enables organizations to forecast equipment reliability with greater accuracy, ultimately improving operational efficiency and minimizing downtime. Embracing these advanced techniques can revolutionize reliability predictions in the defense industry and drive significant improvements in system reliability and maintenance practices.

DESCRIPTION: The Air Force Nuclear Weapons Center Air-Delivered Capabilities Directorate (AFNWC/ND) currently utilizes a simplistic Markov chain event model to derive B61-12 Tail Kit Assembly (TKA) reliability measurements. This approach lacks the specificity required to predict and inform on future reliability trends eliminating opportunities for the program office to prevent reliability issues before they are realized.

PHASE I: As this is a Direct to Phase II topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Applicant shall demonstrate a case study or prototype of having performed similar/applicable work in developing applications. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II: 1. Assess existing Reliability Models for accuracy and completeness
2. Assess Air Delivered Integration Division (NDS) testing data (production, surveillance, test telemetry, etc.)
3. Derive predictive reliability modeling based on future progression of continuous time trajectories
a. Develop with intuitive user interface to ease model runs
b. Ensure rapid data ingestion techniques are available to populate the model
4. Devise a twin neural network consisting of two interlinked networks, one representing the real world and the other the counterfactual world, to inform future decision making
a. Develop with intuitive user interface to ease neural net execution
b. Ensure rapid data ingestion techniques are available to populate/retrain the neural nets
5. All deliverables shall run on a dedicated desktop computer.

Milestones
1. Initial NDS reliability model and NDS data assessments; Contract Award (CA) plus 60 days
2. Initial predictive reliability model delivery; CA plus 90 days (w/iterative monthly deliveries)
4. Validation & verification of the predictive model; CA plus 360 days

PHASE III DUAL USE APPLICATIONS: Capability can transition to other USAF weapon system program offices, but for this SBIR AFNWC/NDS will transition to a Phase III using the B61-12 sustainment program and FYDP programmed funding.

REFERENCES:

1. Vlontzos, Athanasios; Kainz, Bernhard; Lee, Ciaran. "Estimating Categorical Counterfactuals via Deep Twin Networks". https://www.researchsquare.com/article/rs-1684942/v1.

KEYWORDS: predictive reliability modeling; twin neural network; counterfactual data analysis

VERSION 2

TOPIC NUMBER: AF251-D017

TITLE: Integrated Radio and High Sound Reduction Hearing Protection

TECHNOLOGY AREAS: Electronics

OBJECTIVE: Current hearing protection headsets do not attenuate enough sound on their own and do not have an integrated radio allowing communication at short distances (for end-users without radios). The objective is to develop and test a hearing protection headset that enables clear integrated wireless radio communication for maintainers and aircrew in extreme continuous noise environments while also providing enough noise attenuation to protect the hearing of wearers without requiring two layers of protection. A successful system will increase mission effectiveness and speed by enabling constant clear communication (compared to hand signals and wired connection) and reduce warfighter discomfort and fatigue from needing to wear double hearing protection, which also further inhibits communication.

DESCRIPTION: In line with several USAF Operational Imperatives (Tactical Air Dominance OI-4, Resilient Basing OI-5, and Readiness to Deploy and Flight OI-7) it is critical to improve the ability to maintain, launch, and support next generation and older aircrafts [1]. Communication on the flightline has largely remained in the 20th century, however, hindering these objectives for mantainers, engineers, and aircrew. Present communication methods include maintainers and aircrew using hand signals to communicate, shouting, interrupting present task to relocate to transmit message, and using an external wire to connect to an integrated communication system on a vehicle. Maintainers often need to remove their hearing protection (in these extreme noise environments often beyond 110dB) to be able to effectively communicate, which is a material contributor to hearing damage and tinnitus remaining prevalent across the Armed Forces [2], regardless of technical advances. A relevant quote from an AFRL 711 Human Performance Wing Interim Report is, “Double hearing protection is often required in extreme high-noise environments, typically consisting of passive foam earplugs and a circumaural earmuff, headset, or helmet. Although a properly fit foam earplug has the potential to reduce the noise exposure, it also has unintended consequences, such as difficulty hearing an incoming communication signal or an improper fit leading to poor compliance, which can be detrimental to health and mission efficacy” [3]. Double hearing protection, however, is extremely uncomfortable and it further inhibits communication, as outlined in the quote.

Without the ability for maintainers and aircrew to communicate in real-time clearly, errors are more common and operations that would otherwise be simple in low-noise environments take tremendous time, reducing time for other critical tasks. Fatigue is also increased without the ability to effectively block out the high level of noise, further contributing to mistakes and reducing the readiness and health of USAF personnel.

Novel technology that addresses adjacent challenges for consumer applications has become prevalent over the last decade [4] with earbud and headset devices like the AirPods that integrate active noise cancellation and other technologies enabling long-range communication. This SBIR topic is requesting proposals to develop a hearing protection headset integrating modern technology that can provide the same noise attenuation as double hearing protection in a single device (believed to be around 40dB NRR measured to the relevant ANSI standards) and integrated short-range communication communication capabilities to individuals wearing the same headset at ranges beyond 100 meters without an external base station. The headset must be slim and comfortable (tactical headset form factor) with best-in-class awareness/transparency mode and the integrated radio capability must not add material size or weight to headset, be detachable for Type 1 environments, be at least 256-bit encryption, and have range extendable to hundreds of meters through a mesh network.

A successful system will increase mission effectiveness and speed by enabling constant clear communication (compared to hand signals and wired connection) and reduce warfighter discomfort and fatigue from needing to wear double hearing protection, which also further inhibits communication.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made because of this topic. To qualify for this D2P2 topic, the Government expects the Offeror to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement.

Proposers are expected to include a thorough paper on their feasibility assessment of creating and manufacturing a system meeting the objective, aforementioned specifications, and traditional military and Air Force environmental requirements. Acoustic and cyber prototype testing results in relevant environments (i.e. a simulated flightline) are essential with the test methods and standards specified. One specific requirement is that proposers are expected to have at least developed commercial headset with adaptive active noise cancellation and 32dB of NRR attenuation achieved across entire frequency bandwidth (ANSI S3.19 1974).

Proposers should also include a detailed list of their proposed specifications, demonstrating an awareness of current challenges and drawbacks for maintainers and aircrew and available technologies.

PHASE II: In this Direct-to-Phase II, the offeror shall design, prototype, and test a modern headset for Maintainers and Aircrew that achieves the objectives in integrated radio communication and noise attenuation. It is expected several prototype iterations will be delivered through development for end-user testing and feedback, with the final version (TRL 8 and ready for production) meeting all threshold specifications established and regulatory requirements for normal operation. At least 25 headset samples must be delivered of the final design for extensive end-user testing.

It will be critical for the proposer to conduct extensive testing validating the ability for the device to provide at least the same noise attenuation as approved double hearing protection solutions and wireless communication in a variety of harsh environments with next generation aircraft. They will need to work with the relevant hearing protection and cyber authorities such as the USAF Cyberspace Capabilities Center and the USAF Hearing Conservation Program. "

PHASE III DUAL USE APPLICATIONS: Upon successful execution of this Direct-to-Phase II effort, where a TRL8 level is expected, the 1 FW will collaborate with ACC/A4 to transition the system across the Air Force and other branches of the Department of Defense working with the selected company to undergo pilot testing with many other units and engage with the programs of record. The developed headset would have several large commercial applications, starting with aviation ground operations at commercial and private airports. Other applications include heavy industrial facilities, commercial construction, and anywhere with a loud environment where communication is critical.

REFERENCES:

1. United States Government. (n.d.). Department of the Air Force Operational Imperatives. U.S. Department of Defense. https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf

2. Barr, L. (2023, April 24). Report Reveals Military Hearing Loss is Stable. DVIDS. https://www.dvidshub.net/news/443266/report-reveals-military-hearing-loss-stable

3. Gallagher, H. L., Wynn, C. L., Williams, D. A., & Hopkins, C. E. (2022). (tech.). Investigating Double Hearing Protection: Performance of Filtered Earplugs Paired with Headsets/Helmets. Wright-Patterson Air Force Base, Ohio: Air Force Research Laboratory.

4. P. Crum, "Hearables: Here come the: Technology tucked inside your ears will augment your daily life," in IEEE Spectrum, vol. 56, no. 5, pp. 38-43, May 2019, doi: 10.1109/MSPEC.2019.8701198.

KEYWORDS: Command and Control, Secure Communication, Hearing Conservation, Resilient Basing, Tactical Air Dominance, Readiness to Deploy and Flight, Hearing Protection, Wearable

TOPIC NUMBER: AF251-D018

TITLE: AgilePod16V2 Compatible Optical Nose End-cone and High-Resolution EO/IR Attritable Deployment Sensor for Modular Capability – AgilePod ConeHEADs

TECHNOLOGY AREAS: Sensors; Air Platform

OBJECTIVE: OBJECTIVE: Design and develop an AgilePod16V2 (AP16V2) compatible optical end cone and integrate a high resolution, attritable, Electro-Optical/Infra-Red (EO/IR) sensor capable of detecting, tracking, and identifying targets with a National Imagery Interpretability Rating Scale (NIIRS) value of 5 or higher for EOW and 8 or higher for EON.

DESCRIPTION: The Air Force (AF) is currently pursuing Intelligence, Surveillance, and Reconnaissance (ISR) sensors to bring capabilities to non-traditional platforms to enabling non-traditional ISR. An EO/IR end cone mounted sensor would support flight within designated AgilePod16v2 operational environment that could participate in AF or Joint exercises, demonstrations, and/or test events in the Fiscal Year (FY) 2027-2030 time frame. Current AF efforts are focused on high Technology Readiness Level (TRL) commercial off the shelf (COTS) solutions. There is a near-term need to improve upon current capabilities and develop high resolution, low SWaP, attritable, EO/IR sensors that are capable of detecting, tracking, and identifying targets while operating in the podded system. These applications would directly support AF Operational Imperative 3 [1] by both detecting critical targets and distinguishing targets from decoys while enabling a modular capability to be used on non-traditional ISR assets.

System Capabilities:
- AP16V2 end cone and bulkhead mount compatibility [2]
- All sensors must be capable of being networked and interfacing with current Department of Defense (DoD) data transmission/data transfer systems (Datalinks including Line of Sight (LOS) and Beyond Line of Sight (BLOS).
- OMS/UCI compliant
- Sensor must be able to detect and identify targets with a NIIRS value of 5 higher for EOW and 8 or higher for EON
- Total system weight (end cone + sensor) is not to exceed 36 lbs (Threshold) 55lbs (Objective).
- Survive vibration environment of expected natural frequency range of 8-22Hz
- Total system needs to fit within a volume representing the end cone OML 21” x 19” x 16”.
- Sensors are expected to be able to support both day/night operations.

Previous projects have pushed the envelope of this technology but there is a need to repackage the sensor to provide an embedded capability within AgilePod to rapidly test and field ATR algorithms. Additional work needs to be completed to fit the packaging constraints of the end cone [2]. Positioning of the EO/IR sensor within the end cone is needed to reduce drag and decrease the overall size of podded system to fit within a larger number of payload/store envelopes on platforms.

PHASE I: PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide details and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear,

immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have:
• Identified the prime potential Department of the AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified;
• Described integration cost and feasibility with current mission-specific products;
• Described if/how the demonstration can be used by other DoD or Governmental customers.
• Assessment of GOTs/COTs hardware for EO/IR capabilities that can be implemented (hardware similar to targeting camera)
• Describe what modifications are needed for integration and use in this capacity
• Provide technical description of how the capability can be integrated into the platform and provide an airworthy structure
• Describe how MIL-HDBK-516C airworthiness guidelines will be followed

PHASE II: PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a "Phase I-like" effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop a ruggedized EO/IR sensor system based off the defined requirements listed in the topic description. The sensor system should be capable of being tested on an AgilePod16v2 system if testing opportunities become available.

PHASE III DUAL USE APPLICATIONS: PHASE III: Adapt existing design to meet SWaP requirements of multiple attritable platforms by incorporating Modular Open Systems Approach (MOSA) [3] and Sensor Open Systems Architecture (SOSA) [4] standards, exact platform is to-be-determined but should be roughly what is outlined in the description. Ruggedize design for flight environment to include supersonic carriage capability and conduct flight testing. Offeror shall also provide a plan for upgrading the solution to include Anti-Tamper (AT) and cybersecurity capabilities, as agreed upon between the Offeror and the AF customer.

REFERENCES:

1. Department of the Air Force Operational Imperatives (DAF OI) https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf

2. AP16v2 end cone and bulkhead reference diagram - in attachments. AgilePod16v2 Technical Data for end cone and bulkhead assembly to be supplied through ITA after SIBR award.

3. AFMC-Guidebook-for-Implementing-MOSA-in-Weapon-Systems_V2.0_Distro_A.pdf (dafdto.com)

4. https://publications.opengroup.org/standards/sosa - SOSA™ Technical Standard Reference Implementation Guide (opengroup.org)

KEYWORDS: ISR; sensor; EO/IR; AgilePod; pod; modular; attritable; NIIRs; ATR:

TOPIC NUMBER: AF251-D019

TITLE: B61-12 Tail Kit Assembly Modular Avionics Retrofit

TECHNOLOGY AREAS: Weapons

OBJECTIVE: This topic seeks to assess the B61-12 Tail Kit Assembly (TKA) technical baseline for hardware and software retrofit opportunities leveraging modular standards such as VITA 46 VPX or VITA 74 VNX base standards, Hardware Open Systems Technologies (HOST) and Open Group's Sensor Open System Architecture (SOSA). The assessments would result in the prototyping of an Avionics Upgrade Kit for the B61-12 TKA that would meet newly defined open system architecture standards.

DESCRIPTION: The B61-12 TKA technical baseline is in full sustainment. The program office can perform life of type buys and sustain a legacy technical baseline or retrofit the hardware and software of the TKA into a more modular technical baseline. The program office needs a complete analysis and limited prototyping in embedded containerization and embedded hypervisors to understand what opportunities for retrofit are available to transition to open standard architecture while maintaining system capabilities. Implementing modern software methodologies like containerization and hypervisors enables software portability to new hardware and inclusion of additional cybersecurity measures like zero-trust. Implementation of a modular hardware baseline opens opportunities for horizontal integration across mission areas and Services. The result of these strategies is to build a more resilient technical baseline, while increasing competition, and integrating capabilities to address the Great Power Competition.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Air Force expects the applicant(s) to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior or ongoing SBIR/STTR funding agreement. Applicant(s) will have to demonstrate at a minimum a proof of feasibility study building flexible user interface framework that allows for custom UI development based on a user's mission case scenario. The system should show that it is flexible enough to allow third parties to compose multiple workflows/widgets, without new programming. It is strongly preferred that the solution takes into account human factor elements representation for user mission case scenarios and tested such interfaces against real/notional representational graphical mission use cases scenario. Activities would include architecture design, integration roadmap, definitive solution space descriptions and analysis of alternatives.

PHASE II: 1. Assess B61-12 technical baseline (hardware & software) for "retrofit" opportunities.
2. Assess rehosting software on modern processors leveraging a modular standard such as VITA 46 or 74 and the USAF Sensor Open Systems Architecture (SOSA).
a. Technologies to explore include but are not limited to:
i. Embedded containerization.
ii. seL4 embedded hypervisors.
b. Assess performance limitations of rehosting software (timing, interoperability, etc.)
3. Assess impacts to nuclear certification (radiation hardening, design assurance levels, etc.)
4. Perform limited prototyping and risk reduction to rehost B61-12 monolithic Operation Flight Program (OFP_ inside an embedded container and on a modern processor architecture.

PHASE III DUAL USE APPLICATIONS: AFNWC will transition developed technologies and/or prototypes to a Phase III using the B61-12 sustainment program and Future Year Defense Program (FYDP) funding.

REFERENCES:

1. Guertin, Nickolas and Schmidt, Douglas. "The Technical Architecture for Product Line Acquisition in the DoD". https://insights.sei.cmu.edu/blog/the-technical-architecture-for-product-line-acquisition-in-the-dod-fourth-in-a-series/

KEYWORDS: Embedded software development, modular hardware architectures, modular software architectures.

TOPIC NUMBER: AF251-D020

TITLE: Design of a Planar Array Antenna for Electric Magnetic Pulse (EMP) and High Power Microwave (HPM) Testing

TECHNOLOGY AREAS: Nuclear

OBJECTIVE: The goal of this study is to develop a portable, low-cost, and compact antenna array system. This system will be capable of wide bandwidth operations to support various Electromagnetic Pulse (EMP) and High-Power Microwave (HPM) sources, both current and future. The antenna system can be deployed today with existing EMP sources and will also support future low jitter sources for array combining on larger test assets. A standardized coaxial interface will support multiple sources (EMP and HPM), enabling faster and more efficient testing of critical assets.

DESCRIPTION: In the past, the DoD had over 20 EMP simulators across the country for missile and aircraft testing ("EMP Simulators for Missiles and Airplanes," M.K. Bumgardner, et al., February 9, 1974). These simulators had a wide range of capabilities, including both horizontal and vertical polarization, and many used arrays to combine multiple pulsers (10-500 kV) with reconfigurable setups. Depending on the operational scenario of the System Under Test (SUT), test setups varied: vertical missile in launch stage, horizontal flight, aircraft experiencing horizontal or vertical EMP, etc. Today, only a few EMP simulators remain at fixed sites, with limited adjustability and reconfigurability. The art of the EMP simulator array has been lost, and there is a need to recreate a portable and reconfigurable simulator.

Efforts within the electromagnetic effects Test and Evaluation (T&E) community are underway to develop low jitter sources specifically for EMP testing. However, a variety of pulsers (EMP, RS-105, HPM) are available today that meet some test requirements. What is lacking is a rugged, portable Transverse Electromagnetic Mode (TEM) array structure capable of delivering the EM field to test assets in a reconfigurable manner.

The prototype objective is to deliver a system that can be set up in a day at a test site and be reconfigurable for three antenna configurations: horizontal bounded wave, vertical bounded wave, and overhead radiating, all in TEM mode. The system should be large enough for a 20-meter missile but also scalable to different sizes. It should have sufficient holdoff for 1.5 MV sources and bandwidth for low jitter EMP sources (not more than 300 ps jitter), UltraWide Band (UWB) sources, and HPM sources up to X Band. This requires an electromagnetic model and simulation (M&S) effort to ensure the launch section has sufficient bandwidth for fast risetimes and higher frequency content.

This approach is similar to existing Gigahertz TEM (GTEM) cells, which are driven by a wide range of sources. However, this system is designed for open test volumes and outdoor use. The focus of this effort is on the antenna arrays, launch area, interconnections, terminations, spatial combining, impedance matching, lifting structure, and ruggedness of a portable system, not on the pulser itself.

An example of a pulser that would be used is the Applied Physical Electronics LC (APELC) 1 MV RS-105 pulser (IRAD), a 10 kV FID pulser. This and other wideband sources may be used for demonstration. AFNWC will coordinate with the vendor during concept development to determine which DoD assets (pulsers) will be used. Corresponding impedance matching circuits and adapters will be designed and built.

RS-105 simulators exist up to the 1 MV range, high voltage coaxial cables exist in the >1 MV range for short pulses, and low jitter pulsers have been demonstrated in the 100s kV range. Placing the launch section on the bounded wave structure and connecting to ground sources via coaxial cable allows connection to existing sources not designed to be lifted. Some allowance for weight will be included for future pulsers to be mounted with the launch section.

For example, a 1 MV pulser on the proposed array produces a 50 kV/m field across a 20m SUT.

PHASE I: This topic is part of the D2P2 program, so no Phase I awards will be made. However, "Phase 1-type" feasibility documentation should be provided to demonstrate proof of concept for an individual planar antenna. APELC has built over 10 RS-105 simulators of various voltages and sizes, and the array approach has been in use as recently as the 1990s.

PHASE II: The objective is to design and develop a planar array antenna capable of illuminating a 20-meter SUT, driven by either Government Furnished Equipment (GFE) or the vendor's pulser. This builds on existing RS-105 simulators but aims to advance the design with improved ruggedness for transportability and a wider bandwidth. An M&S deliverable will model a larger system's electromagnetic performance for larger SUTs, such as full-size aircraft, using various technical approaches with sources ranging from 100kV to 1.5 MV.

PHASE III DUAL USE APPLICATIONS: For Phase III the initial application is anticipated to be an arrayed pulse power phaser, with a horizontal or vertical polarization that can be used for EMP E1 subsystem or system level testing which can be transported based on program needs for AFNWC. The contractor will have to work with DoD and civilian agencies to customize the test capability for various mission critical system and infrastructure applications. Other applications of the PCSS triggering systems are expected to include future large-scale pulsed power systems requiring many thousands of high reliability spark gap triggering systems. The contractor will have to work with both the Air Force Nuclear Weapons Center (AFNWC) and the Defense Threat Reduction Agency (DTRA) for detailed Test & Evaluation (T&E) requirements.

REFERENCES:

1. Sierra, Gustavo, Transportable Electromagnetic Pulse System.

2. Nickolas, Seth, Photoconductive Semiconductor Switch Driven Antenna and Array Design.

KEYWORDS: compact; emp; hpm; pulsar; antenna array; transverse electromagnetic mode

TOPIC NUMBER: AF251-D021

TITLE: Long Kill Chain via Secure Private Clouds

TECHNOLOGY AREAS: Electronics; Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The primary objective of this solicitation is to develop a resilient, flexible, and cost-effective private communications network that shall operate at the edge, supporting both military and civilian applications in remote and contested environments. The proposed network shall establish a continuous, secure communication link between nodes, enabling instantaneous collaboration, on-the-fly mission planning, and Over The Air (OTA) updates. The system shall have the capability to interface with larger networks, including potential integration with Joint All-Domain Command and Control (JADC2) initiatives, ensuring seamless communication between various platforms and systems.

To meet the requirements of such environments, a Perpetual Flight UAV platform shall be utilized as a centralized router and communications node, providing the necessary hardware and computational power near the Edge. The UAV platform shall maintain a persistent presence in remote or challenging environments, ensuring continuous communication availability for critical operations.

Furthermore, the proposed network shall utilize an affordable 3G/4G/5G waveform for connectivity, with the potential for future upgrades to other waveforms as technology advances. This approach ensures that the network remains cost-effective while still maintaining a high level of flexibility and adaptability. The use of a cloud-native integration platform shall enable seamless integration and deployment of different communication systems on the centralized router, facilitating easy and verifiable creation of interfaces between various communication vehicles.

DESCRIPTION: I. Introduction
This proposal aims to address the challenge of maintaining robust and secure communication networks in remote and contested environments for diverse military and civilian applications. With the inevitability of Networked, Collaborative, and Autonomous (NCA) weapons, the need for continuous, secure communication networks has become a cornerstone for their successful integration. These networks are essential for enabling instantaneous collaboration and on-the-fly mission planning, as well as supporting Over The Air (OTA) updates. To meet these requirements, this proposal suggests using existing technologies, such as Windriver's private cloud solutions, StarlingX, and Open Radio Access Network (O-RAN). StarlingX is a cloud-native, Kubernetes, container-based infrastructure project, while O-RAN is a concept focused on transforming traditional radio access network (RAN) architectures to create a more flexible, interoperable, and cost-effective network infrastructure. To provide the necessary hardware and computational power near the Edge, a Perpetual Flight UAV platform will be used as a centralized router and communication node. The proposal also includes the use of a cloud-native integration platform to enable easy and verifiable creation of interfaces between various communication vehicles, ensuring

seamless integration and deployment of communication systems. The primary objective of this solicitation is to demonstrate the development of a security-assured, resilient private communications network capable of being deployed at the Edge.

II. Technical Approach

The proposed solution will harness the capabilities of Windriver's private cloud technologies, StarlingX, and O-RAN to provide a unified, open-source edge platform capable of supporting critical infrastructure applications and services. Key elements of the technical approach include:

A. StarlingX Infrastructure: As a cloud-native, Kubernetes, container-based project, StarlingX offers a fully featured open-source distributed cloud platform that is well-suited for supporting edge applications. The integration of StarlingX will provide a flexible, reliable, and easily scalable foundation for the proposed private communications network.

B. Open Radio Access Network (O-RAN): O-RAN is aimed at transforming traditional RAN architectures to create a more flexible and interoperable network infrastructure. By leveraging O-RAN, the proposed solution will enable seamless integration of existing wireless technologies like 4G and 5G with traditional radio communications used in weapon-to-weapon communications. Moreover, O-RAN's emphasis on interoperability is essential in creating a robust network that can operate effectively in contested environments.

C. Perpetual Flight UAV: To facilitate and route communications from various sources, additional hardware and computational power are needed near the edge. The Perpetual Flight UAV, an uncrewed solar-powered aircraft capable of perpetual flight and supporting a payload of up to 800 pounds, is proposed as a centralized router and communications node to meet this requirement. The UAV can maintain a persistent presence in remote or challenging environments, ensuring continuous communication availability for critical operations.

D. Edge Device to UAV Router Integration: A cloud-native integration platform with a plug-and-play approach will enable the easy and verifiable creation of interfaces between various communication vehicles. This platform will allow for seamless integration and deployment of different communication systems on the centralized router. The solution will also provide the necessary tools for integration between the Edge device and the UAV router to ensure a reliable and secure connection.

PHASE I: This topic is a Direct-to-Phase Two (D2P2) topic. Proposers interested in submitting a DP2 proposal must provide documentation to substantiate that the scientific and technical merit and feasibility equivalent to a Phase I project has been met. Proposers for the DP2 solicitation must, at a minimum, exhibit competence in three of the following ten capabilities to be considered, with preference given to those demonstrating proficiency in four or more through previous projects or work experience. These capabilities may encompass, but are not restricted to:

1. Proven experience in developing and implementing radio communication systems
2. Proven experience in creating and integrating modular software for communication systems
3. Proven experience in designing and implementing communication interfaces for various vehicles or nodes
4. Proven experience in developing cloud-native integration platforms for designing, developing, and verifying systems
5. Proven experience in creating seamless and verifiable interfaces between various communication vehicles using a plug-and-play approach
6. Proven experience in using and integrating StarlingX infrastructure for supporting critical infrastructure applications at the network edge
7. Proven experience in leveraging Open Radio Access Network (O-RAN) technologies for building

flexible, interoperable, and cost-effective network infrastructure
8. Proven experience in utilizing Perpetual Flight UAV platforms for maintaining a persistent presence in remote or challenging environments and providing continuous communication availability for critical operations
9. Proven experience in integrating communication systems with larger networks
10. Proven experience in utilizing affordable 3G/4G/5G waveforms for connectivity

PHASE II: Secure, Private, Pop-up Conductivity at the Edge
Objective 1: Develop a ground-based prototype of the mobile private network leveraging Wind River/StarlingX and Tangram for integration and management of a system at the Edge.
Objective 2: Conduct laboratory testing to validate network reliability, security, and interoperability from private cloud to embedded device at the Edge.
Objective 3: Plan and execute a flight test demonstration on the Perpetual Flight UAV platform to assess the system's performance in a real-world environment.

Long-kill Chain Multi-Connection Router
Objective 4: Integrate prototype with existing communication methods such as Joint All-Domain Command and Control (JADC2) initiatives.

PHASE III DUAL USE APPLICATIONS: Objective: Following the successful completion of Phase II, the developed system is expected to be field-tested and integrated with existing communication methods, such as Joint All-Domain Command and Control (JADC2) initiatives. At the Phase III entry, the technology is anticipated to reach a Technology Readiness Level (TRL) of 7-8. While the primary focus of this SBIR/STTR-funded R&D project is the development of solutions for the Department of Defense (DoD), the technology also has significant potential for commercial applications.

Commercial Applications:

1. Augmenting Cellular Coverage: With the growing demand for mobile connectivity and the need for high-quality communication services, the technology can be adapted to augment cellular coverage in densely populated areas during peak usage events, such as concerts, sporting events, or large public gatherings. Additionally, the technology can provide temporary support in the event of natural disasters or emergency situations where existing infrastructure may be damaged or overwhelmed.

2. Providing Services to Remote Locations: The system can be deployed for various communication and data exchange purposes in remote locations where traditional infrastructure may be inadequate or uneconomical. This includes rural areas, offshore platforms, or remote industrial facilities, where the absence of reliable, secure, and resilient communication can hinder operations and productivity.
3.
Temporary or Portable Solutions: In areas with difficult terrain, where the construction of permanent infrastructure is challenging or not practical, the system can be deployed as a temporary or portable solution. This could include mountainous regions, forests, or desert environments. Additionally, the system could provide connectivity services for temporary construction sites or short-term events.
4.
Rapid Deployment Solutions: The technology also has the potential for rapid deployment in emergency situations or for disaster relief efforts, where time is critical, and communication capabilities are required to coordinate rescue and recovery operations effectively.

REFERENCES:

1. DARPA HR0011-24-S-0053: Tactical Technology Office (TTO) - Advanced Autonomous Systems.

2. DARPA HR0011-24-S-0054: Strategic Technology Office (STO) - Networked Autonomy.

3. AF242-0003: Dynamic Spectrum Utilization ([Defense.gov](https://www.defense.gov/News/Releases/Release/Article/2376743/dod-announces-600-million-for-5g-experimentation-and-testing-at-five-installati/))

4. AF242-0002: Modeling and simulation of large scale deployments of autonomous systems.

KEYWORDS: 5G;
Radio;
Communications;
Edge Node;
Over The Air Updates;
Private Cloud;
Networked Collaborative Autonomous (NCA)

TOPIC NUMBER: AF251-D022

TITLE: Multispectral False Alarm Mitigation

TECHNOLOGY AREAS: Information Systems; Weapons; Sensors; Electronics; Battlespace

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a system that can optically detect, ID, and track UAS up to 100lbs and 100knots, and up to 10km in range, while also providing optically driven false alarm mitigation determination(s). The system should be capable of detect & ID of many objects simultaneously, providing individual determinations on each detected object for false alarm mitigation usage. The system should also be capable of layering hardware and software techniques for reliable detect, ID, and track in differing physical environments and mission scenarios.

DESCRIPTION: Improvised and near peer UAS operations continue to evolve and morph. Active UAS combat in various parts of the world provide lessons learned and new tactics for UAS and Counter UAS operations teams to experiment with. Tactics include silent flight, mass attack, complex diversion and simple swarming. More dynamic smart swarming employed manually by human control or machine piloting is beginning to emerge and will continue to increase in complexity over the next few years.

Many Counter UAS solutions have attributes that allow adversaries to game them and still complete their mission of disrupting DoD military operations or causing loss of life or military equipment. This topic is focused on developing modern concepts that can provide early warning detection & ID of multiple UAS outside the wire, independent of type of UAS, size of UAS, threat speed, altitude, flight path, and inter swarm coordination techniques. These concepts can include air and ground sensors, passive detection techniques, and air surveillance outside of the wire.

There are significant complexities in all phases of the kill chain and not all these problems can be solved under this topic. This effort is focused on early detection and increased fidelity of ID of adversary operations & UAS to allow more time to prevent an adversary from successfully completing their mission.

PHASE I: This is a Direct to Phase 2 (D2P2) topic. Phase 1 like proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort via some other means (e.g. IRAD, or other funded work). It must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II: Develop a system that can detect, ID, & track UAS being employed in autonomous and complex ways against US military entities world-wide, while also providing outputs to assist in false alarm mitigation for C-UAS. It is permissible to propose only part of the complete solution, as long as identification and/or false alarm mitigation techniques are included. If detect, ID, and/or track are not included as a part of your proposed solution, it is necessary to address which technologies and interfaces are required to augment your proposed system. In other words, your proposed identification & false alarm mitigation technique(s) should account for the complexities of detect, ID, and track. The developed system is expected to layer techniques such as spectral filtering, optical hardware, and at-the-edge software/AI/ML techniques for reliable identification of UAS up to 100lbs and 100knots at 10km ranges.

i. Develop and demonstrate a real prototype system for multiple UAS up to 100lbs, 100knots, out to 10km range, and with highly dynamic flight paths
ii. Integrate an appropriate UAS tracking system for initial detection cue
iii. The system should be as autonomous as possible but able to be manually controlled based on policy
iv. The system should be able to deal with threats on many sides of an area up to 10km, while minimizing the number of ground or air assets
v. Develop and demonstrate UAS ID inside and outside the wire with additional false alarm mitigation data for use in threat determination
vi. System should be designed for a single person physical setup for ease of rapid deployment
vii. System should be designed with minimal to no calibration needs during setup & operation

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to provide airfield security, but it could also be used for National Airspace (NAS) policing, commercial UAS fleet management and UAS awareness for commercial use.

REFERENCES:

1. Army Planning Demo of Systems to Counter Group 3 UAS, https://www.defensedaily.com/army-planning-demo-of-systems-to-counter-group-3-uas/army/

2. Pentagons Counter Drone Boss tackles rising threat https://www.defensenews.com/unmanned/2023/03/10/pentagons-counter-drone-boss-tackles-rising-threat/

3. Layered Defense is the best option https://insideunmannedsystems.com/for-counter-uas-layered-defense-is-the-best-option/

KEYWORDS: Intelligence, Surveillance and Reconnaissance (ISR), Unmanned Aircraft Systems (UAS), Counter Unmanned Aircraft Systems (C-UAS), Tipping and cueing, Infrared designation, EO/IR UAS tracking, UAS Radar, C-UAS False Alarm Mitigation (CFAM), Multi-Spectral, Spectral filtering

TOPIC NUMBER: AF251-D023

TITLE: Optical Fence Line (OFL)

TECHNOLOGY AREAS: Sensors; Electronics; Information Systems; Battlespace

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a low cost system that can optically detect, ID, and track UAS up to 50 meters above the ground and along a fence line to form an enclosed secure area. The system should be capable of detect & ID of many objects simultaneously, providing individual determinations on each detected object. The system should provide alarms of objects crossing the fence line to ensure proper response from security personnel. The Fence line may be as large as an entire military installation and the capability should be scalable.

DESCRIPTION: Improvised and near peer UAS operations continue to evolve and morph. Active UAS combat in various parts of the world provide lessons learned and new tactics for UAS and Counter UAS operations teams to experiment with. Tactics include silent flight, mass attack, complex diversion and simple swarming. More dynamic smart swarming employed manually by human control or machine piloting is beginning to emerge and will continue to increase in complexity over the next few years. The ability of an adversary to fly below the radar but over fences needs to be addressed.

PHASE I: This is a Direct to Phase 2 (D2P2) topic. Phase 1 like proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort via some other means (e.g. IRAD, or other funded work). It must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II: Develop a system that can detect, ID, & track UAS being employed in autonomous and complex ways against US military entities world-wide, while also providing outputs to assist in false alarm mitigation for C-UAS. It is permissible to propose only part of the complete solution, as long as identification and/or false alarm mitigation techniques are included. If detect, ID, and/or track are not included as a part of your proposed solution, it is necessary to address which technologies and interfaces are required to augment your proposed system. In other words, your proposed identification & false alarm mitigation technique(s) should account for the complexities of detect, ID, and track. The developed system is expected to layer multiple sensors into a single sensor array establishing an eclosed optical fence line reaching 50 meters in height.

i. Develop and demonstrate a real prototype system that can be affordably scaled to a complete fenceline
ii. Integrate or simulate wide area tracking systems that would complement a fence line detection system
iii. Complete the design of the system, demonstrate performance of a prototype system through flight experimentation and demonstration at an operationally relevant environment

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to provide airfield security, but it could also be used for National Airspace (NAS) policing, commercial UAS fleet management and UAS awareness for commercial use.

REFERENCES:

1. Army Planning Demo of Systems to Counter Group 3 UAS, https://www.defensedaily.com/army-planning-demo-of-systems-to-counter-group-3-uas/army/

2. Pentagons Counter Drone Boss tackles rising threat
https://www.defensenews.com/unmanned/2023/03/10/pentagons-counter-drone-boss-tackles-rising-threat/

3. Layered Defense is the best option
https://insideunmannedsystems.com/for-counter-uas-layered-defense-is-the-best-option/

KEYWORDS: Intelligence, Surveillance and Reconnaissance (ISR), Unmanned Aircraft Systems (UAS), Counter Unmanned Aircraft Systems (C-UAS), Electro Optical Sensors (EO), Image Fusion, panoramic lenses, Machine Learning

TOPIC NUMBER: AF251-D024

TITLE: Data Informed Software Enabled Weapons Mission Applications

TECHNOLOGY AREAS: Air Platform; Battlespace

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The Air force Research Lab Munitions Directorate (AFRL/RW) aims to create a framework to push real time updates to weapon systems. Currently, weapon behaviors are not informed based on real-time data. The objective of this effort is to demonstrate the performance to be gained by using data gathered in real time to enhance weapon performance. Data from the field should continuously influence performance models, and be leveraged by artificial intelligence based analytics to increase the capability of weapon effectiveness in adversarial environments. Swappable AI-based components will improve autonomous decision making by impacting key areas such as mission planning, mission data, and collaborative strategies for targeting, guidance, and estimation.

The desired solutions should leverage the Weapons Open Systems Architecture (WOSA), increasing the opportunity for innovative solutions from a variety of vendors that may have niche expertise in specific WOSA domains. By using a modular architecture, Software Enable Weapons solutions enable tailored effects and performance that will adapt to real-world observed capabilities.

The overall goal is to develop novel collaborative machine learning-based control and decision-making strategies for multi-agent systems that can dynamically adjust and collaborate to achieve system-level missions in adversarial and uncertain environments.

DESCRIPTION: Currently, weapons are optimized to have a high-level of performance in very specific use-cases or a low-level of performance across a wide variety of use-cases. The refresh cycle for weapons is slow and weapons are not able to be tailored dependent on the situation, nor are their capabilities adaptable to a changing operational environment. The overall vision of Software Enabled Weapons is to create an “app-store” like environment where WOSA compliant, modular software apps can be modified to enhance the weapon’s effectiveness. This SBIR effort looks to find data-driven, modular solutions that will ultimately be integrated within a weapon’s “app-store.” Algorithms delivered as WOSA compliant applications could be created for any domain within the WOSA framework. This could include changes in the flight control system, the fuze behavior, guidance and navigation algorithms, seeker performance, health monitoring, networked collaborative autonomy behaviors, and others.

Some of the challenges to consider are algorithmic scalability assuming a constrained communications environment, varying and limited compute and processing power, decenetralized learning, uncertainty, multi-modal adversary, contested environments, physics-informed learning, complex relationships between platforms. However, the scope of this effort is not to solve the challenges of the software update pipeline, but instead to focused on developing the potential apps that would be pushed to the weapon.

PHASE I: As a D2P2 effort, a proposer should already have integrated machine learning algorithms on flight, or flight equivalent hardware, and have a demonstrated ability to execute a Continuous Integration continuous Development (CICD) pipeline to update their algorithms. The performer should have experience using generative artificial intelligence or reinforcement learning techniques. They should have demonstrated executing reinforcement learning based decision-making strategies in real-world scenarios.

PHASE II: The expectation for this effort is for the performer to demonstrate data-driven weapon behavior solutions that are dependent on observed data in the environment. The performer must be able to show adaptability to unexpected situations in the adversarial environment using sparse data sets. The Phase II effort should demonstrate using artificial intelligence techniques to update performance models of weapons or to create novel approaches to weapon behaviors. The effort should also explore using generative artificial intelligence or reinforcement learning to enhance heterogeneous weapon selection, sensor placement, and guidance strategies to optimize towards mission objectives.

The objectives for this effort is to deliver applications that can be integrated into the WOSA framework, including demonstrations of how the behavior of a weapon would adapt as new data is observed. The performer is encouraged to use open-source data sets for developing algorithms that may be applicable to the weapons domain.

The performer should look to leverage representative simulation environments, such as AFSIM, or other frameworks to train agents in representative environments. The applications built for different WOSA domains (such as navigation, communications, guidance, etc…) should be demonstrated in a WOSA compliant environment. The application will be able to take in new data and adjust its algorithm based on new data received from the field. The application will demonstrate an increase in effectiveness after ingesting new data. The application will possess the capability to be tailored to a scenario as new information is revealed to it, or have specific parameters for the scenarios for which it is optimal. The applications provided should be hardware agnostics, weapon-centric, modular, and reusable to be accepted for integration during Phase III.

PHASE III DUAL USE APPLICATIONS: Phase III of this effort would include application integration into the Software Enabled Weapons pipeline, to be flown on a modular weapons system surrogate. The expected TRL at the end of Phase III will be TRL 7 after a end-to-end prototyping demonstration.

The applications developed for the Software Enabled Weapons program would be expected to go through proper software certification channels to ensure application compliance with DoD regulations.

REFERENCES:

1. Voyager: An Open-Ended Embodied Agent with Large Language Models https://arxiv.org/pdf/2305.16291

2. Self-Supervised Policy Adaptation During Deployment https://bair.berkeley.edu/blog/2021/02/25/ss-adaptation/

3. NVIDIA Isaac Sim https://developer.nvidia.com/isaac/sim

KEYWORDS: Artificial Intelligence; autonomous vehicle; network collaborative autonomy; open system architecture; modular weapon system; agile development; mission planning.

TOPIC NUMBER: AF251-D025

TITLE: Spatial Tracking for Enhanced Automated Manufacturing - Extended Reality (STEAM-XR)

TECHNOLOGY AREAS: Sensors; Information Systems; Human Systems

OBJECTIVE: This topic seeks to develop Extended Reality (XR)-based software that can support aircraft maintenance training modernization and operational use by enabling active training and task assistance as well as automated training content generation.

DESCRIPTION: It is essential that the Air Force to modernize its air maintenance training procedures to meet the demands of future operations and deter our adversaries. XR technology has the potential to provide a new platform for our maintainers to continuously develop and augment their skills. Current solutions suffer from rigid pre-recorded training content that is not appropriate for the high mix low volume nature of aircraft maintenance and repair. However, there are critical S&T challenges that must be solved to fully leverage this technology beyond what is currently being done. Specifically, active training and task assistance as well as automated generation of training content and digital twins must be enabled to fully realize the potential of XR-based for aircraft sustainment. The primary S&T challenge of this project is to create a near real-time, XR-based, markerless motion tracking solution that approaches 5mm accuracy when dealing with aircraft component sized parts. This will enable the primary objectives of active training and task assistance, as well as automated generation of XR training content for high mix cases. The active training concept goes beyond showing users what should be done and monitors that tasks are being done correctly. This is key for aircraft maintenance as there are many tedious tasks prone to accidental human error even for experienced users. Similarly, with regard to generating XR training content we must move towards a model where an XR programming expert is not required to write code to capture the many possible scenarios for which training content is needed. Thus, experts on the wide variety of high mix maintenance tasks currently being done can simply watch themselves performing the tasks with an XR device to generate training content for new users. Doing the tracking through the XR device is key to the envisioned applications. Aircraft repair depots are large complex, dynamic environments. It is not feasible to install external 3D scanning and tracking hardware for every possible use case. Further, such tools typically suffer from complicated calibration procedures that leads to poor adoption in the depots. Demand signals from the organic industrial base are clear that an inside-out XR-based solution with no additional infrastructure or time-consuming calibration procedures is necessary.

PHASE I: This topic is intended for XR-based aircraft maintenance training technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-like” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. Specifically, given that this effort requires XR-based inside-out markerless tracking of complex objects, the desired Phase I-like effort should have established a capability to spatially scan, generate 3D from 2D reconstructions, and then recognize specific static but potentially complex objects via a commercial, off-the-shelf augmented reality (AR) device’s onboard sensors. Ideally the Phase-I-like effort would also establish the ability to localize an AR device with respect to a digital version of a detected static object. Reported results showing both the level of localization accuracy, benchmark objects used, and complexity/size of object limitations should be provided. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the

AF need, i.e., how it has been modified; Described integration cost and feasibility with current mission-specific products; Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-like” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technology in order to conduct a small number of relevant demonstrations. Specifically, the offeror will (1) Augment existing XR-based markerless spatial scanning and localization for static objects with markerless model-based object tracking.; (2) Integrate AI and selective scanning to enable motion tracking to approach real-time updates for potentially complex objects; (3) Demonstrate the technology in a “crawl before you walk” approach by initially tracking one object with a stationary XR device, then track 1 object with a moving XR device, then track 2 objects with a moving XR device, and finally track many objects moving; (4) Leverage XR-based tracking tools to implement an active training use case; (5) Leverage XR-based tracking tools to implement an automated training content generation use case; (6) Test the new capabilities in an operating environment. The offeror must identify technology hurdles they are expected to encounter during the development program, as well as potential solutions to mitigate risk to the program.

PHASE III DUAL USE APPLICATIONS: The contractor will increase the Technology Readiness Level of the XR software tools developed under the Phase II effort and validate performance and achievement of objectives in pilot production at a USAF air logistics center. The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning the technology to various defense aerospace Original Equipment Manufacturers, their supply chain, and the Air Force and broader DoD organic industrial base. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES:

1. Arena, Fabio, et al. "An overview of augmented reality." Computers 11.2 (2022): 28;

2. Bottani, Eleonora, and Giuseppe Vignali. "Augmented reality technology in the manufacturing industry: A review of the last decade." Iise Transactions 51.3 (2019): 284-310;

3. Aharchi, M., and M. Ait Kbir. "A review on 3D reconstruction techniques from 2D images." Innovations in Smart Cities Applications Edition 3: The Proceedings of the 4th International Conference on Smart City Applications 4. Springer International Publishing, 2020;

4. Han, Pengfei, and Gang Zhao. "A review of edge-based 3D tracking of rigid objects." Virtual Reality & Intelligent Hardware 1.6 (2019): 580-596;

KEYWORDS: extended reality, augmented reality, mixed reality, spatial tracking, 3d from 2d reconstruction, spatial scanning

TOPIC NUMBER: AF251-D026

TITLE: Scaled Silicon Carbide on Insulator for Quantum Applications

TECHNOLOGY AREAS: Sensors; Materials; Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The Air Force is interested in wafer-scale, quantum-grade silicon carbide on insulator (SiC-OI) as a product to develop next generation integrated quantum photonics technologies. Minimum requirements should be at least 100 millimeter wafers, sub-micron device layer thickness, and total thickness variation below 20 nanometers.

DESCRIPTION: There are existing processes used to produce few millimeter scale, but these need to be scaled up and developed at the wafer scale in order to support high volume production. To-date, epitaxial growth of isotopically pure silicon carbide (SiC) on top of a commercial SiC wafer substrate, followed by bonding onto an SiO_2 handle wafer, followed by a CMP etch to get to a ~200 nanometer thickness of the epitaxially grown SiC layer has produced material quality sufficient for quantum applications at the few mm scale. Thickness uniformity of this process suffers at larger scales and this work would involve process development and control to scale to the larger wafer-scale.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-like” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential, demonstrating the ability to produce few millimeter scale materials suitable for quantum applications, and possession of the tools and equipment necessary to produce materials at the wafer-scale. The offeror must show they possess the necessary equipment such as wafer bonders, CMP machines, isotopic purification of SiC, and epitaxial growth equipment necessary to produce materials at the wafer scale. It must have validated the product-market fit between the proposed solution and a potential AF stakeholders.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-like” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall develop minimum 100 mm SiC-OI wafers with total thickness variation (TTV) less than 20 nanometers, surface roughness less than 0.5 nanometers, isotopically purified SiC device layers of less than 1 micrometer thickness, and demonstrated optical losses in the device layer of less than 1 decibels/centimeter. The offeror shall also demonstrate a commercially viable process yield for meeting the above wafer metrics. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. Potential follow-on Phase III efforts would include fabrication and processing of integrated quantum photonics optical components and testing of components, deterministic spin defect and color center placement/implantation, and process development for electrical biasing.

REFERENCES:

1. https://login.wrs.idm.oclc.org/login?qurl

KEYWORDS: integrated quantum photonics; silicon carbide; color centers; integrated photonics; spin defects;

TOPIC NUMBER: AF251-D027

TITLE: Rapid and Affordable Propulsion Manufacturing Technologies for Munitions

TECHNOLOGY AREAS: Electronics; Materials; Air Platform; Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The objective is to develop innovative manufacturing technologies to enable highly-producible static and rotating structures for small gas turbine engines suitable for affordable, rapidly manufactured modular munitions, with focus on agile casting and additive manufacturing techniques. This objective targets improvements in propulsion manufacturing and supply chain outcomes across several factors, including: significant reduced lead times to initial prototype hardware and quantities suitable engine development activities quantities; demonstration of agility to accommodate minor geometry and scale changes to support rapid development of derivative engine designs; and approaches that enable access to a wide-supply base of capital-intensive casting and/or additive manufactured hardware suppliers (supporting distributed manufacturing concepts). Associated manufacturing technology demonstrations will result in prototype hardware relevant to affordable modular munition concepts, suitable for future rig and test activities, and with a credible approach to propulsion supplier adoption.

DESCRIPTION: The objective is to develop manufacturing and materials technologies suitable for the development of affordable and high-rate and gas turbine engine solutions for munitions and autonomous collaborative platforms. This objective targets improvements in propulsion manufacturing and supply chain outcomes, to include significant reductions in required labor time, reduced long-lead and cycle times, increased manufacturing rates, and unlocking broader base of supply chain availability and capabilities, all enhanced relative to historical military acquisition experience for these systems.

DESCRIPTION: Relevant technology domains include low cost materials and processing, novel manufacturing and assembly approaches (to include assembly fabrication, and inspection automation), as well as processing concepts levered from other mass-market industries. This objective encompasses a focus on innovative development approaches for all engine subsystems and accessory components.

This objective also recognizes that historic market dynamics have traditionally led industry design systems to focus on engine performance and endurance over reduced-capability designs manufactured at high rates, and subsequently unique military derivative engines carry a burden of associated complexity and conservatism as a result. This object seeks to explore technology demonstrations on the prospective capabilities of “mass-produced”, non-man-rated, and in some cases expendable turbine engines. Domains of interest also include design system and manufacturing qualification approaches regarding material property requirements and that enable broader supply chain agility (to include the use of commercial material grades versus aerospace grades, reducing dependence on single-source additive manufacturing systems and vendors, and enhanced “build-to” design packages that reduce risks to suppliers). This topic expects to deliver at least two manufacturing technology demonstrations for turbine engines and associated accessory hardware with a credible pathway to industry adoption, that enable significant reductions in required labor time, reduced long-lead and cycle times, increased manufacturing rates, and/or unlock a broader base of supply chain availability and capabilities.

This objective also recognizes that the adoption of non-traditional technologies and approaches may challenge typical industry standards, design practices, DoD policies, and/or federal regulations, and the objective also seeks to understand the relevant government policies that may require accommodation in order to enable adoption of these new manufacturing technologies and approaches.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. This feasibility study must include an assessment of the state of the casting and/or additive manufacturing service market for turbine engine components, and communicate how offeror’s innovations contribute to cost and schedule reductions for labor costs, material costs, non-recurring engineering costs, and/or reductions in initial prototype or serial production cycle times from the view of a propulsion system supplier acquiring components for development activities. This assessment must also identify the offeror’s present casting and/additive manufacturing capability and the technology domains it proposes to refine through this topic.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-like” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution. The successful Phase 2 effort will deliver at least two manufacturing technology demonstrations resulting in prototype hardware suitable for future rig and engine testing recommended by offeror, and demonstrate agility through an offeror-proposed collection of metrics associated with the objective statement. The Offeror should communicate how their technology approach will result in a credible pathway to propulsion supplier adoption. The Phase 2 awardee will build on the current state of the art to advance the Technology Readiness Level in supporting these outcomes of interest by delivering designs and physical prototypes that demonstrate enhanced performance in one or more of the areas above. The awardee will coordinate with the Department of the Air Force technical point of contact (TPOC) via regular information exchange meetings and technical reports. The final deliverable will be turbine-engine relevant hardware prototypes manufactured via the proposed manufacturing technology demonstration activities.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded turbine engine manufacturing capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES:

1. https://www.af.mil/News/Article-Display/Article/2199852/;

2. https://sam.gov/opp/eae04982a242429e825efb961bbcf9f5/view

KEYWORDS: propulsion; turbine engines; autonomous collaborative platforms; affordable mass; munitions;

Defense Health Agency (DHA)
2025.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Health Agency (DHA) SBIR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies. DHA SBIR encourages participation in innovation and entrepreneurship by women and socially or economically disadvantaged persons.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. The instructions below are important to review, as they include agency-specific requirements that add to or deviate from the DoD Program BAA. Proposals that do not address agency-specific requirements may be considered non-responsive. Only Government personnel will evaluate proposals submitted under this solicitation cycle.

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: Active Solicitations (dodsbirsttr.mil). Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: Sign Up form (campaigner.com).

Specific questions about the DHA SBIR Program and agency-specific instructions included below should be directed to: DHA SBIR Program Management Office (PMO) Email: usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.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 within the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed **20 pages** and must follow the format and content requirements provided in the DoD SBIR Program BAA. Do not duplicate the electronically-generated Cover Sheet or insert information associated with the Technical Volume into other sections of the proposal, as these will count toward the 20-page limit.

Only the electronically-generated Cover Sheet and Cost Volume are excluded from the 20-page limit. Technical Volumes that exceed the 20-page limit will be deemed non-compliant and will not be evaluated.

Cost Volume (Volume 3)

The Phase I Base amount must not exceed $250,000 over a 6-month period of performance. Costs must be clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Please review the updated Percentage of Work (POW) calculation details included in the DoD Program BAA. DHA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement Officer.

Travel must be justified and should relate to direct Research Development Test & Evaluation (RDT&E) Technology Readiness Level (TRL)-increasing task costs. Travel costs must include the purpose of the trip(s), number of trips, origin and destination, length of trip(s), and number of personnel.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by DHA during proposal evaluations.

Supporting Documents (Volume 5)
Volume 5 is provided for proposing SBCs 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.

Fraud, Waste and Abuse Training (Volume 6)
Fraud, Waste and Abuse 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 to proceed with proposal submission.

Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Volume 7)
Small business concerns must complete the Disclosures of Foreign Affiliations or Relationships to Foreign Countries webform in Volume 7 of the DSIP proposal submission. Please be aware that the Disclosures of Foreign Affiliations or Relationships to Foreign Countries WILL NOT be accepted as a PDF Supporting Document in Volume 5 of the DSIP proposal submission. Do not upload any previous versions of this form to Volume 5. For additional details, please refer to the DoD Program BAA.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees unless a topic is otherwise marked. Phase II is the demonstration of the technology found feasible in Phase I. Specific due date, content, and submission requirements of the Phase II proposal will be provided by the DHA SBIR PMO; typically during month five of the Phase I contract.

Due to limited funding, the DHA SBIR Program reserves the right to limit awards under any topic. Only proposals considered to be of superior quality will be funded. Small businesses submitting a proposal are required to develop and submit a Commercialization Strategy describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal, including plans to pursue appropriate seed-stage investment. This plan shall be included in the Technical Volume.

The Cost Volume must contain a budget for the entire 24-month Phase II period in an amount not to exceed the maximum dollar amount of $1,300,000. Budget costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site) and shall be presented side-by-side on a single Cost Volume Sheet.

DHA SBIR Phase II proposals have seven volumes: Proposal Cover Sheets; Technical Volume; Cost Volume; Company Commercialization Report; Supporting Documents; Fraud, Waste, and Abuse; Disclosures of Foreign Affiliations or Relationships to Foreign Countries.

The Technical Volume has a 40-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Technical Volumes that exceed the 40-page limit will be deemed non-compliant and will not be evaluated.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
The DHA SBIR Program does not participate in the Technical and Business Assistance (formerly the Discretionary Technical Assistance Program). Contractors shall not submit proposals that include Technical and Business Assistance.

The DHA SBIR Program offers a Commercialization Readiness Program providing assistance to small businesses that receive Phase I and Phase II awards.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. Non-selected companies may request feedback within 15 calendar days of the non-select notification. The Corporate Official identified in the firm's proposal shall submit the feedback request to the SBIR Office at usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.mil. Feedback is provided in an official PDF via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral feedback will not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the feedback request.

NOTE: Feedback is not the same as a FAR Part 15 debriefing. Acquisitions under this solicitation are awarded via "other competitive procedures". Therefore, offerors are neither entitled to nor will they be provided FAR Part 15 debriefs.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement. Protests after Award, as further prescribed in FAR 33.106(b), FAR 52.233-3, should be submitted to:

Ms. Samantha L. Connors SBIR/STTR Chief, Contracts Branch 8
Contracting Officer
U.S. Army Medical Research Acquisition Activity
Email: samantha.l.connors.civ@health.mil

AWARD AND CONTRACT INFORMATION
Phase I awards will total up to $250,000 for a 6-month effort and will be awarded as Firm-Fixed-Price Purchase Orders.

Phase II awards will total up to $1,300,000 for a 24-month effort and will typically be awarded as Firm-Fixed-Price contracts. If a different contracting type is preferred, such as Cost-Plus, the rationale as to why must be included within the proposal.

Phase I/Phase II awardees will be informed of contracting specialist, contracting officer, and Technical Point of Contact/Contract Officer Representative upon award.

ADDITIONAL INFORMATION

RESEARCH INVOLVING HUMAN SUBJECTS, HUMAN SPECIMENS/DATA, OR ANIMAL RESEARCH

The DHA SBIR Program highly discourages offerors from proposing animal or human use research during Phase I due to the significant lead time required to prepare documentation and secure approval, which could substantially delay the funding and performance of the Phase I award.

Prior to contract award when an IRB is indicated, proposers must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human subjects, human specimens, or research with animals. If necessary, approvals are not obtained within two months of notification of selection, the decision to award may be terminated.

Offerors are expressly forbidden to use, or subcontract for the use of, laboratory animals in any manner without the express written approval of the U.S. Army Medical Research and Development Command (USAMRDC) Animal Care and Use Review Office (ACURO). Written authorization to begin research under the applicable protocol(s) proposed for this award will be issued in the form of an approval letter from the USAMRDC ACURO to the recipient. Modifications to previously approved protocols require re-approval by ACURO prior to implementation.

Research under this award involving the use of human subjects, to include the use of human anatomical substances or human data, shall not begin until the USAMRDC's Office of Human Research Oversight (OHRO) provides formal authorization. Written approval to begin a research protocol will be issued from the USAMRDC OHRO, under separate notification to the recipient. Written approval from the USAMRDC OHRO is required for any sub-recipient using funds from this award to conduct research involving human subjects. If the Offeror intends to submit research funded by this award to the U.S. Food and Drug Administration, Offerors shall propose a regulatory strategy for review.

*NOTE: Exempt animal or human research use shall also reflect 'yes' on the proposal coversheet for USAMRDC ACURO and OHARO records.

Non-compliance with any provision may result in withholding of funds and or termination of the award.

For more information please visit the MRDC Office of Human Research Oversight website here: USAMRDC: USAMRDC: Office of Human Research Oversight (OHRO) (health.mil)

FEDERAL FACILITY USE

The DHA SBIR Program highly discourages small business concerns (SBCs) from subcontracting to a federal facility and/or utilizing for testing due to the significant lead time required to secure approval, which could substantially delay the performance of the award.
Use of federal facilities is prohibited without an approved waiver from the DHA SBIR/STTR Office.

An SBC whose proposed work includes federal facility use is required to provide a written justification, uploaded to the Supporting Documents (Volume 5), that includes the following information:

1. An explanation of why the SBIR/STTR research project requires the use of the federal facility, including data that verifies the absence of non-federal U.S. facilities, in support of the overall mission and research area.
2. Evidence that there is no applicable U.S. facility that has the ability or expertise to perform the specified work.
3. Why the Federal Agency will not and cannot fund the use of the Federal facility or personnel for the SBIR/STTR project with non-SBIR/STTR funds.

The DHA SBIR Program has the right of refusal. Companies that fail to meet requirements specified above will be at risk of delay to award or funding.

If the proposal is selected, the U.S. Army Medical Research Acquisition Activity (USAMRAA) will assist in establishing the waiver for DHA SBIR/STTR Office approval. If approved, the proposer will subcontract directly with the federal facility and not a third-party representative.

Transfer of funds between a company and a Military Lab must meet the following APAN 15-01 requirements (the full text of this notice can be found at https://usamraa.health.mil/SiteAssets/APAN%2015-01%20Revised%20Feb%202018.pdf):

(1) The DoD Intramural Researcher must obtain a letter from his/her commanding officer or Military Facility director authorizing his/her participation in the Extramural Research project. This letter must be provided to the Extramural Organization for inclusion in the proposal or application.

(2) The DoD Intramural Researcher must also coordinate with his/her local RM office (or equivalent) to prepare a sound budget and justification for the estimated costs. Where there are no DoD-established reimbursement rates [e.g., institution review board (IRB) fees, indirect cost rates, etc.], the Military Facility's RM office (or equivalent) must provide details of how the proposed rates were determined. The DoD Intramural Researcher must use the budget and justification form enclosed in APAN 15-01 when developing the estimated costs and provide it to the Extramural Organization for inclusion in the proposal or application.

(3) The Extramural Research proposal or application must include a proposed financial plan for how the Military Facility's Intramural Research costs will be supported [i.e., directly funded by DoD, resources (other than award funds) provided by the Awardee to the Military Facility, or award funds provided by the Awardee to the Military Facility (in accordance with the requirements below)].

(4) The DoD Intramural Researcher should also coordinate with his/her technology transfer office.

INTERNATIONAL TRAFFIC IN ARMS REGULATION (ITAR)
For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain nonprofit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases, such as Phase III, if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

System for Award Management (SAM)
As stated in FAR Provision 52.204-7 System for Award Management, proposing Small Business Concerns must be registered in SAM, https://sam.gov, at the time of submission 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.

DHA SBIR 25.1 Topic Index

DHA251-001	Platelet Contractility / Retraction Measurement Device
DHA251-002	A Mobile Application for Prediction of Blast Overpressure Exposure in Civilian and Military Operations

DHA251-001 TITLE: Platelet Contractility / Retraction Measurement Device

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casualty Care

OBJECTIVE: Development of a portable, high throughput, handheld device that characterizes platelet contractility (a measurement of platelet functional viability) as a transfusion release criterion for military and civilian blood banks and transfusion services.

DESCRIPTION: Conventional assays intended to characterize platelets in vitro fail to provide a comprehensive assessment of platelet function, only capturing information about adhesion, aggregation, or storage contamination status in platelet blood products (e.g. pH, blood cultures). These deficiencies are exacerbated in traumatically injured patients. Information about platelet metabolism and signaling is limited in current platelet function tests. Thromboelastography (TEG) is low throughput and measures clot properties; however, information about platelet function may be missed.1 Light transmission/impedance aggregometry are susceptible to analytical variables, require high sample volume, and are manually intensive and time-consuming.2,3 Platelet contraction requires all aspects of cell physiology in order to successfully cause clot retraction.4 However, current methods to measure clot retraction, such as visual observation or laboratory-based assays, are limited by their complexity, high costs, and the need for trained personnel, preventing their use in time-sensitive or resource-limited settings; additionally, these methods for measuring clot retraction do not provide quantitative measurements, and results are subject to interpretation or only provide binary output (retraction/no-retraction). Currently, there are no commercial instruments or assays that can quantitatively measure clot retraction.

Platelets are crucial to prevent excessive bleeding following traumatic injury,5 the leading cause of preventable combat deaths. Platelet transfusions significantly improve the hemostatic outcome in actively bleeding patients. The manufacture and storage of platelet products for transfusion leads to a decline in platelet function. There is no effective test for platelets in the bag providing proof of function to serve as quality control of the platelet product. Platelet yield and pH are currently the only required quality control tests for stored platelet products, but they may not provide sufficient information about platelet quality and function.

This effort seeks to develop a device based on a method that can use low sample volume and high throughput to screen donors and platelet-containing products for dysfunction(s) for in vitro and in vivo platelet research, prior to product release to hospitals, for routine platelet quality control, and/or for clinical use in patients. This device will significantly impact military (anticipated use in Role of Care 2 and 3 settings) civilian blood banking and transfusion services. The need for rapid deployment of platelets in hemorrhage scenarios has continued to spur development of new techniques, media, storage bags, and transport containers to enhance and extend platelet shelf-life, and a definitive, clinically relevant measurement of platelet functional viability will provide the metrics required to determine the impact of these advances, aligning with the US Air Force medical service ICD for blood-like products, technology, and documents of joint hemorrhage control. The goal of this topic is to develop a novel handheld device that measures clot retraction dynamics, provides portability and ease of use, facilitates rapid decision-making, integrates with existing systems (e.g. interfacing with electronic medical records (EMRs) or clinical decision support systems), and supports a wide range of applications (e.g. routine clinical diagnostics, point-of-care testing, and plate biology research environments). If the technology is fielded for military use, it may require additional security measures such as cybersecurity for data protection.

PHASE I: Phase I will consist of designing schematics and diagrams resulting in the development of a proof-of-concept prototype that will form the basis for a portable, handheld, device that can characterize platelet contractility (AKA “clot retraction”) from a blood or platelet-rich plasma sample as a definitive measurement of the platelets' functional viability. Limited, benchtop testing of the technology should be provided to assess accuracy, reproducibility, and reliability in measuring clot contractility parameters. Performer will conceptualize a method to quantitatively measure the platelet capacity for clot retraction and determine the technical feasibility to miniaturize the technology for handheld usage. It is expected that Phase I will result in clear methodology for the approach, demonstration of feasibility for miniaturization, sensor technology, and data processing. A detailed plan for further development, including regulatory approval pathways and commercialization strategies, should be provided.

PHASE II: Phase II will focus on production and optimization of prototype hardware from Phase I. Emphasis on device design optimization for field and clinical use, including robustness, power supply, speed of results (≤30 min from start of test to results desired), weight, throughput and user interface should be included. Preclinical studies should be conducted by the end of Phase II that demonstrate validated performance of the fabricated device using human blood platelets. Validation of device output metrics should be conducted in comparison or correlation with accepted clinical and/or laboratory-based assays. The key performance parameter is reporting the output metric(s) of the platelet contractility ("clot retraction") measurement. The values associated with (preliminary) expected normal ranges for these metrics for a healthy adult (free of antiplatelet medication) are required. Output from the device should be capable of quantifying the function and viability of the platelets to the user based on these normal ranges. Required Phase II deliverables will include: 1) successful refinement of a prototype product, 2) successful evaluation of the efficacy of the product, and 3) delivery of no less than 3 prototypes that provide data demonstrating outcomes. For this phase, the applicant will include the FDA regulatory path, which will provide a clear plan on how FDA clearance will be obtained if exemption is not applicable. It is also recommended that the applicant begin establishing relationships with commercialization partners to facilitate transition of the technology.

PHASE III DUAL USE APPLICATIONS: This Phase III effort should result in a device that is commercially viable in civilian clinics and militarily relevant by providing a solution to a known capability gap: measuring platelet function through clot contractility. The vision for this product is a lightweight, handheld device that will assay platelet functional viability and provide this data to the user in the context of a range of values defined as clinically "normal". Phase III will consist of device design finalization, delivery of at least 3 devices for military testing, FDA-required testing (e.g. validation testing to aid in regulatory approval), as well as development of any related training and usage materials. Potential buyers for the commercialized product include DoD and civilian blood donor centers, as well as DoD and civilian clinical laboratories that conduct hematology work. The product generated should be assigned a national stock number (NSN) to be added to the Defense Logistics Agency's electronic catalog (ECAT), General Services Administration (GSA) Advantage, etc. for purchase by individual units using Government Credit Card or for enterprise-level purchase orders. The FDA may eventually direct usage of the device as it provides insight into the capability of the blood product to provide the desired function.

REFERENCES:

1. Lipets EN, Ataullakhanov FI. Global assays of hemostasis in the diagnostics of hypercoagulation and evaluation of thrombosis risk. Thromb J. 2015;13(1):4.
2. Stratmann J, Karmal L, Zwinge B, Miesbach W. Platelet Aggregation Testing on a Routine Coagulation Analyzer: A Method Comparison Study. Clinical and applied thrombosis/hemostasis : official journal of the International Academy of Clinical and Applied Thrombosis/Hemostasis. 2019;25:1076029619885184.
3. Nakahara H, Sarker T, Dean CL, Skukalek SL, Sniecinski RM, Cawley CM, et al. A Sticky Situation: Variable Agreement Between Platelet Function Tests Used to Assess Anti-platelet Therapy Response. Front Cardiovasc Med. 2022;9:899594.

4. Jansen EE, Hartmann M. Clot Retraction: Cellular Mechanisms and Inhibitors, Measuring Methods, and Clinical Implications. Biomedicines. 2021;9(8).
5. Hamada SR, Garrigue D, Nougue H, Meyer A, Boutonnet M, Meaudre E, et al. Impact of platelet transfusion on outcomes in trauma patients. Crit Care. 2022;26(1):49.

KEYWORDS: Blood platelets, platelet activation, diagnostic techniques (medicine), clinical laboratory techniques (medicine), blood storage, blood transfusions, portable equipment, platelet function, platelet shelf-life, platelet contraction

DHA251-002 TITLE: A Mobile Application for Prediction of Blast Overpressure Exposure in Civilian and Military Operations

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: Develop and evaluate a mobile application to monitor and predict blast overpressure exposure, providing guidance for improved safety measures during explosives/weapon training in military and civilian environments.

DESCRIPTION: Military units, civilian special weapons and tactics teams (SWAT), and commercial mining professionals are routinely exposed to explosive threats in training or real-world environments. Repeated heavy weapon firing, commercial demolitions, or use of explosive devices to obtain forceful entry to facility targets during training and in real-world operations expose these personnel to blast overpressure threats. These threats may be further amplified for detonations in enclosed spaces including buildings, tunnels, mines, or bunkers. Given the serious threat that blast waves generated by heavy weapons and explosive devices pose to military and civilian operators, there is a pressing need to optimize safety protocols to protect these personnel during training.
Recent characterization of blast exposures recorded during explosive events demonstrate that servicemembers and first responders may be repetitively exposed to low-level blast while detonating explosives, conducting ordnance disposal, or firing weapon systems [Carr et al, 2016]. Repeated exposures, even within manufacturer described allowable limits, have been associated with acquired head injury and cognitive deficits including delayed verbal memory, visual-spatial memory deficits and impaired executive function. Recent reporting reveals that years after the service, civilian and military members involved in ordnance disposal or other high-risk activities may experience chronic brain health effects and may have elevated suicide rates [Stone et al 2024].
The application of computational models of blast overpressure (BOP) interaction with the human body and the surrounding structures validated by experimental data, collected in real world environments, could be useful to develop dual-use military, civilian or industrial safety training, operational protocols, and support operational medical mission planning [Spencer et al 2023]. The latest generation of mobile devices, linked to wearable sensors could provide a user-friendly platform for BOP algorithm use that could be used by individual military, civilian law enforcement personnel, mining, and industrial safety personnel for monitoring repeated blast exposures which could contribute to acute and chronic brain health effects. Such devices could provide fast computing capabilities, ample data storage, and user-friendly graphical user interfaces (GUI). They could also host a range of applications for image/video-based generation of architecture/geometry of structures, recording and processing of blast noise. The goal of this project is to develop a mobile application for commercially available mobile platforms to predict blast exposure by leveraging mobile sensing and computing capabilities, providing guidance for improved safety measures during explosives/weapon training in military and civilian environments.

PHASE I: Develop design specifications for a mobile application capable of predicting the blast exposure on humans in open and closed spaces. It will be the performer's responsibility to access algorithms and blast exposure models available in peer reviewed publications such as the Journal of Military Medicine or other open-source literature and reports. Discuss and finalize the design specifications with the TPOC. Design specifications should include setting up blast scenes, simulating the blast exposure, and keeping track of exposure times during activities. Develop and demonstrate the proof of concept on selected weapons and explosive devices in both open and closed spaces.

PHASE II: The goal of Phase II for this project is to develop, demonstrate and deliver a functional prototype of the mobile application for predicting and monitoring blast exposure caused by explosive devices and heavy weapons during training. Implement an initial functional mobile GUI for setup, execution and analytics of blast wave loads generated by explosive devices on structures and personnel in

pre-defined training sites. Develop or leverage existing computational models for accurate prediction of blast exposure loads on servicemembers using mobile computing platforms. Integrate the computing “engine” into the functional mobile application framework.
Demonstrate the mobile application capability to simulate blast dose to individual civilian safety and military personnel in both open field and closed facilities. Explore the on-device sensing and detection capabilities for integration into the mobile application. It is performer’s responsibility to obtain access to Servicemembers either directly or in collaboration with DoD laboratories to demonstrate the mobile application and to collect feedback. In the final stage of Phase II, document, demonstrate and deliver the working prototype of mobile application for evaluation and feedback by military/civilian law enforcement stakeholders and prospective end users. Develop recommendations for deployment of the platform for use in military and civilian environments including occupational safety and health personnel, military/civilian/first responders, and industrial safety personnel.

PHASE III DUAL USE APPLICATIONS: Phase III will involve deployment, testing, evaluation, and improvement of the mobile platform for military and civilian training environment use. The mobile blast exposure and diagnostic monitoring mobile application should support current and future activities within DoD, civilian government agencies, and industrial/commercial interests. The application could be an invaluable tool for industrial safety, safer civilian/military range training, and operational mission planning efforts. A mobile platform for recording and monitoring blast exposure could be used by civilians involved in commercial explosive demolition, explosive coal, rock and mineral mining, and others.

REFERENCES:

1. Carr W, Stone JR, Walilko T, Young LA, et al., (2016) Repeated low-level blast exposure: a descriptive human subjects study. Military medicine. 1;181(suppl_5):28-39.
2. DePalma RG, Hoffman SW (2018) Combat blast related traumatic brain injury (TBI): Decade of recognition; promise of progress. Behavioral Brain Res. 340;102–5
3. Spencer, R.W., Brokaw, E., Carr, W., et al. "Fiscal Year 2018 National Defense Authorization Act, Section 734, Weapon Systems Line of Inquiry: Overview and Blast Overpressure Tool—A Module for Human Body Blast Wave Exposure for Safer Weapons Training." Military medicine 188.Supplement_6 (2023): 536-544.
4. Stone JR, Avants BB, Tustison NJ, et al. "Neurological effects of repeated blast exposure in Special Operations personnel." Journal of neurotrauma 41.7-8 (2024): 942-956.

KEYWORDS: Blast wave, human body blast exposure, civilian/military operations, industrial explosions, mathematical modeling, mobile applications, brain injury.

VERSION 4

Missile Defense Agency
25.1 Small Business Innovation Research
Direct to Phase II Proposal Instructions

Introduction

The Missile Defense Agency's (MDA) mission is to develop and deploy a layered Missile Defense System (MDS) to defend the United States, its deployed forces, allies, and friends from missile attacks in all phases of flight.

The MDA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the MDA SBIR/Small Business Technology Transfer (STTR) Program Management Office (PMO), located within the Innovation, Science, & Technology directorate.

All topics published in the MDA SBIR 25.1 Broad Agency Announcement (BAA) are Direct to Phase II (DP2). Offerors responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. MDA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the Defense SBIR/STTR Innovation Portal (DSIP) Listserv to remain apprised of important programmatic and contractual changes.

- Full component-specific instructions and topic descriptions are available on DSIP at https://www.dodsbirsttr.mil/submissions/solicitation-documents/active-solicitations. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

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

Missile Defense Agency
SBIR/STTR Program Management Office
MDA/DVA
Bldg. 5224, Martin Road
Redstone Arsenal, AL 35898
Email: sbirsttr@mda.mil

PLEASE NOTE: Please read the following MDA DP2 proposal instructions carefully prior to submitting your proposal. Proposals not conforming to the terms of this announcement will not be considered for negotiation and/or award. MDA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by MDA will be funded. MDA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include, but not limited to, matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD Announcement and MDA instructions carefully prior to submitting your proposal. Please go to https://www.sbir.gov/about/policies to read the SBIR/STTR Policy Directive issued by the Small Business Administration.

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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 SBIR/STTR awards in the SBIR/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 that are 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.

Offeror Small Business Eligibility Requirements
Each offeror must qualify as a small business at time of award per the Small Business Administration's (SBA) regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Small businesses that are selected for award will also be required to submit a Funding Agreement Certification document and be registered with Supplier Performance Risk System https://www.sprs.csd.disa.mil/ prior to award.

Ownership Eligibility
Prior to award, MDA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR/STTR Program Eligibility. These documents include, but may not be limited to, the Business License; Articles of Incorporation or Organization; By-Laws/Operating Agreement; Stock Certificates (Voting Stock); Board Meeting Minutes for the previous year; and a list of all board members and officers. If requested by MDA, the offeror shall provide all necessary documentation for evaluation prior to SBIR award. Failure to submit the requested documentation in a timely manner as indicated by MDA may result in the offeror's ineligibility for further consideration for award.

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 participating agencies in the SBIR or STTR program. For more information, please visit the SBA's Firm Registration Page: https://app.www.sbir.gov/company-registration/overview.

Organization Conflicts of Interest (OCI)
The basic OCI rules for Contractors that support development and oversight of SBIR topics are

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

All applicable rules under the FAR 9.5 apply.

If you, or another employee in your company, developed or assisted in the development of any SBIR requirement or topic, please be advised that your company may have an OCI. Your company could be precluded from an award under this BAA if your proposal contains anything directly relating to the development of the requirement or topic. Before submitting your proposal, please examine any potential OCI issues that may exist with your company to include subcontractors and understand that if any exist, your company may be required to submit an acceptable OCI mitigation plan prior to award.

In addition, FAR 3.101-1 states that Government business shall be conducted in a manner above reproach and, except as authorized by statute or regulation, with complete impartiality and with preferential treatment for none. The general rule is to avoid strictly any conflict of interest or even the appearance of a conflict of interest in Government-contractor relationships. An appearance of impropriety may arise where an offeror may have gained an unfair competitive advantage through its hiring of, or association with, a former Government official if there are facts indicating the former Government official, through their former Government employment, had access to non-public, competitively useful information. (See Health Net Fed. Svcs, B-401652.3; Obsidian Solutions Group, LLC, B-417134, 417134.2). The existence of an unfair competitive advantage may result in an offeror being disqualified and this restriction cannot be waived.

It is MDA policy to ensure all appropriate measures are taken to resolve OCIs arising under FAR 9.5 and unfair competitive advantages arising under FAR 3.101-1 to prevent the existence of conflicting roles that might bias a contractor's judgment and deprive MDA of objective advice or assistance, and to prevent contractors from gaining an unfair competitive advantage.

Use of Foreign Nationals (also known as Foreign Persons), Green Card Holders, and Dual Citizens
See the "Foreign Nationals" section of the DoD SBIR Program announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens, or green card holders listed will be subject to security review during the contract negotiation process (if selected for award). MDA reserves the right to vet all un-cleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed person and/or firm is found ineligible by the Government to perform proposed work, the Contracting Officer will advise the offeror of any disqualifications but is not required to disclose the underlying rationale. MDA may require offerors to address follow-up questions in order to determine eligibility.

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 SBIR topics are subject to ITAR and/or EAR. If selected for award negotiations, 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.

Ownership Eligibility

If selected for award, MDA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR program eligibility. These documents include, but may not be limited to, the Business License; Articles of Incorporation or Organization; By-Laws/Operating Agreement; Stock Certificates (Voting Stock); Board Meeting Minutes for the previous year; and a list of all board members and officers. If requested by MDA, the contractor shall provide all necessary documentation for evaluation prior to 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.

Rights in Noncommercial Technical Data and Computer Software – SBIR Program (DFARs 252.227-7018 Class Deviation 2020-O0007 Revision 1)

Use this link for full description of Data Rights:
https://www.acq.osd.mil/dpap/policy/policyvault/USA001352-23-DPC.pdf

Fraud, Waste, and Abuse

All offerors must complete the fraud, waste, and abuse training (Volume 6) that is located on the Defense SBIR/STTR Innovation Portal (DSIP) (https://www.dodsbirsttr.mil). Please follow guidance provided on DSIP to complete the required training.

To report fraud, waste, or abuse, please contact:

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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

DP2 Proposal Submission Guidelines and Requirements

Proposal Submission

The MDA SBIR 25.1 DP2 proposal submission instructions are intended to clarify the Department of Defense (DoD) instructions (https://www.dodsbirsttr.mil) as they apply to MDA requirements. This announcement is for MDA SBIR 25.1 DP2 topics only. The offeror is responsible for ensuring that DP2 proposals comply with all requirements. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

All proposals MUST be submitted online using DSIP (https://www.dodsbirsttr.mil). Any questions or technical issues pertaining to DSIP should be directed to the DoD SBIR/STTR Help Desk: DoDSBIRSupport@reisystems.com. It is recommended that potential offerors email the topic author(s) to schedule a time for topic discussion during the pre-release period.

Classified Proposals

Classified proposals ARE NOT accepted under the MDA SBIR/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 SBIR/STTR contract must use the security classification guidance provided under that contract to verify new SBIR/STTR proposals are unclassified prior to submission. 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 must be spelled out the first time they are used within the technical volume (Volume 2), the technical abstract, the anticipated benefits/potential commercial applications, and the keywords section of the proposal. This will help avoid confusion when proposals are evaluated by technical reviewers.

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). Acronyms that are not spelled out in the abstracts, anticipated benefits, and keywords will be removed.

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. In some instances, the MDA SBIR/STTR PMO may utilize the DoD

Secure Access File Exchange (SAFE) website (https://safe.apps.mil) to provide information and/or documentation to offerors.

Proposal Status

Proposing firms will be notified of selection or non-selection status for a DP2 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.

Proposal Layout

For MDA DP2 proposals, MDA has provided a template that may be used to create the technical volume, Volume 2, of the DP2 proposal. The Volume 2 template can be found here: https://www.mda.mil/global/documents/pdf/MDA%20SBIR%20phase%20II.pdf

All pages within the technical volume (Volume 2) must be numbered consecutively. Proposals may not exceed 25 pages, may not have a font size smaller than 10-point, must use a font type of Times New Roman, and must be submitted on standard 8-1/2" x 11" paper with one-inch margins. The header on each page of the Technical Volume should contain your company name, topic number, and proposal number assigned by DSIP. The header must be included in the one-inch margin.

Proposal Feedback

MDA will provide written feedback to unsuccessful offerors regarding their proposals upon request. Requests for feedback must be submitted in writing to the MDA SBIR/STTR PMO within 30 calendar days of non-selection notification. Non-selection notifications will provide instructions for requesting proposal feedback. Only firms that receive a non-selection notification are eligible for written feedback.

Technical and Business Assistance (TABA)

The SBIR/STTR Policy Directive allows agencies to enter into agreements with suppliers to provide technical assistance to SBIR/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 databases.

All requests for TABA must be completed using the MDA SBIR/STTR Phase II TABA Form (https://www.mda.mil/global/documents/pdf/SBIR_STTR_PHII_TABA_Form.pdf) and must be included as a part of Volume 5 of the proposal package using the "Other" category. MDA WILL NOT accept requests for TABA that do not utilize the MDA SBIR/STTR Phase II TABA Form or are not uploaded using the DSIP "Other" category as part of Volume 5 of the Phase II proposal package.

An SBIR/STTR firm may acquire the technical assistance services described above on its own. Firms must request this authority from MDA and demonstrate in its SBIR/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 $10,000. This will be an allowable cost on the SBIR/STTR award. The amount will be in addition to the award and is not subject to any burden, profit or fee by the offeror. The amount is based on the original contract period of

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performance and does not apply to period of performance extensions and/or enhancements. Requests for TABA funding outside of the base Phase II period of performance (24 months) will not be considered.

The purpose of this technical assistance is to assist SBIR/STTR awardees in:
1. Making better technical decisions on SBIR/STTR projects;
2. Solving technical problems that arise during SBIR/STTR projects;
3. Minimizing technical risks associated with SBIR/STTR projects; and
4. Developing and commercializing new commercial products and processes resulting from such projects including intellectual property protections.

SBIR/STTR Proposal Funding

All MDA SBIR/STTR contracts are funded with 6.2/6.3 funding which is defined as:

1. Applied Research (6.2), Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.

2. Advanced Technology Development (6.3), Includes all efforts that have moved into the development and integration of hardware for field experiments and tests.

As stated in Section VI "CLAUSE H-08 PUBLIC RELEASE OF INFORMATION", MDA requires prior review and approval before public release of any information arising from STTR-sponsored research. As such, MDA does not consider STTR-sponsored research as fundamental research.

Protests Procedures

Refer to the DoD Program Announcement 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.

Proposal Submission Requirements and Proposal Format

Proposals submitted to an MDA SBIR DP2 topic must provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of the topic has been met and describes the potential commercial applications. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the proposal must have been substantially performed by the offeror and/or the Principal Investigator (PI).

A complete DP2 proposal consists of the following volumes:

- Volume 1: Proposal Cover Sheet
- Volume 2: Technical Volume **(25 page maximum)**
- Volume 3: Cost Volume
- Volume 4: Company Commercialization Report
- Volume 5: Supporting Documents
    - Quality Management Questionnaire (**required – use "other" upload category**),
    - Letters of Support (**optional – use "Letter of Support" category**),
    - MDA Phase II TABA Form (**optional – use "other" upload category**).
- Volume 6: Fraud, Waste, and Abuse Certification
- Volume 7: Disclosures of Foreign Affiliations or Relationships to Foreign Countries

VERSION 4

Volume 1 – Proposal Coversheet (Required)

- A coversheet will be automatically generated by DSIP and placed at the beginning of your PDF proposal package document.

Volume 2 – Technical Volume (Required – 25 page maximum)

- Use of the MDA provided DP2 template is recommended. The template can be obtained at the following URL: https://www.mda.mil/global/documents/pdf/MDA%20SBIR%20phase%20II.pdf . The technical volume should include the following 11 sections:

(1) **Executive Summary.**
Provide a summary of the key objectives that will be accomplished in the DP2 effort.

(2) **Phase I Proof of Feasibility.**
The offeror must describe work performed that substantiates Phase I feasibility as described in the topic.

Proposers interested in participating in DP2 must include Phase I feasibility documentation that substantiates the scientific and technical merit and ensure that the Phase I feasibility described in the topic has been met and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above in previous work or research completed. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the PI. Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.

(3) **Description of Proposed DP2 Technical Effort and Objectives.**
Define the specific technical problem or opportunity addressed and its importance.

(4) **Phase II Technical Objective and Statement of Work**.
Enumerate the specific objectives of the Phase II work, and describe the technical approach and methods to be used in meeting these objectives. The statement of work should provide an explicit, detailed description of the Phase II approach, indicate what is planned, how and where the work will be carried out, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.

(5) **Related Work.**
Describe significant activities directly related or similar to the proposed effort, including any conducted by the PI, the proposing firm, consultants, or stakeholders. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must accentuate its state-of-the-art technology and how it relates to the topic to capture the Government’s interest for further development. In addition, please indicate whether your firm has performed on a classified government contract in the past as either a prime or subcontractor.

(6) **Relationship with Future Research or Research and Development.**

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State the anticipated results if the project is successful. Discuss the significance of the Phase II effort in providing a foundation for Phase III research and development or commercialization.

(7) **Key Personnel.**
Identify at least two key personnel who will be involved in the Phase II effort including information on directly related education and experience. A concise resume of the PI that includes a list of relevant publications (if any) authored by the PI, must be submitted. All resumes count toward the page limitation in the technical volume.

a) **Foreign Persons**: ALL offerors proposing to use foreign persons, 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 an SBIR/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 a 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 is found ineligible by the government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

(8) **Facilities/Equipment**
Describe the equipment and physical facilities necessary to carry out the Phase II effort. Items of equipment to be purchased (as detailed in the cost proposal) shall be justified under this section. Also, certify that the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local governments (name) 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.

(9) **Subcontractors/Consultants**.
Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be described in detail and identified in the Cost Volume. A minimum of one-half of the research and/or analytical work in Phase II, as measured by direct and indirect costs, must be carried out by the offeror, unless otherwise approved in writing by the Contracting Officer.

(10) **Prior, Current or Pending Support of Similar Proposals or Awards.**

While it is permissible to submit identical proposals or proposals containing a significant amount of essentially equivalent work for consideration under numerous federal program solicitations or Broad Agency Announcements (BAA), it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning prior, current, or pending support of similar proposals or awards, it must be disclosed to the soliciting agency or agencies as early as possible.

(11) **Commercialization Strategy**

The Commercialization Strategy must address the following questions:

a) What is the first product that this technology will go into (identify the components of the MDS and areas within the commercial marketplace where you can transition this technology)?
b) Who will be your customers, and what is your estimate of the market size?
c) How much funding will you need to bring the technology to market, how will you acquire the necessary funds, and how do you expect to integrate this technology into the MDS?
d) Does your company have marketing expertise? If yes, please elaborate. If not, how do you intend to bring that expertise into the company?
e) Who are your competitors, and what makes you more competitive with your technology?

The commercialization strategy must also include a schedule showing the quantitative commercialization results from the Phase II project at one year after the start of Phase II, at the completion of Phase II, and after the completion of Phase II (i.e., amount of additional investment, sales revenue, etc.). After Phase II award, the company is required to report actual sales and investment data in its Company Commercialization Report at least annually.

Volume 3 – Cost Volume (Required)

Complete the on-line cost proposal in DSIP. Your cost volume may not exceed $2,000,000 (or $2,010,000 if TABA is included – use of the MDA Phase II TABA form is required if applying for TABA). Proposals whose cost volumes exceed $2,000,000 (or $2,010,000 if TABA is included) will not be evaluated or considered for award. The Phase II Period of Performance is generally 24 months. MDA will not accept any deviation to the percentage of work requirements.

Volume 4 – Company Commercialization Report (CCR) (Required)

The CCR allows companies to report funding outcomes resulting from prior SBIR and STTR awards. The CCR is required for DP2 proposals. The information contained in the CCR will not be considered by MDA during proposal evaluations.

Small businesses must complete the CCR by logging into their account at https://www.sbir.gov. Please refer to the "Instructions" and "Guide" documents contained in the DSIP Dashboard for more detail on completing and updating the CCR.

Once the CCR is certified and submitted on SBIR.gov, it must be uploaded to Volume 4: Company Commercialization Report in the Firm Information section of DSIP by the Firm Admin.

Volume 5 – Supporting Documents

MDA will accept the following documents under Volume 5:

1. Quality Management Questionnaire (**Required** – use "other" upload category)
2. TABA Request (Optional – use "other" upload category)

3. Letter of Support (Optional – use "Letter of Support" upload category)

   If including a request for TABA, the MDA Phase II 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 "Letter 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.

   Note that letters of support from any MDA officials or references to such letters in a proposal WILL NOT be accepted and may result in the rejection of the proposal.

Any additional documentation included as part of Volume 5 WILL NOT be considered.

Volume 6 – Fraud, Waste, and Abuse Certification (Required)
All offerors must complete the fraud, waste, and abuse training that is located on DSIP.

Volume 7 – Disclosures of Foreign Affiliations or Relationships to Foreign Countries
Small business concerns must complete the Disclosures of Foreign Affiliations or Relationships to Foreign Countries webform in Volume 7 of the DSIP proposal submission. Please be aware that the Disclosures of Foreign Affiliations or Relationships to Foreign Countries WILL NOT be accepted as a PDF Supporting Document in Volume 5 of the DSIP proposal submission. Do not upload any previous versions of this form to Volume 5. For additional details, please refer to the DoD SBIR Program BAA.

References to Hardware, Computer Software, or Technical Data
In accordance with the SBIR/STTR Policy Directive, SBIR contracts are to conduct feasibility-related experimental or theoretical Research/Research & Development (R/R&D). Phase II is not for formal end-item contract delivery or ownership by the Government of the contractor's hardware, computer software, or technical data.

The SBIR/STTR Policy Directive states that Agencies may issue Phase II awards for testing and evaluation of products, services, or technologies for use in technical or weapons systems.

As a result, the technical proposal should not use the term "Deliverables" when referring to your hardware, computer software, or technical data. Instead use the term: "Products for Testing, Evaluation, and/or Demonstration (possibly destruction)."

The standard formal deliverables for a Phase II are the:
(a) Report of Invention and Disclosure
(b) Contract Summary Report: Final Report
(c) Certificate of Compliance: SBIR_STTR Life-Cycle Certification
(d) Status Report: Quarterly Status Reports
(e) Computer Software Product: Product Description (if applicable, for Government Testing, Evaluation, and/or Demonstration ONLY)
(f) Technical Report - Study Services: Prototype Design and Operation Document
(g) Contract Summary Report: Phase III Plan

(h) Final Summary Chart: SBIR/STTR Transition Summary Chart
(i) Government Property Inventory Report: Government Furnished Property (GFP) and Contractor Acquired Property (CAP) Listing

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.

MDA Proposal Evaluations and Selection
MDA will evaluate DP2 proposals using scientific review criteria based upon technical merit and other criteria as discussed in this document. MDA reserves the right to award none, one, or more than one contract under any topic. MDA is not responsible for any money expended by the offeror before award of any contract.

DP2 proposals will be evaluated based on the criteria outlined below, including potential benefit to the MDS. Selections will be based on best value to the Government considering the following factors:

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

Please note that potential benefit to the MDS will be considered throughout all the evaluation criteria and in the best value trade-off analysis. When combined, the stated evaluation criteria are significantly more important than cost or price.

It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Technical reviewers will base their conclusions on information contained in the proposal. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be contained in Volume 2 and will count toward the applicable page limit. Qualified letters of support and/or requests for TABA, if included, MUST be uploaded as part of Volume 5 and will not count towards the Volume 2-page limit. Letters of support shall not be contingent upon award of a subcontract.

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 reference https://www.dcaa.mil/Portals/88/AccountingSystemRequirementsPreAwards_1.pdf for more information on obtaining a DCAA approved accounting system.

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.

VERSION 4

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.

VERSION 4

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."

VERSION 4

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 SBIR 25.1 Topic Index

MDA251-D001	Environment Effects on UV/VIS/IR Observables of Hypersonic Configurations Under Non-Traditional Viewing Conditions
MDA251-D002	Innovative Space-based Multicolor Sensors
MDA251-D003	High-efficiency, High-Performance Cross Domain Solution (CDS) for Unattended Applications
MDA251-D004	Passive Autonomous Vulnerability Screening of Systems Outside the Accreditation Boundary
MDA251-D005	Low Cost Divert and Attitude Control System
MDA251-D006	Scramjet Propulsion Technologies
MDA251-D007	Battle Management / Command and Control (BM/C2)
MDA251-D008	Novel Engagement
MDA251-D009	Modularized, Rapidly Reconfigurable Solid Propellant-based Launch System
MDA251-D010	Containerized Launching Platform

MDA251-D001 TITLE: Environment Effects on UV/VIS/IR Observables of Hypersonic Configurations Under Non-Traditional Viewing Conditions

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy; Hypersonics; Advanced Infrastructure & Advanced Manufacturing

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

OBJECTIVE: Develop an innovative model of low- and high-altitude atmospheric effects on the ultraviolet (UV), visible (Vis), and infrared (IR) observables of hypersonic configurations that includes, but is not limited to, non-local thermodynamic equilibrium (NLTE) effects to support the detection of dim, fast-moving targets by observing assets employing unconventional viewing geometries.

DESCRIPTION: In order to exploit more observable properties of hypersonic configurations, a separate topic is proposed to undertake the task of expanding relevant predictive tools into the ultraviolet (UV) and visible (Vis) regimes of the electromagnetic spectrum. However, these observables and their contrast against various backgrounds (i.e., black space, earth limb, terrain, sea, clouds) are modified by atmospheric effects when being viewed by observing assets. In addition, challenging viewing conditions for a number of missile defense missions are driving needs for novel sensing solutions such as constellations of remote sensing satellites [1] or limb-viewing un-crewed aerial vehicles. Among the most pressing needs is the enhanced detection and tracking of dim targets such as hypersonic cruise missiles viewed against an Earth background. The already small target signal can be obscured by a varied and cluttered natural environment which will include, but is not limited to, the effects of atmospheric attenuation, non-local thermodynamic equilibrium (NLTE) earth limb radiation, aurora, and cloud background effects. Further complications arise when utilizing off-nadir and limb viewing geometries resulting in: significantly greater impacts from refraction, non-uniform ground surface distances on the focal plane, and the significant increase in dynamic range due to the Earth background.

To provide the desired capability, a high-fidelity atmospheric effects model is needed--one that includes, but is not limited to: the radiation transport solution between the sensor and the observed scene, the ability to model background environments at infrared-through-ultraviolet wavelengths, broken cloud fields, significant refractive effects at long ranges, and NLTE effects. Additionally, the solution must be traceable to current standard codes such as the Standardized All-Altitude Modulation Model (SAMM) [2] and the Standardized Atmosphere Generator (SAG) [3]. The model should enable the prediction of observed target contrast signatures for sensor systems and is expected to be used with scene generation tools such as the Fast Line-of-sight Imagery for Target and Exhaust-plume Signatures (FLITES) [4] code.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer’s development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives.

Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

(i.e., the small business must have performed a proof of concept like "Phase I" component and/or other validation in a relevant environment, and/or at a much higher TRL level (5 or higher) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology in previous work or research completed.)
IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Develop and deliver the next-generation environment effects model with improved prototype atmospheric radiation transport capability based on current standard models such as SAMM and the proof of concept demonstrated by the Phase I evidence. As part of the Phase II effort, the small business should identify measured data which can be used to establish evidence of validation of the Phase II models under DoD-relevant conditions. In addition, the integration of the Phase II prototype software within the stakeholders' current simulation process, such as those using the Joint Navy-Army-NASA-Air Force (JANNAF) Exhaust Plume and Signature Subcommittee (EPSS) signature prediction suite [5], should be demonstrated for relevant missile defense scenarios of interest to the Missile Defense Agency. The prototype software should also demonstrate the capability to integrate with relevant scene generators such as FLITES. All software developed under this effort, including executable and source code, as well as associated databases, makefiles, and example case input/output files should be delivered during the course of contract performance to enable the Government to test the resulting prototype. The corresponding final software products and technical/user manuals should also be delivered to the Government.

PHASE III DUAL USE APPLICATIONS: There are a number of government and private organizations that rely on ultraviolet, visible, and infrared atmospheric radiation and transmission models and simulations for defense purposes as well as non-defense, commercial remote sensing applications. Work performed under this effort will yield a modeling capability for high-fidelity defense and commercial applications requiring atmospheric characterization and forecasting, atmospheric correction, and remote sensing.

REFERENCES:

1. Michael Luu and Daniel E. Hastings, "Review of On-Orbit Servicing Considerations for Low-Earth Orbit Constellations," AIAA ASCEND 2021, paper AIAA 2021-4207; doi: 10.2514/6.2021-4207
2. Hoang Dothe, James W. Duff, John H. Gruninger, Prabhat K. Acharya, Alexander Berk, and James H. Brown, "Users' Manual for SAMM®2, SHARC-4 and MODTRAN□4 MERGED," AFRL-VS-HA-TR-2004-1001 (2004).
3. Raphael Panfili, Hoang Dothe, John Gruninger, and James Duff, "Characterizing temperature and water vapor of the environment using the standardized atmosphere generator (SAG) empirical model," Imaging Spectrometry XXII: Applications, Sensors, and Processing, SPIE 10768, 107680K (2018); doi: 10.1117/12.2321712
4. Crow, D., C. Coker, and W. Keen, "Fast Line-of-sight Imagery for Target and Exhaust-plume Signatures (FLITES) Scene Generation Program," Proc. SPIE 6208, 62080J (2006);   5. Vaughn,

M. E., Jr, "The JANNAF Initiative: Plume/Wake/Hypersonic Flowfield and Hardbody Signature Prediction Capabilities for the Near Term," 39th JANNAF Exhaust Plume and Signatures Subcommittee Meeting, (2022).

KEYWORDS: Atmospheric effects; backgrounds; contrast signature; remote sensing; non-Local Thermodynamic Equilibrium; non-LTE; infrared; visible; ultraviolet; simulation environments; SAG; SAMM; JANNAF; FLITES

MDA251-D002 TITLE: Innovative Space-based Multicolor Sensors

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Microelectronics; 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: Demonstrate innovative space-based sensing technology for detection and tracking of detection of dim, high speed maneuvering targets.

DESCRIPTION: Detection of small and dim, high speed maneuvering targets, such as hypersonic vehicles by space based EO/IR sensors is challenging because these targets may appear dim and small in infrared images. The analyses show these targets could appear to be one order of magnitude dimmer than the usual targets. Lowering sensors' altitude helps, but decreases the associated signal-to-clutter ratios. This topic seeks an innovative, space-based, multi-color with optimized configuration including IR/UV sensing solution to detect and track dim and small, fast maneuvering targets. Recent studies show multispectral IR and UV sensing provides a more robust detection mechanism than using IR alone, as hypersonic vehicles emit in UV where there is little solar background, making UV sensing technologies more feasible at various angles and times of the day, which might be an issue with IR. Using UV spectral from the shock layer of near-space flight trajectories in the "solar blind" band region offers a much better contrast.

The proposers will identify the optimized sensing configuration, and the proposed physical EO/IR sensor suite should be compatible with the existing sensor platforms with minimum performance degradation in a space environment (proton, electron, and heavy ion fluxes etc.)

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

(i.e., the small business must have performed a proof of concept like "Phase I" component and/or other validation in a relevant environment, and/or at a much higher TRL level (5 or higher) and describe the

potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology in previous work or research completed.)
IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Define a viable multicolor sensing approach that could maximize the capability of detection and tracking of small and dim, high-speed maneuvering targets with optimal spectral wavebands for space-based spectral detection. Design, develop and test the prototype of innovative Space based Multicolor Sensors based on spectral radiation and transmission mechanisms of near-space hypersonic vehicles of low-signal characteristics, with minimum performance degradation in a space environment.

PHASE III DUAL USE APPLICATIONS: Complete the sensor technology development, perform required testing, integrate and transition the final solution to the space-based sensors systems. Mature and transition this multicolor sensing technology to EO/IR sensor foundries for commercial remote sensing applications.

REFERENCES:

1. F. Lesage, R. Stowe, R. Lestage, P. Harris, R. Farinaccio, N. Hamel, N., and R. Pimentel,“Development of hypersonic technologies for long-range precision strike,” Defence R&DCanada –Valcartier, Technical Report, TR 2011-004, August 2013.
2. K. Thoma, U. Hornemann, M. Sauer, and E. Schneider, “Shock waves—henomenology,experimental, and numerical simulation,” Meteoritics & Planetary Science, vol. 40, no. 9–0,pp. 1283–296, 2005
3. E. Oron, Y. Bar-Shalom, and M. Lachish, “Advanced IR imaging and tracking for hypersonicintercept,” in 1997 IEEE Aerospace Conference, vol. 1: IEEE, pp. 139–48, 1997.

KEYWORDS: space sensing, UV sensor, IR detector, small dim target detection

MDA251-D003 TITLE: High-efficiency, High-Performance Cross Domain Solution (CDS) for Unattended Applications

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

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OBJECTIVE: Integrate State of the Art technologies to achieve a new benchmark for Cross Domain Solution performance, efficiency, and security suitable for unattended applications.

DESCRIPTION: The Missile Defense Agency (MDA) seeks novel designs for cross-domain solutions usable for a variety of environments including space which are simultaneously capable of high performance, high efficiency, and high security. High performance is defined as achieving 100 Gb per second throughput. High efficiency entails minimizing size, weight, power, and ensuring that the critical metric remains below 12 watts (<12 watts) at maximum throughput. High security means it must self-protect by maintaining integrity and confidentiality given an adversary has physical access resulting from a foreign military sale.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer’s development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

(i.e., the small business must have performed a proof of concept like “Phase I” component and/or other validation in a relevant environment, and/or at a much higher TRL level (5 or higher) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology in previous work or research completed.)
IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Proposals would be evaluated to the degree that they deliver a complete integrated solution that demonstrates performance, efficiency, and functionality in a variety of environments. The vendor solution would be subject to laboratory assessment using a standard rule format but arbitrary rule set for function and performance. Additionally, the vendor solution will be subject to laboratory assessment to determine the degree to which the system defends against reverse engineering, cyber-attacks, and physical attacks. The solution must be compliant with Current National Security Agency (NSA) guidelines regarding Cross Domain Solutions including the NSA's Raise the Bar – Level 5. The solution must be compliant with current DoD Anti-Tamper Technical Implementation Guidance and the Air Force's Open Mission Systems Anti-Tamper Interface Control Document. The solution must be suitable for export under the Foreign Assistance Act and Arms Export Control Act.

PHASE III DUAL USE APPLICATIONS: Successful demonstration of the technology open the vendor to government, International exports, and commercial markets for Cross Domain Solutions, data diodes, and communications for Military, space, and financial sectors for example.

REFERENCES:

1. https://www.nsa.gov/Cybersecurity/Partnership/National-Cross-Domain-Strategy-Management-Office
2. International Traffic in Arms Regulations (ITAR) (22 C.F.R. Part 120-Part 130)

KEYWORDS: CDS; NSA; Export; Tamper

MDA251-D004 TITLE: Passive Autonomous Vulnerability Screening of Systems Outside the Accreditation Boundary

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Integrated Sensing and Cyber; Emerging Threat Reduction; Microelectronics; 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: Create autonomous tools to passively screen for vulnerabilities on systems outside the Missile Defense Agency's (MDA's) accreditation boundary.

DESCRIPTION: The Missile Defense Agency (MDA) has a need to identify externally reachable vulnerabilities in software that is of interest to the military and associated mission sets. Similarly, the MDA needs to illuminate potential externally facing vulnerabilities that are observable through passive cyber reconnaissance techniques within its own networks. Current techniques to address these needs are time-consuming, non-comprehensive, and have limited visibility. A possible alternative approach is through the intersection of automated software fuzzing and code identification with external, automated, passive cyber risk sensing on a global scale. This integration of software fuzzing and risk sensing introduces automation to reduce manual cycles, leverages global-scale datasets to enhance visibility, and generate comprehensive software bill of materials to increase application coverage.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

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IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted

within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Vendors are expected to demonstrate automated passive cyber reconnaissance tools remotely on one or more third party networks outside of MDA's accreditation boundary. Metrics for success are: reach (degree of access to third parties outside of MDA's accreditation boundary), degree of automation, comprehensiveness (effectiveness across vulnerability types), reliability (false positives/false negatives), non-attribution (degree of passivity), and usability (degree to which tools can be operated by humans and incorporated into existing ecosystems.

PHASE III DUAL USE APPLICATIONS: The same needs of MDA are prevalent across the DoD and Commercial Enterprise sector.

REFERENCES:
1. Mission Assurance Cyber Tools (JFAC.apps.dos.mil/tools)
2. Common Vulnerability Enumeration Data Base (CVE.Mitre.org)

KEYWORDS: Autonomous; Autonomy; Vulnerability; Vulnerabilities; Accreditation

MDA251-D005 TITLE: Low Cost Divert and Attitude Control System

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 affordable divert and attitude control system technologies.

DESCRIPTION: Divert and attitude control systems (DACS) utilize rockets to control a vehicle's path and orientation. Recent advances in manufacturing processes could reduce the cost of DACS utilizing moderate chamber pressures and combustion temperatures. This topic seeks technologies to minimize the cost of DACS with a target system cost of less than $100,000 per DACS using 1.3 hazard class propellants. Proposed solutions may be individual components for DACS, but must show awareness of entire DACS system. DACS must have 10:1 ratio of divert thrust to weight of DACS. Solutions must allow 20 year shelf life, for simple transportation, and logistics, and maintain a constant ready status.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

(i.e., the small business must have performed a proof of concept like "Phase I" component and/or other validation in a relevant environment, and/or at a much higher TRL level (5 or higher) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology in previous work or research completed.)
IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Conduct DACS system level trades to identify requirements of components. Demonstrate performance of DACS and/or components in relevant environment. Proposers must demonstrate scalability of the proposed manufacturing process to achieve cost requirements at high production rates and survivability of the components in a relevant environments.

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PHASE III DUAL USE APPLICATIONS: Produce a DACS by processes which minimize cost when scaled to full production rate, and test the developed system in a simulated environment.

REFERENCES:

1. G. Sutton, Rocket Propulsion Elements, Danvers, Maine: John Wiley & Sons, 2017.
2. K. Wooten, Additive Manufacturing of Silicon Carbide (SiC) Ceramic Rocket Nozzles, Monterey, California: Naval Postgratuate School, 2020.

KEYWORDS: Hypersonics, Propulsion

MDA251-D006 TITLE: Scramjet Propulsion Technologies

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

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: Advance scramjet propulsion technologies to extend the range of propulsion systems for the missile defense system.

DESCRIPTION: MDA is interested in increasing the time, range, and defeat opportunities of future missile systems by replacing the traditional upper stage with scramjet technology. The goals of this topic are to identify the engagement advantage of using scramjets as interceptor upper stages and advance technologies to improve scramjet performance.

Scramjet advantages to study include potentially longer loiter system for earlier engagements, more maneuverability through mid-course, and enabling other defeat opportunities.

Technologies should improve scramjet performance through increased maneuverability, maximization of operational envelope (including low and high altitudes and low and high velocities), minimization of mass and volume, and maximization of total impulse. Specific technologies to advance include (but are not limited to) 1) Higher endothermic capacity synthetic fuels to enhance scramjet heat exchange capability and reduce coking onset; 2) storage solutions that enable use of hydrogen fuel, 3) More robust, less expensive ignition systems; and 4) Scramjet measurement/diagnostics sensors readily applicable to ground and flight test; 5) Advanced high-temperature, hypersonic-capable materials for use in solid-state fabrication of inlet and fluid dynamics components for scramjet applications; 6) Near/net-shape inlet and fluid dynamic components for scramjet applications; and 7) Cost effective thermal barrier coating processes and/or materials for internal flow paths. All solutions must assume 20 year shelf life with fully loaded interceptor and simplified deployment logistics consistent with military munitions.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

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IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Efforts must include system-level trade studies and intercept engagement analysis utilizing scramjet as an upper stage. Compare performance with a throttling rocket motor upper stage. Intercept engagement studies do not need to include endgame. Discuss assumptions with government representatives. Utilize system level trades to inform technology and component requirements.
Develop and demonstrate new technologies to improve scramjet performance. Proposals should identify one or more technologies to advance. Conduct testing of the technology(ies) in relevant environment, and implement changes as necessary.

PHASE III DUAL USE APPLICATIONS: Partner with a system integrator to determine relevant design sizes and to demonstrate the technologies developed in phase II in a representative environment.

REFERENCES:
1. A. Kumar, Numerical Simulation of Scramjet Inlet Flow Fields, NASA, 1986.
2. P. J. Drummond, M. Bouchez and C. R. McClinton, Overview of NATO Background on Scramjet Technology, Langley Research Center, 2006.

KEYWORDS: Propulsion; Hypersonics

MDA251-D007 TITLE: Battle Management / Command and Control (BM/C2)

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

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OBJECTIVE: Deliver new technologies, software, and or systems sufficiently mature to be tested in a Battle Management / Command and Control (BM/C2) environment to assess the improvement in performance obtained over current Battle Management / Command and Control systems.

DESCRIPTION: This Direct to Phase II topic will examine the LEFT OF LAUNCH THROUGH POST ENGAGEMENT ASSESSMENT segments of the battlespace. Proposed concepts will build upon and incorporate prior foundational knowledge and technologies for the MID-COURSE & TERMINAL segments of the missile defense problem set. Solutions will consider any available pre-launch Indications and Warnings (I&W), Signals Intelligence (SIGINT), Imagery Intelligence (IMINT), and other information sources, for the purpose of identifying and delivering new technologies, software, and or systems sufficiently mature to be tested in a Battle Management / Command and Control (BM/C2) environment.

Testing of deliverables will be conducted in a laboratory environment to measure and evaluate the improvement in performance obtained over current BM/C2 systems. Testing will include Post Intercept Assessment (PIA) evaluations of intercepted target complex objects in addition to assessing the implementation and effectiveness of Left Through Right Integration (LTRI) technologies and LTRI Concepts of Operation (CONOPS). Successful offerors may be required to obtain a Facility Clearance Level (FCL), have classified storage capability, and the ability to produce, process, store, and securely transmit and receive classified information.

MDA is interested in next generation Battle Management and Command and Control (BM/C2) technologies and techniques that expand the battlespace further left of launch through post-engagement assessment using any available I&W, SIGINT, IMINT or sensing measurement and track data to build probability likelihood maps for missile launches based on available (or unavailable) feature sets. The proposals submitted should support the missile defense mission and have the ability to support the larger Integrated Air and Missile Defense (IAMD) mission. Key attributes are distributed, survivable, intelligent BM/C2. Specific technologies include (but are not limited to):
a. Cloud enabled, edge deployable, scalable, distributed BM/C2 architecture technologies
b. Advanced, multi-domain data processing including machine-to-machine processing
c. BM/C2 digital assistants that partner with humans to execution missions including autonomy/semi-autonomy and Artificial Intelligence/Machine Learning (AI/ML) technologies
d. AI decision aids that highlight the enemy kill-chain and identifies Courses of Action (COAs) to affect critical steps in the process

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

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(i.e., the small business must have performed a proof of concept like "Phase I" component and/or other validation in a relevant environment, and/or at a much higher TRL level (5 or higher) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology in previous work or research completed.)
IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Deliver new technologies, software, and/or systems sufficiently mature to be tested in a Battle Management / Command and Control (BM/C2) laboratory environment to assess the improvement in performance obtained over current Battle Management / Command and Control systems.

PHASE III DUAL USE APPLICATIONS: The Phase III activity would be to transition the laboratory environment tested technologies to an operational BM/C2 environment to further assess the improvement in operational performance as well as the compatibility with currently deployed BM/C2 systems.

REFERENCES:

1. Battle Management/Command and Control, and Communications (BM/C3), Environmental Assessment https://apps.dtic.mil/sti/citations/ADA213942
2. Battle Management: DOD and Air Force Continue to Define Joint Command and Control Efforts https://www.gao.gov/products/gao-23-105495
3. Command and Control, Battle Management, and Communications (C2BMC) https://missilethreat.csis.org/defsys/c2bmc

KEYWORDS: Battle Management; Command and Control; Kinetic and Non-Kinetic; Directed Energy; Artificial Intelligence

MDA251-D008 TITLE: Novel Engagement

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

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OBJECTIVE: Develop technologies to add additional effectors and a delivery mechanism to support the MDA mission.

DESCRIPTION: The Missile Defense Agency (MDA) is seeking new and innovative concepts for effectors, decoys, countermeasures and a delivery system to quickly fill a battlespace for missile defense, self-protection, deception, and other MDA and partner mission areas. These solutions should support ground, air, sea, and space domains or any combination of these areas. The effectors should operate with minimal external inputs. The delivery system should be able to move regular and irregular shapes, provide a variable aim point, options for on-board and/or external queuing, and have a mechanism for choice of effector to be used. MDA is looking to reduce the reliance on High Explosives (HE) for the initial "boost" of these effectors, and is looking for novel and more sustainable mechanisms that are more sustainable and require little to no logistical support. Proposals should address the time necessary for setup, movement, shutdown, and all relevant specifications for defining the mobility of the system.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

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IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Define the mechanism and affect of the effectors on the enemy kill-chain. Define the delivery system performance and the attributes necessary for the effector packaging. Design, develop, and test the effectors and delivery system.

PHASE III DUAL USE APPLICATIONS: Complete the system level development, perform required testing, and transition and integrate into a Program of Record.

REFERENCES:
1. https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF
2. https://media.defense.gov/2022/Oct/27/2003103921/-1/-1/1/MISSILE-DEFENSE-REVIEW-MDR-FACTSHEET.PDF

KEYWORDS: electronic attack, decoy, deception, countermeasure, delivery system, effector, point defense, area defense

MDA251-D009 TITLE: Modularized, Rapidly Reconfigurable Solid Propellant-based Launch System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Advanced Infrastructure & Advanced Manufacturing; 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 and/or mature a modularized, solid propellant-based, reconfigurable launch system utilizing Additive Manufacturing (AM) techniques to enable design flexibility and reduce overall cost [1].

DESCRIPTION: The Missile Defense Agency (MDA) Targets and Countermeasures (T&C) Directorate designs, develops and provides missile targets to test US missile defenses and support agency strategic goals [2]. A highly-modularized, reconfigurable, solid propellant-based launch system is desired by MDA to allow for rapid and affordable acquisition of flight vehicles that support configuration flexibility with the desire to minimize recurring engineering and allow rapid response to evolving threats.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

(i.e., the small business must have performed a proof of concept like "Phase I" component and/or other validation in a relevant environment, and/or at a much higher TRL level (5 or higher) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology in previous work or research completed.)
IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Complete a detailed prototype system design incorporating additive manufacturing techniques and modular components. Incorporate modeling and simulation and/or relevant ground testing as needed to validate the ability of the designed launch system prototype to survive and deliver a notional hypersonic vehicle to representative flight environments. Demonstrate the system's ability to be reconfigurable to support multiple flight vehicle classes (i.e. short, medium, intermediate, and long range systems).

Proposers must be a small business with a demonstrated track record of participating in commercial launch vehicle operations. Proposers should not propose a solution that is exclusive to MDA nor one that requires ongoing MDA outlays for maintenance and overhead costs. MDA prefers proposals that demonstrate their solution meets the needs of other DOD stakeholders. MDA highly prefers modularized, containerized, and easily-transportable solutions that can be used at a variety of launch sites. MDA encourages teaming arrangements that include commercial launch service providers.

PHASE III DUAL USE APPLICATIONS: Scale-up the capability from the prototype utilizing the new technologies developed in Phase II into a full-scale launch system. Demonstrate the capability via flight testing. Work with missile defense integrators to integrate the technology into a missile defense system level test-bed and test in a relevant environment.

REFERENCES:
1. Office of the Deputy Director for Strategic Technology Protection and Exploitation, Joint Defense Manufacturing Council, “Department of Defense Additive Manufacturing Strategy,” Jan. 2021. Available: https://www.cto.mil/wp-content/uploads/2021/01/dod-additive-manufacturing-strategy.pdf
2. [2] Missile Defense Agency, “MDA Strategic Goals”. Available: https://www.mda.mil/about/mission.html

KEYWORDS: test, hypersonic, targets, launch

MDA251-D010 TITLE: Containerized Launching Platform

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): 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 a self-contained launcher in a ("Container, Express") CONEX or military shipping container.

DESCRIPTION: Develop a Launching Station (LS) within the form factor of a CONEX. The concept will allow THAAD (TH), or any other DoD program, to strategically deploy a LS in a concealed manner. Instead of being tied to the traditional form/deployment of a LS that is easily identified by our adversaries, the CONEX concept will allow for the US Military to deploy into locations away from the traditional footprint.

The CONEX must be self-contained and self-sustaining for a period of time no less than 30 days with host considerations for environmental conditions required for the onboard effector inventory. The CONEX would have the ability to power itself and communicate to Fire Control via current terrestrial interfaces, Starshield (Space Transport Layer) and have the ability to be integrated into the Integrated Battle Command System (IBCS)/Command and Control, Battle Management, and Communications (C2BMC)/THAAD Fire Control and Communications (TFCC). The CONEX will be designed in a manner modular and internally configurable that will allow for any current or future DoD missiles that fit within the form factor to be deployed within the CONEX. A typical concept of operation of this launch system would be placement, and initialization to mission ready in 30 minutes or less on an unimproved site.

PHASE I: Phase I-like proposals will not be evaluated and will be rejected as nonresponsive. For this topic, the Government expects the small business would have accomplished the following in a Phase I-like effort via some other means, e.g., independent research and development (IRAD) or other source, a concept for a workable prototype or design to address, at a minimum, the basic capabilities of the stated objective above. Proposal must show, as appropriate, a demonstrated technical feasibility or nascent capability. The documentation provided must substantiate the proposer's development of a preliminary understanding of the technology to be applied in their Phase II proposal in meeting topic objectives. Documentation should comprise all relevant information including, but not limited to, technical reports, test data, prototype designs/models, and performance goals/results. Feasibility = maturity and what have you already done/validated.

Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met.

(i.e., the small business must have performed a proof of concept like "Phase I" component and/or other validation in a relevant environment, and/or at a much higher TRL level (5 or higher) and describe the

potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology in previous work or research completed.)
IRAD work: Documentation should include the most relevant information including, but not limited to: technical reports, test data, prototype designs/models, and/or performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI).

PHASE II: Develop an accurate and effective design for the manufacturing of a TH LS in a CONEX. The design and mechanical models need to be of sufficient fidelity to show the feasibility of a self-contained LS. The LS must be able to provide power for no less than 7 days of operation through a launch of all interceptors in the LS. The LS must be able to have the ability to cool any internal electronics necessary for LS operation. The LS must be able to communicate via space and terrestrial communication networks.

PHASE III DUAL USE APPLICATIONS: This concept has the potential for applicability to other LS types (i.e. other than TH). The concept could also be developed for application to other Missile Defense System (MDS) programs.

REFERENCES:

1. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjw7p_rzfWGAxVBEFkFHZubCjoQFnoECB8QAQ&url=https%3A%2F%2Fwww.avmc.army.mil%2FPortals%2F51%2FSuccess%2520Stories%2FCWS%2FCWS.pdf&usg=AOvVaw3CulNO0u3IimAuNifTS2nx&opi=89978449
2. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwijlaWZz_WGAxVLGVkFHRgrBAMQFnoECBgQAQ&url=https%3A%2F%2Fcrsreports.congress.gov%2Fproduct%2Fpdf%2FIF%2FIF12135&usg=AOvVaw3bwBKAqZkk0jhFcvI2OyE1&opi=89978449

KEYWORDS: Containerized Launching Station

Appendix A
TECHNICAL PROPOSAL TEMPLATE (VOLUME 2)

INSTRUCTIONS

These instructions and template apply to DoD SBIR/STTR Phase I topics and provide general guidelines for completing the Phase I Technical Volume. Information provided in the Service/Component-specific instructions for the topic of interest take precedence over any instructions listed below.

The template (beginning on the following page) is the format model that may be used to prepare the Phase I Technical Volume. Do not include the instructions provided on this page or any bracketed [ ] guidance in the template.

Disclosure

Offerors that include in their proposals data which they do not want disclosed to the public for any purpose, or used by the U.S. Government except for evaluation purposes, must:

(1) Mark the first page of each Volume of the Submission with the following legend:
"This proposal includes data that must not be disclosed outside the Government and must 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 offeror as a result of-or in connection with-the submission of this data, the Government has 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]";

(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."

Format

The Technical Volume shall meet the following requirements:

- Please refer to Service/Component-specific topic instructions for the page limit and how a technical volume is handled if the stated page count is exceeded. It is the proposing firm's responsibility to verify that the Technical Volume does not exceed the page limit after upload to DSIP. Unless otherwise noted, all content in the Technical Volume will count toward the limit.
- Single column format, single-spaced typed lines.
- Standard 8 ½" x 11" paper format.
- Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
- **The header on each page of the Technical Volume should contain your company name, topic number, and DSIP-assigned proposal number.**
- No font smaller than 10-point. For headers, footers, imbedded tables, figures, images, or graphics that include text, a font size of smaller than 10-point is allowable, though proposers are cautioned that the text may be unreadable by evaluators.

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.

Delete this instruction page and begin the Technical Volume starting with the following page.

[Title]

Volume 2: Technical Volume

[Note: Remove the disclosure statement below if not applicable to your proposal. Refer to Instructions.]

> This proposal includes data that must not be disclosed outside the Government and must 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 offeror as a result of – or in connection with – the submission of this data, the Government has 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>.

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 (include Subcontractors and/or Research Institutions).

(a) [Provide an explicit, detailed description of the Phase I approach. If a Phase I option is required or allowed by the Component (refer to Component-specific instructions for topic of interest), 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.

(b) The 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 of the proper approvals have been obtained. **SBCs proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**]

4. Related Work.

[Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The Technical Volume must persuade evaluators of the proposer's awareness of the state of the art in the topic. Describe any previous work not directly related but similar to the proposed effort. Provide the following: (1) a short description, (2) the client for which work was performed (including the Government Point of Contact to be contacted including e-mail address and phone number), and (3) date of performance including project 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 a Phase II research or research and development effort.

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

6. **Commercialization Strategy.**

[Describe in approximately one page the SBC'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 the project that your company expects to achieve.]

7. **Key Personnel**.

[Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). All resumes will count toward the page limit for Volume 2, as specified in the Component-specific instructions.]

[Principal Investigator Name]
[School, Degree, Year]

Relevant Experience
[A concise description of the principal investigator's relevant technical experience and its application to this topic.]

Relevant Awards or Patents
[List any awards received or patents granted or applications submitted for work related to this topic.]

Relevant Publications
[List any publications relevant to this topic.]

[Repeat this format as necessary to address the qualifications of all key personnel.]

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. The proposal may be deemed nonresponsive if the requested information is not provided. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR/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)). Note: If no foreign nationals will be involved in proposed work, the word "None" can be substituted for the table.]

Name [include direct employees, subcontractors, and consultants]	Foreign National (Yes/No)	Country of Origin	Type of Visa or Work Permit	Level of Involvement (Role)

9. Facilities/Equipment.

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

10. Subcontractors/Consultants.

[Propose efforts as applicable to either SBIR or STTR as follows:

SBIR. Involvement of a university or other subcontractors or consultants in the project may be appropriate. A minimum of two-thirds of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be carried out by the proposing small business firm, unless otherwise approved in writing by the Contracting Officer. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is not required for the use of Federal Laboratories and FFRDCs; however, proposers must certify their use of such facilities on the proposal cover sheet. Subcontracts with other Federal organizations are not permitted. Note that universities cannot publicly release information related to Export Controlled/ITAR restricted topics. (Refer to the DoD SBIR/STTR Broad Agency Announcement for detailed eligibility requirements as it pertains to the use of subcontractors/consultants.)

STTR. Involvement of a Research Institution in the project is required. A minimum of 40 percent of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing small business firm, and a minimum of 30 percent of the research and/or tasks in Phase I, as measured by direct and indirect costs, must be conducted by a single Research Institution. STTR efforts may include subcontracts with Federally Funded Research and Development Centers (FFRDCs). A waiver is not required for the use of Federal Laboratories, but they do not qualify as a Research Partner; proposers may only subcontract to Federal Laboratories within the remaining 30 percent and must certify their use of such facilities on the proposal cover sheet. Subcontracts with other Federal organizations are not permitted. Note that universities cannot publicly release information related to Export Controlled/ITAR restricted topics. (Refer to the DoD SBIR/STTR Broad Agency Announcement for detailed eligibility requirements as it pertains to the use of subcontractors/consultants.]

11. Prior, Current or Pending Support of Similar Proposals or Awards.

[If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, another or the same DoD Service/Component, you must disclose 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, provide contract number.

g) Specify the applicable topics for each proposal submitted or award received.

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

12. <u>Identification and Assertion of Restrictions on the Government's Use, Release, or Disclosure of Technical Data or Computer Software.</u>

The Offeror asserts for itself, or the persons identified below, that the Government's rights to use, release, or disclose the following technical data or computer software should be restricted:

Technical Data or Computer Software to be Furnished with Restrictions	Basis for Assertion	Asserted Rights Category	Name of Person or Organization Asserting Restrictions
[(LIST)]	[(LIST)]	[(LIST)]	[(LIST)]

[Completion of this table and submission of the proposal constitutes signature for the information listed in the table above.]

[**ADDITIONAL INFORMATION/INSTRUCTION:** 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 <u>must</u> be marked with the restrictive legend specified in DFARS 252.227-7018 Class Deviation 2020-O0007. Upon expiration of the twenty-year restrictive license, the Government has unlimited rights in the SBIR data. During the license period, the Government may not release or disclose SBIR data to any person other than its support services contractors except: (1) For evaluation purposes; (2) As expressly permitted by the contractor; or (3) A use, release, or disclosure that is necessary for emergency repair or overhaul of items operated by the Government. See DFARS clause 252.227-7018 Class Deviation 2020-O0007 "Rights in Noncommercial Technical Data and Computer Software – Small Business Innovation Research (SBIR) Program."

If a proposer plans to submit assertions in accordance with DFARS 252.227-7017 Class Deviation 2020-O0007, those assertions must be identified and assertion of use, release, or disclosure restriction MUST be included with your proposal submission. The contract cannot be awarded until assertions have been approved. Please note that only the table is included in the page limitation; any supporting data concerning the contract/grant number and awarding agency, as well as planned use or need of the data asserted, can be provided in Volume 5, Supporting Documents.

The following instructions apply to the fields in the table above (Identification and Assertion of Restrictions on the Government's Use, Release, or Disclosure of Technical Data or Computer Software).

1) For technical data (other than computer software documentation) pertaining to items, components, or processes developed at private expense, identify both the deliverable technical data and each such item, component, or process. For computer software or computer software documentation identify the software or documentation.
2) Generally, development at private expense, either exclusively or partially, is the only basis for asserting restrictions. For technical data, other than computer software documentation, development refers to development of the item, component, or process to which the data pertain. The Government's rights in computer software documentation generally may not be restricted. For computer software, development refers to the software. Indicate whether development was accomplished exclusively or partially at private expense. If development was not accomplished at private expense, or for computer software documentation, enter the specific basis for asserting restrictions.
3) Enter asserted rights category (e.g., Government purpose license rights from a prior contract, rights in SBIR/STTR data generated under another contract, limited, restricted, or government purpose rights under this or a prior contract, or specially negotiated licenses).
4) Corporation, individual, or other person, as appropriate.

Enter “none” when all data or software will be submitted without restrictions.]

Appendix B
DEFINITIONS

The following definitions from the SBA SBIR/STTR Policy Directive, the Federal Acquisition Regulation (FAR) and other cited regulations apply to 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 Federal Government or commercial markets purchase or use.

Cooperative Research and Development

An SBC and a research institution jointly conduct R&D. For purposes of the STTR Program, the SBC performs 40 percent of the work, and the single research institution performs not less than 30 percent of the work. For purposes of the SBIR Program, this refers to work a research institution conducts as the SBC's subcontractor. The proposing SBC must conduct at least two-thirds of the research and/or analytical work in Phase I.

Covered Individual

An individual who contributes in a substantive, meaningful way to the scientific development or execution of a R&D project proposed to be carried out with a DoD-funded award. 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, 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. Details are available here.

NOTE: Export control compliance statements found in the individual Service/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 U.S. Government of any potential export restriction as fundamental R&D efforts proceed.

Federal Laboratory

In 15 U.S.C. §3703, it means any laboratory, any federally funded R&D center (FFRDC), or any center established under 15 U.S.C. §§ 3705 & 3707 that a federal agency owns, leases, or otherwise uses and the Federal Government funds, whether the U.S. Government or the contractor operates.

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

Under 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

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 the Secretary of State determines as a country of concern.

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 that foreign owners, foreign investors, foreign management, or a foreign government establish, direct, or control.

Foreign Government

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

Foreign National

Foreign National (also known as Foreign Person) under 22 CFR 120.16 mean 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 two 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 two-year period.

Fraud, Waste and Abuse

a. Fraud includes any false
b. 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.
c. 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.
d. Abuse includes any intentional or improper use of government resources, such as misuse of rank, position, or authority or resources.
e. The SBIR/STTR Program training related to Fraud, Waste and Abuse is available here. See Section 1.13 for reporting fraud, waste, and abuse.

Funding Agreement

Any contract, grant, or cooperative agreement entered between any Federal Agency and any SBC for the performance of experimental, developmental, or research work, including products or services, Federal Government-funded in whole or in part. DoD Services/Components will only use contracts and other transaction authority (OTA) agreements for all SBIR awards.

Historically Black Colleges and Universities, and Minority-Serving Institutions

Department of Education list for historically Black colleges and universities and minority-serving institutions.

HUBZone Certified Small Business Concern

An SBC with SBA certification 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 R&D 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 IP, 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 R&D 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 R&D award or required to engage in work that would result in substantial overlap or duplication with a Federal R&D 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 R&D award, contrary to the institutional policies or standard terms and conditions of the Federal R&D 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 R&D 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

SBCs 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 SBCs with 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 benchmarks' applications for more experienced firms. Detailed information on benchmark calculations and increased performance standards for more experienced firms can be found here.

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:

a. The covered employee's, their close family members' or other members of their household's financial interests;
b. Other employment or financial relationships (including seeking or negotiating for prospective employment or business); and
c. Gifts, including travel.

Financial interests referred to in this definition's first paragraph may arise from:

a. Compensation, including wages, salaries, commissions, professional fees, or fees for business referrals;
b. Consulting relationships (including commercial and professional consulting and service arrangements, scientific and technical advisory board memberships, or serving as an expert witness in litigation);
c. Services provided in exchange for honorariums or travel expense reimbursements;
d. Research funding or other forms of research support;
e. Investment in the form of stock or bond ownership or partnership interest (excluding diversified mutual fund investments);
f. Real estate investments;
g. Patents, copyrights, and other IP interests; or
h. Business ownership and investment interests.

Principal Investigator/Program Manager

The principal investigator/project manager is the proposing SBC-designated individual who provides the scientific and technical direction to a funding agreement-supported project.

Proprietary Information

Proprietary information is any information that a SBC considers to be non-public information the SBC owns 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 R&D center, as identified by the National Science Foundation in accordance with the government-wide FAR issued in accordance with the Office of Federal Procurement Policy Act Section 35(c)(1). A list of eligible FFRDCs is here.

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 knowledge application toward the production of useful materials, devices, 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 Services/Component guidance. Proposing SBCs 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 service-disabled veteran or service-disabled veterans-owned and controlled SBC 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 percent directly owned and controlled by one or more individuals (who are citizens or permanent resident aliens of the United States), other SBCs (each of which is more than 50 percent 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. (See here for definition of an affiliate.)

Subcontract

A subcontract is any agreement, other than one involving an employer-employee relationship, including consultants, the funding agreement awardee enters calling for supplies or services for the performance of the original funding agreement.

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 where one or more women own at least 51 percent, or in the case of any publicly owned business, women own at least 51 percent of the stock, and women control the management and daily business operations.

Appendix C
POTENTIAL APPLICABLE FEDERAL ACQUISITION REGULATION, DEFENSE FEDERAL ACQUISITION REGULATION SUPPLEMENT CLAUSES

Note: Green cells are potential required Federal Acquisition Regulation (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS) clauses. Blue cells are potential required FAR and DFARS clauses, when applicable.

Clause Number	Title	Date	When Applicable
52.203-17	Contractor Employee Whistleblower Rights	Nov-23	
52.203-19	Prohibition on Requiring Certain Internal Confidentiality Agreements or Statements	Jan-17	
52.204-10	Reporting Executive Compensation and First-Tier Subcontract Awards	Jun-20	
52.204-13	System for Award Management Maintenance	Oct-18	
52.204-18	Commercial and Government Entity Code Maintenance	Aug-20	
52.204-19	Incorporation by Reference of Representations and Certifications	Dec-14	
52.204-21	Basic Safeguarding of Covered Contractor Information Systems	Nov-21	
52.204-23	Prohibition on Contracting for Hardware, Software, and Services Developed or Provided by Kaspersky Lab and Other Covered Entities	Dec-23	
52.204-25	Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment	Nov-21	
52.204-27	Prohibition on a ByteDance Covered Application	Jun-23	
52.204-30	Federal Acquisition Supply Chain Security Act Orders—Prohibition	Dec-23	
52.209-06	Protecting the Government's Interest When Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment	Nov-21	
52.209-10	Prohibition on Contracting with Inverted Domestic Corporations	Nov-15	
52.219-06	Notice of Total Small Business Set-Aside	Nov-20	
52.219-08	Utilization of Small Business Concerns	Feb-24	
52.219-28	Post-Award Small Business Program Representation	Feb-24	
52.222-03	Convict Labor	Jun-03	
52.222-19	Child Labor-Cooperation with Authorities and Remedies	Feb-24	
52.222-21	Prohibition of Segregated Facilities	Apr-15	
52.222-25	Affirmative Action Compliance	Apr-84	
52.222-26	Equal Opportunity	Sep-16	
52.222-36	Equal Opportunity for Workers with Disabilities	Jun-20	
52.222-50	Combating Trafficking in Persons	Nov-21	

Clause Number	Title	Date	When Applicable
52.225-01	Buy American-Supplies	Oct-22	
52.225-13	Restrictions on Certain Foreign Purchases	Feb-21	
52.226-07	Drug-Free Workplace	May-24	
52.226-08	Encouraging Contractor Policies to Ban Text Messaging While Driving	May-24	
52.227-01 Alt I	Authorization and Consent - Alternate I (Apr-84)	Jun-20	
52.227-02	Notice and Assistance Regarding Patent and Copyright Infringement	Jun-20	
52.227-11	Patent Rights-Ownership by the Contractor	May-14	
52.227-20	Rights in Data-SBIR Program	May-14	
52.232-11	Extras	Apr-84	
52.232-23	Assignment of Claims	May-14	
52.232-25	Prompt Payment	Jan-17	
52.232-33	Payment by Electronic Funds Transfer - System for Award Management	Oct-18	
52.232-39	Unenforceability of Unauthorized Obligations	Jun-13	
52.232-40	Providing Accelerated Payments to Small Business Subcontractors	Mar-23	
52.232-01	Disputes	May-14	
52.233-04	Applicable Law for Breach of Contract Claim	Oct-04	
52.242-15	Stop-Work Order	Aug-89	
52.243-01 Alt V	Changes-Fixed-Price Alternate V (Apr-84)	Aug-87	
52.244-06	Subcontracts for Commercial Products and Commercial Services	Feb-24	
52.246-09	Inspection of Research and Development (Short Form)	Apr-84	
52.252-02	Clauses Incorporated by Reference	Feb-98	
52.252-06	Authorized Deviations in Clauses	Nov-20	
52.253-01	Computer Generated Forms	Jan-91	
252.203-7000	Requirements Relating to Compensation of Former DoD Officials	Sep-11	
252.203-7002	Requirement to Inform Employees of Whistleblower Rights	Dec-22	
252.204-7000	Disclosure of Information	Oct-16	
252.204-7003	Control of Government Personnel Work Product	Apr-92	
252.204-7008	Compliance with Safeguarding Covered Defense Information Controls	Oct-24	
252.204-7009	Limitations on the Use or Disclosure of Third-Party Contractor Reported Cyber Incident Information	Jan-23	
252.204-7012	Safeguarding Covered Defense Information and Cyber Incident Reporting (DEVIATION 2024-O0013)	May-24	
252.204-7016	Covered Defense Telecommunications Equipment or Services—Representation	Dec-19	

Clause Number	Title	Date	When Applicable
252.204-7017	Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services—Representation	May-21	
252.204-7018	Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services	Jan-23	
252.204-7019	Notice of NISTSP 800-171 DoD Assessment Requirements	Nov-23	
252.204-7020	NIST SP 800-171 DoD Assessment Requirements	Nov-23	
252.204-7022	Expediting Contract Closeout	May-21	
252.204-7024	Notice on the use of the Supplier Performance Risk System	Mar-23	
252.227-7016	Rights in Bid or Proposal Information	Jan-23	
252.227-7018	Rights in Noncommercial Technical Data and Computer Software--Small Business Innovation Research (SBIR) Program (DEVIATION 2020-O0007) (Jul 23)	Nov-23	
252.227-7019	Validation of Asserted Restrictions--Computer Software	Jan-23	
252.227-7025	Limitations on the Use or Disclosure of Government-Furnished Information Marked with Restrictive Legends	Jan-23	
252.227-7030	Technical Data--Withholding of Payment	Mar-00	
252.227-7037	Validation of Restrictive Markings on Technical Data	Jan-23	
252.227-7039	Patents--Reporting of Subject Inventions	Apr-90	
252.232-7003	Electronic Submission of Payment Requests and Receiving Reports	Dec-18	
252.232-7006	Wide Area WorkFlow Payment Instructions	Jan-23	
252.232-7010	Levies on Contract Payments	Dec-06	
252.235-7010	Acknowledgment of Support and Disclaimer	May-95	
252.235-7011	Final Scientific or Technical Report	Dec-19	
252.243-7001	Pricing of Contract Modifications	Dec-91	
252.244-7000	Subcontracts for Commercial Items	Nov-23	
52.203-03	Gratuities	Apr-84	Exceeding the simplified acquisition threshold.
52.203-05	Covenant Against Contingent Fees	May-14	Exceeding the simplified acquisition threshold.
52.203-06 or Alt I	Restrictions on Subcontractor Sales to the Government or ALT I	Nov-21	Exceeding the simplified acquisition threshold, Alt I commercial products or commercial services.
52.203-07	Anti-Kickback Procedures	Jun-20	Contracts exceeding $150,000.
52.203-08	Cancellation, Rescission, and Recovery of Funds for Illegal or Improper Activity	May-14	Exceeding the simplified acquisition threshold.
52.203-10	Price or Fee Adjustment for Illegal or Improper Activity	May-14	Exceeding the simplified acquisition threshold.
52.203-12	Limitation on Payments to Influence Certain Federal Transactions	Jun-20	Contracts exceeding $150,000.
52.204-02	Security Requirements	Mar-21	May require access to classified information; cost contract (see 16.302) for research and development with an educational institution is contemplated.

Clause Number	Title	Date	When Applicable
52.212-04	Contract Terms and Conditions—Commercial Products and Commercial Services	Nov-23	Commercial products or commercial services.
52.212-05	Contract Terms and Conditions Required to Implement Statutes or Executive Orders-Commercial Items	May-24	Commercial products or commercial services.
52.219-14	Limitations on Subcontracting	Oct-22	Set aside for small business and the contract amount is expected to exceed the simplified acquisition threshold.
52.222-35	Equal Opportunity for Veterans	Jun-20	Contracts exceed $150,000.
52.222-37	Employment Reports on Veterans	Jun-20	If contract contains 52.222-35.
52.222-40	Notification of Employee Rights Under the National Labor Relations Act	Dec-10	Exceeding the simplified acquisition threshold.
52.222-54	Employment Eligibility Verification	May-22	Contracts exceed $150,000.
52.223-03	Hazardous Material Identification and Material Safety Data	Feb-21	Requires the delivery of hazardous materials.
52.229-03	Federal, State, and Local Taxes	Feb-13	A fixed-price contract is contemplated; and the contract is expected to exceed the simplified acquisition threshold.
52.232-02	Payment under Fixed-Price Research and Development Contracts	Apr-84	Fixed Price R&D.
52.233-03	Protest After Award	Aug-96	Exceed the simplified acquisition threshold.
52.242-13	Bankruptcy	Jul-95	Exceed the simplified acquisition threshold.
52.242-17	Government Delay of Work	Apr-84	Supplies other than commercial or modified-commercial products.
52.245-01	Government Property	Sep-21	When property is expected to be furnished.
52.245-09	Use and Charges	Apr-12	When the clause at 52.245-1 is included.
52.246-04	Inspection of Services-Fixed Price	Aug-96	Services, or supplies that involve the furnishing of services, when a fixed-price contract is contemplated, and the contract amount is expected to exceed the simplified acquisition threshold.
52.246-16	Responsibility for Supplies	Apr-84	Supplies, services involving the furnishing of supplies, or research and development, when a fixed-price contract is contemplated, and the contract amount is expected to exceed the simplified acquisition threshold.
52.246-23	Limitation of Liability	Feb-97	Exceed the simplified acquisition threshold.
52.247-34	F.o.b. Destination	Nov-91	When the delivery term is f.o.b. destination.
252.204-7015	Notice of Authorized Disclosure of Information for Litigation Support	Jan-23	Commercial products and commercial services.
252.209-7004	Subcontracting with Firms that are Owned or Controlled by the Government of a Country that is a State Sponsor of Terrorism	May-19	Contracts value of $150,000 or more.
252.211-7003	Item Identification and Valuation	Jan-23	For supplies, and for services involving the furnishing of supplies.
252.223-7001	Hazard Warning Labels	Dec-91	Requires submission of hazardous material data sheets.
252.223-7008	Prohibition of Hexavalent Chromium	Jan-23	For supplies, maintenance and repair services, or construction.
252.225-7001	Buy American and Balance of Payments Program	Feb-24	Acquisition of commercial products and commercial services.

Clause Number	Title	Date	When Applicable
252.225-7002	Qualifying Country Sources as Subcontractors	Mar-22	(i) 252.225-7001, Buy American and Balance of Payments Program. Use if one or more is included: (ii) 252.225-7021, Trade Agreements. (iii) 252.225-7036, Buy American - Free Trade Agreements - Balance of Payments Program.
252.225-7012	Preference for Certain Domestic Commodities	Apr-22	Commercial products and commercial services.
252.225-7052	Restriction on Acquisition of Certain Magnets, Tantalum, and Tungsten	May-24	Products and commercial services, that exceed the simplified acquisition threshold.
252.225-7056	Prohibition Regarding Business Operations with the Maduro Regime	Jan-23	Commercial products and commercial services.
252.225-7060	Prohibition on Certain Procurements from the Xinjiang Uyghur Autonomous Region	Jun-23	Products utilizing funds appropriated or otherwise made available for any fiscal year.
252.225-7972	Prohibition on the Procurement of Foreign-Made Unmanned Aircraft Systems (DEVIATION 2020-O0015)	May-20	
252.225-7967	Prohibition Regarding Russian Fossil Fuel Business Operations (DEVIATION 2024-O0006, Revision 1)	Feb-24	Exceeding the simplified acquisition threshold.
252.228-7001	Ground and Flight Risk	Mar-23	Acquisition, development, production, modification, maintenance, repair, flight, or overhaul of aircraft owned by or to be delivered to the Government.
252.228-7005	Mishap Reporting and Investigation Involving Aircraft, Missiles, and Space Launch Vehicles	Nov-19	Acquisition, development, production, modification, maintenance, repair, flight, or overhaul of aircraft owned by or to be delivered to the Government.
252.235-7002	Animal Welfare	Dec-14	Uses live vertebrate animals.
252.235-7004	Protection of Human Subjects	Jul-09	Involving human subjects.
252.243-7002	Requests for Equitable Adjustment	Dec-22	Exceeding the simplified acquisition threshold.
252.245-7003	Contractor Property Management System Administration	Apr-12	Containing the clause at FAR 52.245-1, Government Property.
252.245-7005	Management and Reporting of Government Property	Jan-24	Containing the clause at FAR 52.245-1, Government Property.
252.247-7023	Transportation of Supplies by Sea	Jan-23	Except - those with an anticipated value at or below the simplified acquisition threshold.