DEPARTMENT OF THE AIR FORCE
24.2 SMALL BUSINESS INNOVATION RESEARCH (SBIR) PHASE I
PROPOSAL SUBMISSION INSTRUCTIONS

The Air Force intends these Phase I proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Offerors must ensure proposals meet all requirements of the SBIR 24.2 BAA posted on the Defense SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

Applicants are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the DAF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "24.2 Address Change".

Points of Contact:

General information related to the AF SBIR/STTR program and proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us. All applicants have ample opportunity to request clarifying information. **The DAF encourages applicants to request clarifying information as early as possible, as delays in such requests constrain the DAF's ability to provide satisfactory resolution to applicant concerns.**

- Questions regarding the DSIP electronic submission system, contact the DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com.
- For technical questions about the topics during the pre-announcement and open period, please reference the DoD SBIR 24.2 BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
  - Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

General information related to the AF Small Business Program can be found at the AF Small Business website, http://www.airforcesmallbiz.af.mil/. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

PHASE I PROPOSAL SUBMISSION

The DoD SBIR 24.2 Broad Agency Announcement, https://www.dodsbirsttr.mil/submissions/login, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic's requirements.

PHASE I PROPOSAL FORMAT

Complete proposals must include all of the following:
Volume 1: DoD Proposal Cover Sheet

Note: If selected for funding, the proposal's technical abstract and discussion of anticipated benefits will be publicly released. Therefore, do not include proprietary information in this section.
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents
Volume 6: Fraud, Waste, and Abuse Training

DoD PROPOSAL COVER SHEET (VOLUME 1)
Complete the proposal Cover Sheet in accordance with the instructions provided via DSIP. The technical abstract should include a brief description of the program objective(s), a description of the effort, anticipated benefits and commercial applications of the proposed research, and a list of keywords/terms. The technical abstract of each successful proposal will be submitted to the Office of the Secretary of Defense (OSD) for publication and, therefore, must not contain proprietary or classified information.

TECHNICAL VOLUME (VOLUME 2):
The Technical Volume should include all graphics and attachments but should not include the Cover Sheet, which is completed separately as Volume 1. The Phase I technical volume (uploaded in Volume 2) shall contain the required elements found below. Ensure that all graphics are distinguishable in black and white.

The Phase I Technical Volume page/slide limits identified for the topics do not include the Cover Sheet, Cost Volume, Cost Volume Itemized Listing (a-h). The Technical Volume must be no smaller than 10-point on standard 8-1/2" x 11" paper with one-inch margins. Only the Technical Volume and any enclosures or attachments count toward the page limit. In the interest of equity, pages/slides in excess of the stated limits will not be reviewed. The documents required for upload into Volume 5, "Other", do not count toward the specified limits.

These instructions supplement the 24.2 SBIR BAA. In addition to the requirements found in the 24.2 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 24.2 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.
    a. Topics AF242-0010, AF242-0011 **ONLY**: the certified and completed DD Form 2345, Military Critical Technical Data Agreement, must be included with the initial proposal submission. Proposals that do not include this document will be disqualified..

2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 24.2 BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)

Note that the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The Air Force does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals submitted in response to DAF topics shall not include TABA.

AIR FORCE PROPOSAL EVALUATIONS

Proposals will be evaluated for overall merit in accordance with the criteria discussed in the 24.2 BAA. DAF is seeking varying technical/scientific approaches and/or varying and new technologies that would be responsive to the problem statement(s) and area(s) of interest in the topic. Multiple procurements are planned and anticipated to be awarded as a result of the topic, each proposal is

considered a separate procurement and will be evaluated on its own merit, and that the Government may award all, some, or none of the proposals. Any per-award or per-topic funding caps are budgetary estimates only, and more or less funding may become available. Funding decisions are made with complete disregard to the other awards under the same topic.

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may decide not to select the proposal for award based upon a totality of the review.

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

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

Department of the Air Force SBIR 24.2 Phase I Topic Index

Topic Number	Topic Name	Maximum Value*	Maximum Duration**	Technical Volume Page Limit***
AF242-0001	Creating a digital twin of legacy aircraft	$180,000.00	6	20
AF242-0002	Modeling and simulation of large scale deployments of autonomous systems	$180,000.00	6	20
AF242-0003	Acoustic Recorders for Persistent High-Altitude Sensing	$180,000.00	6	20
AF242-0004	Intelligent Traffic Management System (ITMS)	$180,000.00	6	20
AF242-0005	Next Generation Field Calibration Suite for Radiometric Sensors	$180,000.00	6	20
AF242-0006	Fast-Response Flow Meters for Onboard Systems (Harsh Chemicals)	$180,000.00	6	20
AF242-0007	Rotor High Speed Imaging System	$180,000.00	6	20
AF242-0008	Fire Ignition Video Analysis Tool	$180,000.00	6	20
AF242-0009	Graphene CBRN Overgarment	$180,000.00	6	20
AF242-0010	All-Passive Nonreciprocal Power Limiters	$180,000.00	6	20
AF242-0011	Chip scale resonant sensors	$180,000.00	6	20
AF242-0013	Outer Mold Line Material Condition Probe	$180,000.00	6	20
SF242-0014	Into the Wild-Transitioning Basic Rsh Algs to Ops	$180,000.00	6	20
SF242-0015	Programmability of Regional and/or Local Multi-Source PNT for Joint All-Domain Operations	$180,000.00	6	20
SF242-0016	Neuromorphic Camera for Space Domain Awareness	$180,000.00	6	20
SF242-0017	Cover glass solutions	$180,000.00	6	20

SF242-0018	Neon recovery and reliquefication for low temperature characterization of infrared focal plane arrays	$180,000.00	6	20
SF242-0019	Hydrogenation for defect passivation in (Si)GeSn alloys	$180,000.00	6	20
SF242-0020	Exploring Proliferated Warfighter Space Architecture (PWSA)	$180,000.00	6	20

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

AF242-0001 TITLE: Creating a digital twin of legacy aircraft

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

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

OBJECTIVE: The topic objective is to develop a faster, more cost-effective way to integrate new equipment at the system design/digital engineering level by creating a digital twin of the B-52H legacy aircraft system. This digital twin will include CAD models and SysML models, and be connectable to various models in different systems. The end state of this project is to have a digital engineering environment that is dynamically connected to an accredited simulation environment, enabling seamless integration of digital engineering models with other systems/products.
To achieve this objective, applicants are asked to propose a solution for creating a digital twin of a legacy system.

DESCRIPTION: The end state is to solicit industry for innovative approaches of designing Digital Twin (CAD and SysML files) for the B-52, a legacy aircraft that is planned to continue in service through the 2050's. AFGSC is interested in commercial solutions that develop the CAD and SysML baseline models for the B-52H so that future Non Recurring Engineering costs can be reduced over time as future concepts and systems are developed. This topic is designed to generate demonstrable success with model development, and build momentum with the ultimate success being follow on contract awards to completely develop and integrate these models into digital engineering and accredited digital simulation environments. Any data developed during this project will be government-owned, and that the government will have unlimited rights to use, modify, reproduce, release, perform, display, or disclose such technical data or computer software.

PHASE I: Awardee(s) will define a system concept, perform a feasibility study, and propose an solution for creating a digital twin of the B-52 legacy system. The developed CAD and SysML models developed during this project will be government-owned, and that the government will have unlimited rights to use, modify, reproduce, release, perform, display, or disclose such technical data or computer software.

PHASE II: The objective of the Phase II SBIR will be to further develop the digital twin of a legacy aircraft for equipment integration and testing created in Phase I. The project will focus on refining and improving the digital twin, creating a well-defined deliverable prototype that can be used for commercialization.

The project will involve the following steps:

Refinement of the 3D Model
The 3D model of the aircraft created in Phase I will be refined and improved to enhance its accuracy and functionality. This will involve further validation of the model to ensure its accuracy and the addition of new components to improve its functionality.

Integration of New Equipment
The digital twin will be used to simulate the integration of new equipment with the aircraft. The simulation will involve testing the new equipment in different scenarios to identify potential issues and make necessary modifications.

Testing
The digital twin will undergo rigorous testing to ensure its accuracy and functionality. The testing will involve simulating a wide range of scenarios, including extreme weather conditions, equipment failures, and system malfunctions.

Success Criteria
The success criteria for this project will be the creation of a well-defined deliverable prototype that accurately simulates the installation of new equipment and changes to the aircraft's systems. The prototype should be able to simulate a wide range of scenarios, including equipment integration and testing, extreme weather conditions, equipment failures, and system malfunctions, and be validated through comparison to the actual aircraft.

Commercialization Plan
A commercialization plan will be developed to promote the technology and identify potential licensing and partnership opportunities. A marketing strategy will also be developed to reach potential customers and partners. The proposer will have identified potential customers and partners and have a plan to seek additional funding opportunities to continue the development of the digital twin technology and explore other potential applications in the aerospace industry.

Operating Parameters/Prototyping Expectations
The digital twin prototype will be able to simulate a wide range of scenarios, including equipment integration and testing, extreme weather conditions, equipment failures, and system malfunctions. The prototype will be validated through comparison to the actual aircraft, and its accuracy and functionality will be tested in a wide range of scenarios. The prototype will also be tested to ensure its compatibility with different equipment and systems. Additionally, the prototype will be tested for ease of use and user-friendliness.

Conclusion
The success of the Phase II project will result in a well-defined deliverable prototype of the digital twin of a legacy aircraft for equipment integration and testing. The prototype will be able to simulate a wide range of scenarios and be validated through comparison to the actual aircraft. The prototype will provide a safer, more efficient, and cost-effective way to test and integrate new equipment with legacy aircraft. Finally, the commercialization potential of this project is significant, with a potential market among aerospace companies, government agencies, and military organizations."

PHASE III DUAL USE APPLICATIONS: The objective of the Phase III/Dual Use SBIR project will be to develop and commercialize the digital twin of a legacy aircraft for equipment integration and testing created in Phase II. The project will focus on transitioning the technology to government and commercial applications and achieving a high technology readiness level (TRL).

Expected Phase III Effort

The expected Phase III effort will involve developing and commercializing the digital twin technology for government and commercial applications. The technology will be refined and optimized to meet the specific requirements of these applications. The project will involve collaboration with potential customers and partners to identify their specific needs and develop a plan for commercialization. The project will also involve seeking additional funding opportunities to further develop the technology and explore other potential applications in the aerospace industry.

Expected TRL at Phase III Entry
The expected TRL at Phase III entry is 9, which means the technology is fully developed, tested, and validated in relevant environments. The digital twin will have been tested and validated in a wide range of scenarios, and its accuracy and functionality will have been demonstrated through comparison to the actual aircraft. The technology will be ready for commercialization and deployment.

Additional Transition Planning
The additional transition planning for this Phase III project will involve identifying the government approvals required for the commercialization of the technology. The project team will work closely with the Department of Defense (DoD) to identify any necessary certifications, approvals, or standards that need to be met for the technology to be deployed in military applications. The project team will also work with potential commercial partners to identify any necessary certifications, approvals, or standards required for commercial deployment.

Known Government Approvals Required
The known government approvals required for this project will vary depending on the specific application and customer. However, potential approvals that may be required include certification by the Federal Aviation Administration (FAA) or the Department of Defense (DoD), compliance with relevant military standards, and approval by the appropriate government agencies.

Additional DAF Customer Opportunities
The additional DAF customer opportunities for this project include potential applications in military and commercial aviation. The digital twin technology can be used to improve the safety and performance of aircraft, reduce risk, save time and money, and increase efficiency. The technology can also be used for training and maintenance, providing a realistic and accurate representation of the aircraft that can improve safety and reduce errors during actual operations. The project team will work closely with potential customers and partners to identify additional opportunities for deployment and commercialization of the digital twin technology.

REFERENCES:
1. GAO-23-106453;

KEYWORDS: Digital twin; Legacy aircraft; Equipment integration; Testing; Virtual model; Accurate data; Physical dimensions; Risk reduction; Accredited digital simulation; Time and money saving; Realistic representation; Designing CAD; SysML files; B-52; Non Recurring Engineering cost reduction; Digital engineering; Model development

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AF242-0002 TITLE: Modeling and simulation of large scale deployments of autononomous systems

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

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

OBJECTIVE: The objective of this topic are:

1) To further progress towards the vision for swarms of UAVs outlined in the USAF Small UAS Flight Plan (2016-2036) (reference 1) and the DoD Small UAS Capability Description Document (draft - 2023). Those documents describe the potential mission impact that large numbers of affordable but capable UAVs could have. The Flight Plan also defines key system attributes and technical challenges as well as acquisition strategies that mitigate those challenges.
2) To further progress in this area the focus of this specific topic is on the modeling and simulation of autonomous systems at large scale in activities such as maritime surveillance, base defense, suppressing enemy air defense systems and supporting air operations.

DESCRIPTION: This topic focuses on modeling and simulation (M&S) of large scale deployments of autonomous system in support of military operations. The M&S efforts will use simple models of the platforms and sensors and focus on command and control (C2), communications requirements, collaboration between autonomous systems, tactics, techniques, and procedures (TTPs) and strategies for employment.

The primary driver for these simulations is the development of approaches to decentralized command and control of these systems including collaboration between small groups of autonomous systems with limited communication to higher level controllers.

The decentralized aspect is important because the goal is for autonomous systems to be able to coordinate their activities in small groups while operating under a set of higher level commands.
The initial use cases involve UAVs for maritime surveillance, but the modeling framework should be extensible to other types of autonomous systems. To stress the generality this topic description uses the phrase “drones” to mean any robotic system with some degree of autonomy.

PHASE I: Phase I award(s) will focus on defining architectures and implementation for modeling and simulation of decentralized command and control of autonomous systems at scale. The goals for this effort include defining an approach that aligns with the USAF primary system simulator, AFSIM. Ideally simulations done using the decentralized C2 simulator can be used to guide the higher fidelity simulations done using AFSIM.

Deliverables from this phase would include designs for simulation frameworks with open interfaces enabling developers of C2 and machine learning algorithms to incorporate their software into the simulations.

PHASE II: Phase II award(s) will focus on development and testing of the modeling and simulation environments, adding visualizations, developing common libraries for integration with data feeds, AI/ML and building human interfaces.

PHASE III DUAL USE APPLICATIONS: Collaborative autonomous systems will have a role in public safety, logistics and other commercial activities. Modeling and simulation of these capabilities will be necessary for successful employment. This technology will likely have a large impact on society in the next 5 to 10 years.
Commercial applications for mission planning, command and control and system test and verification would benefit from having a robust modeling and simulation capability.

REFERENCES:

1. USAF Small UAS Flight Plan (2016-3036) https://apps.dtic.mil/sti/pdfs/AD1013675.pdf;
2. DoD Small UAS Capability Description Document (DOD SUAS CDD);
3. Papers by PLA researchers;

KEYWORDS: UAV;drone;swarm;digital engineering;mbse;model-based systems engineering;autonomy

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AF242-0003 TITLE: Acoustic Recorders for Persistent High-Altitude Sensing

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: High altitude balloons occupy the 'middle ground' between the Earth's surface and space because they can capture signatures that are difficult to record from either ground stations or satellites. Over the last decade, acoustic sensors on high altitude balloons have captured a diverse set of phenomena, including rocket launches, aircraft, spacecraft reentry, ground explosions, earthquakes, thunder, wind turbines, and even freight trains.

However, these sensors have consisted of repurposed ground micro barometers that have relatively high intrinsic noise levels. Currently there are no high quality, low size, weight, power and cost (SWaP-C) commercially available acoustic sensors with the required sensitivity and environmental resilience for use in the low atmospheric pressures and extreme temperatures found at high altitudes.

Adding an acoustic sensor to a HAB sensor suite will enable the detection, tracking and identification of ships and aircraft, even when they maintain radio silence, because their acoustic signatures are detectable at long ranges in the stratosphere. Currently, most acoustic recorders used on HABs were designed for use at the Earth's surface, where wind noise is much greater and therefore intrinsic sensor noise is less important. In contrast, background noise levels is extremely low on free floating balloons, far lower than would ever be realized on the ground.

This effort is related to existing infrasound detectors deployed around the world at ground level for the detection of explosions (chemical and nuclear) as well as seismic events.

DESCRIPTION: The work that would be accomplished in this specific topic would result in a new class of sensor that when deployed on a high altitude balloon (HAB) would enable the detection and tracking of aircraft, ships and other sources with acoustic signatures such as explosions, rocket launches, space object re-entry.

The proposed work would result in a combined acoustic sensor/accelerometer package meant for high altitude balloons. The sensor would be capable of recording faint sound waves emanating from distant sources and utilizing the accelerometer to determine the direction of origin of the signal. This would permit the detection, tracking, and identification of human and natural phenomena such as chemical and nuclear explosions, aircraft, ships, hypersonic objects, meteors, volcanic eruptions, and earthquakes. Additional diagnostics such as the existence and state of health of infrastructure such as bridges, dams, and industrial facilities could be collected also.

These acoustic sensors are expected to be lightweight with low power requirements. Most of the sensor data processing can be performed at the sensor reducing the data bandwidth requirements.

These sensors could be an important part of the growing interest in HABs for surveillance, electronic warfare, and communications support. Because of their small size, low weight, low power requirements and low cost, combined with their ability to provide information on a wide range of activity and threats, they could be used on almost all HAB platforms. The intent is to make it simple to add the sensor to existing HABs with larger payloads, thereby developing an acoustic network from already-extant constellations. The sensor package could be flown on small, dedicated balloons as well.

PHASE I: In Phase I, awardee(s) will produce a preliminary design with resource requirements, performance, and cost estimates.

Included in the resource requirements are size, weight and power for both the sensor and any on-board processing. To reduce data communication requirements most signal processing will need to be done on board.

The performance estimates include sensitivity and noise level across from infrasound (0.1 Hz) to the lower-mid range of human hearing (1 kHz), as well as the accuracy of direction of arrival measurements. Cost estimates should include low volume initial production costs as well as estimates for a commercial product.

PHASE II: During Phase II the awardee(s) would complete its preliminary designs from Phase I, develop prototype that can be evaluated in altitude chambers and on short duration high altitude balloon flights and incorporate the results of these tests into low-rate initial production articles for testing. The proposed high altitude platform is the Sandia heliotrope solar hot air balloon, which can deliver a payload of up to 2 kg at the target altitudes for several hours of level flight. This is a standard platform for high altitude infrasound sensing. Multi-day high altitude balloon flights would be used for operational testing of the test articles. The results of the operational testing would be incorporated into designs that would become commercial products under a Phase III award.

Because these devices should be relatively inexpensive and fairly well understood it is reasonable to accomplish this during a Phase II contract.

PHASE III DUAL USE APPLICATIONS: During Phase III the acoustic sensors would become a commercial product available for use by DoD and IC, and potentially our allies, on high altitude balloon flights to refine their concept of operational employment and tactics, techniques and procedures.

The Army and Navy use of high altitude balloons would likely benefit from incorporating acoustic sensors on their platforms.

Having acoustic sensors on multiple high altitude balloons in a region results in better geolocation of targets. Follow-on efforts to develop algorithms for exploiting acoustic data from multiple sources would enhance the utility of this data.

REFERENCES:

1. Silber, S. A. and Bowman, D. C. (2023). Detection of the Large Surface Explosion Coupling Experiment by a sparse network of balloon-borne infrasound sensors. MDPI Remote Sensing 15, 542.
2. Bowman, D. C., Rouse, J. W., Krishnamoorthy, S. and Silber, S. A. (2022). Infrasound direction of arrival determination using a balloon-borne aeroseismometer. The Journal of the Acoustical Society of America – Express Letters 2 (5)

3. Garcia, R. F., Klotz, A., Hertzog, A., Martin, R., Gérier, S., Kassarian, E., Bordereau, J., Venel, S. and Mimoun, D. (2022) Infrasound from large earthquakes recorded on a network balloons in the stratosphere. Geophysical Research Letters 49 (15), e2022GL098844
4. Bowman, D. C. and Albert, S. A. (2018). Acoustic Event Location and Background Noise Characterization on a Free Flying Infrasound Sensor Network in the Stratosphere. Geophysical Journal International 213, p. 1524-1535;

KEYWORDS: high altitude balloons;stratospheric sensors;acoustic sensor;infrasound;microbarometer;remote sensing

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AF242-0004 TITLE: Intelligent Traffic Management System (ITMS)

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

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

OBJECTIVE: The proposed topic is to develop an integrated Intelligent Traffic Management System (ITMS) that addresses the complex traffic management needs of Joint Base San Antonio (JBSA) and significantly improves the efficiency and security of base access across 502 ABW installations. The ITMS will seamlessly integrate with our existing infrastructure, providing real-time, automated gate traffic status updates to base personnel and visitors, while minimizing gate congestion, reducing security risks, and improving the overall user experience.

DESCRIPTION: The ITMS will leverage commercial industry best practices, and be capable of handling high-volume traffic during peak hours, as well as the surges in traffic experienced during our Basic Military Training Graduation ceremonies. By leveraging geolocation technology, the ITMS will guide personnel and visitors to the most efficient gate based not only on their proximity but also on real-time traffic conditions and wait times. This capability will maximize base access efficiency, reduce congestion, and improve satisfaction among base personnel and visitors alike.

In addition, the system will also enhance base security by detecting and reporting attempted pedestrian and wrong-way entrances, providing invaluable input to the Base Defense Operations Center (BDOC), Crisis Action Team (CAT), Command Post (CP), and Public Affairs (PA).

The ITMS needs to be accessible through the JBSA App or similar API, and will integrate with the AF Connect application. The system will also ensure compatibility with our existing traffic management systems, such as DBIDS and Cameras, facilitating seamless integration and a more efficient traffic management process.

Finally, the ITMS will be compliant with DoD Cybersecurity Policies, including RMF, NIST 800-53 and 800-171 and incorporate effective user management capabilities, allowing us to establish separate permissions for JBSA personnel and visitors, thereby ensuring appropriate Force Protection. With the capacity to identify or utilize AF Connect for data storage, the system will handle high volumes of traffic data securely and efficiently, enhancing the overall effectiveness and operational security of our base."

PHASE I: The principal objective of Phase I is to gauge the scientific and technical value and feasibility of the proposed Intelligent Traffic Management System (ITMS) within the operational environment of Joint Base San Antonio (JBSA). This phase involves a rigorous review and evaluation of existing technologies, with the aim of identifying viable solutions that can address the specific needs of JBSA. Key aspects of this evaluation include real-time traffic management, geolocation-based direction, integration with existing systems, and security enhancements.

Following the comprehensive technology evaluation, the phase moves towards conceptualizing the ITMS. This involves designing a preliminary model that aligns with JBSA's unique needs, incorporating critical features like real-time traffic reporting, geolocation services, pedestrian and wrong-way detection, as well as seamless integration with systems like DBIDS, Cameras, and platforms such as JBSA App and AF Connect. The culmination of this phase will be a thorough feasibility analysis of the preliminary ITMS design, providing vital insights for Phase II development.

Examples of information included in the feasibility study:
Current Commercial Solutions Evaluation: The initial part of the project will involve conducting a thorough review of existing traffic management solutions to understand their capabilities and limitations, and to see how they can be applied to JBSA's specific needs.

Requirement Mapping and Technology Evaluation: The project team will match the specific requirements of JBSA to potential technologies that could be part of the ITMS. This step will help identify the best technologies for the project and highlight any areas that might need custom solutions.

Conceptualization and Preliminary Design: A preliminary design for the ITMS will be developed based on the requirements and the identified technologies. This design will include key features like real-time traffic reporting, integration with existing systems like DBIDS, Cameras, and security measures like pedestrian/wrong-way detection.

Feasibility Analysis: An in-depth feasibility analysis will be conducted to identify potential barriers and risks, assess economic viability, and ensure that the design is in alignment with JBSA's operational practices and timelines.

Use Cases: The project will consider various use cases, including peak traffic management, security enhancement, system integration, user management, and data handling. These use cases will help evaluate the system's ability to meet JBSA's needs effectively."

PHASE II: Building upon the groundwork of Phase I, Phase II's primary objective is to propel the Intelligent Traffic Management System (ITMS) from concept to a comprehensive, tangible prototype. This phase is vital in demonstrating the scientific, technical, and commercial merit of the ITMS for Joint Base San Antonio (JBSA). This stage involves intensive research and development, solidifying design, software programming, testing, and verification processes.

Objectives and Expectations for the Phase II Period of Performance

Technical Design Refinement: Leveraging the insights from Phase I, the project team will refine and finalize the ITMS design. This involves addressing potential limitations identified in the feasibility analysis and integrating suggestions from the JBSA personnel and stakeholders.
Prototype Development: The approved design will be transitioned into a fully functioning ITMS prototype. The prototype will incorporate essential features like real-time traffic management, geolocation-based directions, integration capabilities with existing systems, pedestrian/wrong-way detection, and user management.

System Testing: The developed prototype will undergo rigorous testing to ensure its functionality, performance, compatibility with existing systems, and overall robustness. Any bugs or glitches identified will be addressed and rectified in this stage.

Prototype Deployment and Field Validation: Post the successful completion of system testing, the ITMS prototype will be deployed in a controlled setting within JBSA for a pilot run. The field validation will

provide crucial insights into the system's effectiveness and any unforeseen challenges in a real-world environment.

Prototyping Expectations

Operating Parameters: The ITMS should efficiently handle peak and off-peak traffic conditions, provide accurate real-time traffic updates, and suggest the most efficient routes for personnel and visitors. It should also reliably detect pedestrian and wrong-way movements.

Testing Requirements: The prototype should undergo comprehensive functional, compatibility, performance, and stress testing. This will ensure the system's readiness for full deployment, its integration with JBSA's existing infrastructure and systems, and its performance under varying loads.

Success Criteria: The ITMS prototype's success will be determined by its ability to meet all technical specifications, its effectiveness in managing traffic, its seamless integration with existing systems, its user-friendly interface, and positive feedback from JBSA's personnel and visitors during the pilot deployment.

Phase II aims to deliver a robust and fully functional ITMS prototype that can be deployed to enhance the traffic management and security at JBSA, contributing significantly to improving the base's overall efficiency and safety. The successful implementation of this phase sets the stage for Phase III, which focuses on DoD cybersecurity compliance, fielding and full-scale deployment of the ITMS across JBSA."

PHASE III DUAL USE APPLICATIONS: Phase III of the Intelligent Traffic Management System (ITMS) is focused on transitioning the system from a validated prototype to a fully operational and commercialized product, which is to be deployed across the Joint Base San Antonio (JBSA). At the onset of this phase, the system will be at a Technology Readiness Level (TRL) 7 or higher, demonstrating its readiness for operational deployment. The efforts of this phase will encompass fine-tuning of the system based on Phase II feedback, preparation for commercialization, large-scale deployment across JBSA, and provision of post-deployment support for maintenance and continuous improvement.

An integral part of this phase is adhering to DoD cybersecurity processes, thus ensuring the system's robust security and resilience to cyber threats. This includes obtaining an Authority to Operate (ATO), which underscores the ITMS's compliance with federal security directives and its readiness to operate within the DoD network.

REFERENCES:

1. Air Force Instruction (AFI) 35-101, Public Affairs Responsibilities and Management;
2. Air Force Instruction (AFI) 31-101, Integrated Defense;
3. Department of Defense Instruction (DoDI) 2000.16;

KEYWORDS: Traffic Management System; Real-Time Data; Geolocation; Base Security; User Management; Data Integration; Automated Reporting; Sensor Technology; Infrastructure Modernization; Facial Recognition

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AF242-0005 TITLE: Next Generation Field Calibration Suite for Radiometric Sensors

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: The objective of this topic is to design and construct a system that provides a mobile trailer, outfitted with an array of extended blackbody sources with aperture areas of 24”x24” or greater, for the purpose of field reference calibration data for radiometric imagers.

DESCRIPTION: Radiometric Imager calibrations are required for accurate signature data of air and ground targets, as well as airborne strategic expendables (e.g., flares and chaff). Calibration requires a truth source called a blackbody that emits heat across an extended panel.
The goal for this project is to provide better truth sources, with more pixels on source for banded radiometers on the test range.

The requirement is a mobile lab with an array of six to eight black body source panels, each with an extended area aperture of 24” or greater and a temperature range of a temperature span from ambient to 600° C variable by panel. Temperature readings and controls need to be controllable from a remote interface located in the imagers control area.

The blackbody should be installed in a manner that makes them visible by a tracking mount holding radiometric imagers at a minimum distance of 100 yards. Blackbody sources should have a probe well for the purpose of self-calibration and temperature reading verification.

PHASE I: Awardee(s) will determine the feasibility of mounting large frame blackbodies to a mobile structure. Questions for which answers will be sought include:

1. What blackbodies will be used to meet our requirements?
2. What type of mobile platform to carry the blackbodies?
3. How will the blackbodies be controlled remotely? What operating and maintenance requirements would be involved in the upkeep of the system?

PHASE II: The questions answered in Phase l will serve as the foundation for the prototype delivered in Phase ll. The prototype will be some sort of ground based trailer, towed by a government pick up truck, and capable of housing the required blackbodies.

PHASE III DUAL USE APPLICATIONS: The proposed trailer can be adapted to fit a wide variety of needs within the DoD. The device will also provide valuable data that could be of interest to various academic institutions and weather organizations. In Phase lll, efforts will be made to identify any other organizations who might be interested in using this device.

REFERENCES:

1. Berk, A., P.K. Acharya, L.S. Bernstein, G.P. Anderson, P. Lewis, J.H. Chetwynd, and M.L. Hoke, "Band Model Method for Modeling Atmospheric Propagation at Arbitrarily Fine Spectral Resolution";

KEYWORDS: Infrared; Blackbody; Calibration; longwave Infrared; MWIR; LWIR; UV; ASTE; IRCM; Signature; Radiometric; Radiometer; Extended Area; Aperture; Radiation; Emitter

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AF242-0006 TITLE: Fast-Response Flow Meters for Onboard Systems (Harsh Chemicals)

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

OBJECTIVE: To develop a fast-time-response, low flow-impedance, flow meter compatible with a pyrophoric fluid such as Tri-ethyl Aluminum (TEA) that has a small form factor and is easily integrated with standard stainless-steel tubing for use as flight hardware.

DESCRIPTION: Pyrophoric liquids such as triethylaluminum are currently being used in the Towed Airborne Plume Simulator (TAPS) to simulate the plumes of surface to air missiles in order to test aircraft missile warning systems. The flow rate of the pyrophoric liquid is controlled to simulate the temporal behavior of the intensity of a missile plume. The radiometric intensity produced by TAPS burner is strongly proportional to the flow rate of the pyrophoric fuel controlled through a specialized valving system. The system currently is lacking an accurate method of measuring the pyrophoric liquid flow rate during the TAPS burner operation. Measuring this flow rate during a burn will allow control system improvements and provide valuable diagnostic and health information. Flow sensors are unavailable that meet the requirements for time response, flow rate range, and compatibility with pyrophoric fuels which ignite upon the presence of oxygen. The viscosity of the target fluids is 2-3 centipoise. It is preferred that the solution be non-intrusive, having no effect on the flow; otherwise, having minimal impedance to the flow. Digital and analog outputs are desired to provide maximum flexibility with control and data systems.

The sensor must be repeatable and have sufficient linearity to be capable of being absolutely calibrated. The flow meter must meet current turbine flow meter specifications using low pressure-drop methods and with a relatively small form factor. The flow meter must be capable of being non-destructively operated with gaseous (typically air or nitrogen) flow when the liquid is not present. The flow meter must be able to withstand harsh vibration and temperature (roughly -40 °F to 120 °F) environments without significant degradation in performance. The flow meter must be designed with modular replacement and installation in mind.

The desired performance characteristics include:
-Repeatability of ±0.2% of reading (threshold), ±0.04% of reading (objective), ±0.02% of reading (stretch goal)
-Linearity of ±0.5% and ±0.1% using software (threshold), ±0.2% and ±0.05% using software (objective), ±0.05% and ±0.01% using software (stretch goal)
-Calibration Uncertainty of ±0.5% of reading (threshold), ±0.2% of reading (objective), ±0.05% of reading (stretch goal)
-Accuracy of ±0.4% of reading + 0.2% of full scale (threshold), ±0.2% of reading + 0.2% of full scale (objective), ±0.1% of reading + 0.1% of full scale (stretch goal)
-Response Time to Step Change in Flow Rate of ≤ 4 millisecond (threshold), ≤ 1.0 millisecond (objective), ≤ 0.2 millisecond (stretch goal)
-Flow Range of 0.05 to 5 gal/min (threshold), 0.05 to 10 gal/min (objective), 0.05 to 30 gal/min (stretch goal)
-Power Supply Voltage to be fixed input in the range of 5 to 30 VDC (threshold), uses any arbitrary voltage in the range from 5 to 24 VDC (objective), uses arbitrary voltage in the range from 303 to 52 VDC (stretch goal)
-Effective output Resolution of 2048 levels (threshold), 4096 levels (objective), 8192 levels (stretch goal)
-Maximum Power Usage of 100 Watts (threshold), 10 Watts (objective), 1 Watt (stretch goal)
-Size of 6”x3”x1” (threshold), 4”x2”x1” (objective), 2”x2”x0.5” (stretch goal)
-Maximum Operating Pressure of 130 psi (threshold), 160 psi (objective), 180 psi (stretch goal)
-Tubing Size of 0.5” to 1.0” (threshold), 0.25” to 2.0” (objective), 0.25” to 3” (stretch goal)

-Materials of Construction of 304/306 stainless steel (threshold), 304/306 stainless steel (objective), Performance alloy (stretch goal)
-Performance Life of 10,000 hours (threshold), 50,000 hours (objective), 100,000 hours (stretch goal)

PHASE I: Awardee(s) will develop a proof of principle design concept that satisfies the aforementioned requirements. Awardee(s) will research current methodologies and COTS components to conceptualize a prototype flowmeter. Awardee(s) will verify any potential high technical risk elements through analysis or empirical demonstration and assess potential points of failure and uncertainty of the measurement.

PHASE II: Awardee(s) will develop of a flow meter that meets the space, power, and packaging requirements of the flight-ready TAPS system. Awardee(s) will demonstrate flow meter performance in a relevant environment for up to 100 hours or until failure. Awardee(s) will sequentially evaluate three additional working prototype systems incorporating lessons learned to achieve a sufficiently robust and reliable flow meter technology that meets all objective requirements and/or stretch goals.

PHASE III DUAL USE APPLICATIONS: Awardee(s) can expect to formalize the production process and design the appropriate machinery/infrastructure to support full-scale commercial production.

REFERENCES:

1. Clark C, Zamora M, Cheesewright R, Henry M, “The dynamic performance of a new ultra-fast response Coriolis flow meter”, Flow Measurement and Instrumentation 17 (2006), pp391-98, doi:10.1016/j.flowmeasinst.2006.07.002;
2. Coriolis Flowmetering Technology: Theory and Practice: https://eng.ox.ac.uk/airg/research/coriolis-research/;
3. Commercial Flow Meter (less than 4 ms response time, gaseous flow only) https://www.axetris.com/en-fr/mfd/products/mass-flow-meter;
4. Commercial Flow Meter (20 ms response time, liquid flow, measures line pressure and temperature as bonus feature) https://www.instrumart.com/brand-category/994/3049/alicat-scientific-flow-meters?gad_source=1&gclid=EAIaIQobChMImMO3lMXEgwMVbDPUAR2mrQNZEAAYASAAEgJLJvD_BwE;

KEYWORDS: flow meters; pyrophoric; flow measurement; turbine meter; positive displacement meter; vortex shedding meter; magnetic meter; ultrasonic flow meter; Coriolis type; thermal meter

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AF242-0007 TITLE: Rotor High Speed Imaging System

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

OBJECTIVE: Develop a high-speed imaging system synchronized with the rotation of a rotor hub that will allow visualization of a “still” image of the hub and its instrumentation while the rotor is spinning and with the ability to control the rotational position of the hub as it is displayed in the “still” image.

DESCRIPTION: Reduction in Lost Test Time (LTT) through application of new health monitoring capability for rotorcraft testing. NFAC rotorcraft tests utilize hundreds of research data signals and rely on real time health monitoring to ensure safe operations. Much of the instrumentation used for health monitoring is mounted in the rotating frame. Cables transfer the analog signals to the fixed frame through a slip ring. There are often multiple wire harnesses and connector unions near the root end of each rotor blade that are tied off and secured to the rotor hub to prevent centrifugal forces and vibrations from fatiguing the wires to failure. Despite substantial efforts to secure wires pre-test, the likelihood of repair work at some point during a test is high. There is currently no way to detect the onset of a failure in real time until a signal becomes intermittent or is lost, which means damage has already been experienced and LTT is incurred. A high-speed imaging system synchronized with the rotation of a rotor hub that will allow the test team to visualize a “still” image of the hub and its instrumentation while the rotor is spinning with the ability to control the rotational position of the hub shown in the “still” image. This capability would provide visualization of wiring issues before more significant damage occurs.

PHASE I: Awardee(s) will develop a proof of principle design concept that satisfies the aforementioned requirements based upon research of current methodologies and COTS components to conceptualize a prototype system. Identify potential high technical risk elements through analysis or empirical demonstration and assess potential points of failure and uncertainty of the measurement. If possible, awardee(s) will demonstrate the feasibility of the approach in a laboratory environment.

PHASE II: Awardee(s) will develop a prototype system that meets the listed requirements, demonstrate the performance in a relevant environment and provide an appropriately ruggedized protype appropriate for permanent installation in the NFAC facility. Awardee(s) will assist NFAC personnel in fully integrating the system into existing NFAC video system that allows system control and image display in the NFAC control room.

PHASE III DUAL USE APPLICATIONS: This system technology could have applications for rotor system visualization in other ground-testing or flight-testing environments. At NFAC, this type of system could evolve from a health monitoring system to a data acquisition system depending on the research objectives of a test entry.

REFERENCES:

1. "Deformation Measurements of Helicopter Rotor Blades Using a Photogrammetric System”. Chenglin Zuo *, Jun Ma, Chunhua Wei, Tingrui Yue and Jin Son.

KEYWORDS: high speed photography; rotor hub; rotor system

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AF242-0008 TITLE: Fire Ignition Video Analysis Tool

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

OBJECTIVE: Awardee(s) will develop a thermal video analysis tool capable of temporal and spatial discrimination of fragment flash and armor piercing incendiary (API) projectile function cloud in three dimensions using data from both high-speed visual and infrared camera systems.

DESCRIPTION: Work has been underway for many years to understand the fire ignition phenomena in aircraft dry bays (void spaces) from the interaction of an impacting ballistic threat with a flammable fluid container such as a fuel tank. These threats include fragments produced by a warhead detonation, which cause a vaporific flash when impacting aircraft structural materials, or API projectiles, which result in release and ignition of incendiary material upon impact. The fragment or core of the projectile can penetrate the fluid container, releasing the fluid into a dry bay where the flash or incendiary functioning is occurring, and the overlap of these events results in an onboard fire. A fire ignition can start rapidly when the fluid is first spurting from the tank. During ballistic testing, many methods have been used to visualize the flash or function interaction with the leaking fuel. Both visual and infrared high-speed cameras have been used to capture the event as it unfolds. However, analysis of the event is difficult and subject to many variables, even when multiple cameras are employed from various angles and with multiple camera settings. Even with the presence of thermocouples and calibrated infrared cameras, it is very difficult to accurately capture temperature at precise locations over time. Both the timing and physical overlap in space of the flash/function and fuel are critical. Various data processing tools have been used to examine this issue, but identification of the size, location, volume, and relative intensity of the flash/function is very difficult. The presence of ignited material particles from the threat and spall from impacted aircraft surfaces makes characterization of the event even more difficult.

This SBIR Phase I effort will focus on demonstrating a post-test processing tool for capturing both temporal and spatial characteristics of the flash/function cloud in relation to leaking fuel, so more informed models can be developed to predict fire ignition. The tool must help distinguish between the presence of the flash/function and the origin of fire ignition. This requires a more accurate characterization of the flash/function cloud, including the size, location, volume and intensity of areas of the cloud. The final tool must not only provide this characterization but must be able to track the presence and relative location of leaking fuel, particularly as it interacts with the cloud. This tracking must be possible in both low and bright light conditions. It must also provide a means for observing the event with both visual and infrared high-speed camera data and being able comparing and contrast these data.

PHASE I: Awardee(s) will conduct a literature review and feasibility study to determine capability to characterize ballistic fragment flash and API projectile function size, location, volume, and relative intensity over time, while observing leaking fuel during dry bay fire testing.

PHASE II: Awardee(s) will design, develop, and demonstrate a software tool capable of characterizing the temporal and spatial characteristics of ballistic fragment flash and API projectile function, an ability to distinguish these characteristics throughout the flash/function duration, identification of adjacent fuel leakage temporal and spatial characteristics, overlap of the two elements, and timing and location of fire ignition with minimal manual manipulation.

PHASE III DUAL USE APPLICATIONS: Development of this tool will enable greater characterization of other ballistic event phenomena, such as warhead threat detonation and fragmentation, and hydrodynamic ram. It could also have commercial potential for forensic investigation of events recorded by video imagery.

REFERENCES:

1. Choi, J.; Han, T.; Lee, S.; Song, B. “Deep learning-based small object detection.” J. Inst. Electron. Inf. Eng. 2018, 55, 57–66.
2. Kim, H.; Park, M.; Son, W.; Choi, H.; Park, S. “Deep Learning based Object Detection and Distance Estimation using Mono Camera.” J. Korean Inst. Intell.t Syst. 2018, 28, 201–20.

KEYWORDS: ballistic threat; flash; function; incendiary; fire ignition; temporal; spatial

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AF242-0009 TITLE: Graphene CBRN Overgarment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Emerging Threat Reduction; Mission Readiness & Disaster Preparedness; Nuclear; Sustainment & Logistics; Military Infectious Diseases

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OBJECTIVE: By using Graphene, provide a two-part CBRN Protective overgarment with the first part protecting the wearer from most if not all CBRN agents while reducing the weight and thermal load of the overgarment. The second part will be using Graphene to create ballistic plating up to level III+ while weighing a fraction of what current level III+ plates (roughly between 4-11 pounds). With the reduced weight it would allow the wearer to don more protective pieces to areas such as the arms, legs, and other body parts.

DESCRIPTION: Results of breakthrough times for the Graphene suit against CBRN agents and compare them to the current protective overgarment as well as comparing the results to Level B and Level A Chemical suits used in HAZMAT.

Ballistic test results for the lighter weight level III+ plates showing that the Graphene plates can meet or exceed the standard of current plates.

PHASE I: Awardee(s) will determine if a Graphene composite is a suitable replacement by testing CBRN agents against the material while measuring breakthrough times. The 1st part of the suit should be a cloth like graphene composite allowing maneuverability for the wearer. Items to be used for testing will be precursors to CWAs as well as the most lethal final product that can be legally obtained for testing purposes before it is sent to Dugway Proving grounds.
The 2nd part or outer layer of the suit will be made out of a Graphene/Polymer composite for ballistic protection only and does not need to protect the wearer from CBRN agents as that is what the 1st layer is designed for.

PHASE II: Awardee(s) will develop a proof-of-concept prototype.
The 1st layer of should be able to incapsulate most of the members body ideally being like that of a hooded dive suit however not as tight.

The 2nd layer should allow for further body coverage without sacrificing maneuverability as well as negating the need for Kevlar further reducing the weight while still maintaining shock absorption properties of Graphene.

PHASE III DUAL USE APPLICATIONS: Awardee(s) can expect to develop commercialization of the suit, manufacturing methods, cost analysis, and finalize the suit's capabilities. This phase will require involving other branches of service per public law 103-160. For this idea to be approved it must become a joint program with validated research from each branch of service. After the research is conducted every branch of service must agree to the use of the suit before acquisitions take place to replace the JSLIST.

REFERENCES:

1. S. Bhattacharjee; R. Joshi; A.A. Chughtai; C.R. McIntyre; “Graphene Modified Multifunctional Personal Protective Clothing”. Adv Mater Interfaces, 2019 Nov 8; 6(21): 1900622.

KEYWORDS: Graphene; CBRN; Defense

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AF242-0010 TITLE: All-Passive Nonreciprocal Power Limiters

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Quantum Science; 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: Design, fabricate and characterize a new category of optical nonlinear metasurfaces operating as asymmetric power limiters. Such devices will be important for the protection of sensitive equipment from external interference, in particular waves from different directions in free space. The use of nonlinear effects will allow the proposed devices to be all passive, without the need of external biasing fields or signals, in contrast to other approaches for designing nonreciprocal devices, which are based on magnetic biasing or modulation with electrical signals. Furthermore, they will be ultra-thin and light-weight, making them suitable for mobile applications. The nonreciprocal response will provide an isolation larger than 10 dB, an insertion loss in the order of 1 dB over a large range of input powers and angles of incidence.

DESCRIPTION: Nonreciprocal devices are very important components for civilian and defense communication systems, in order to protect sensitive components from external interferences. Such devices are conventionally realized through magnetic materials under static magnetic fields, but this approach is accompanied by several problems, including the scarcity of magnetic materials, the large size and weight of the magnets required for the magnetic biasing and the incompatibility of magnetic materials with integration technologies. For this reason, the design of magnet-free nonreciprocal devices has recently attracted a lot of attention, with the majority of proposed approaches based on spatiotemporal modulation of appropriately designed circuits. However, these approaches often require external modulation sources, which may not be an option for applications where availability to external power supply is limited. For these cases, reciprocity can be broken by combining spatial asymmetries with nonlinear responses. In particular, including nonlinear effects in asymmetric resonators, it is possible to achieve very large transmission from one side and very small from the opposite one for sufficiently strong input signals. This call explores the application of these concepts to metasurfaces for free space isolation, protection and radiation hardening, and power limiting, operations of great importance for DoD applications.

PHASE I: Awardee(s) will explore the modelling and designing of nonlinear optical metasurfaces operating as free-space asymmetric power limiters. Analytical models to understand the underlying physics and full-wave simulations to develop optimum designs will be carried forward. Phase I awards should include preliminary fabrication experiments that demonstrate the feasibility of the approach and benchmarks on the improved properties.

PHASE II: In the Phase II effort, the design and fabrication process identified in Phase I will be evolved towards improving several metrics of the devices, including bandwidth, insertion loss, nonreciprocal power range and incident angles range. Towards this direction, different approaches, including multi-layer and multi-resonant metasurfaces will be explored, and realization of an optimal prototype will be carried forward.

PHASE III DUAL USE APPLICATIONS: The Phase III work will demonstrate the repeatability of the fabrication process and the feasibility of the proposed approach for large scale fabrication. A partnership with industry to commercialize the technology will be created. Beside the applications across all branches of the armed forces, civilian applications of this technology will be explored, including communication systems, laser protection, etc. Furthermore, exploration of these concepts for the realization of broadband and broad-angle power limiter metasurfaces will be investigated.

REFERENCES:

1. Lax B. & Button K. J. Microwave ferrites and ferrimagnetics (McGraw-Hill, 1962).
2. Estep, N., Sounas, D. L., Soric, J. & Alu, A. “Magnetic-free non-reciprocity based on parametrically modulated coupled-resonator loops,” Nature Physics 10, 923-927 (2014).
3. J. Soric, D. L. Sounas, and A. Alù, “Non-Magnetic, Non-Linear Radio-Frequency Isolator with Large Isolation and Small Insertion Loss,” in 2016 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, Fajardo, Puerto Rico, June 26 - July 1, 2016.;

KEYWORDS: Power limiter; nonreciprocal; chip scale; nonlinearity; modulation; isolation; interference

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AF242-0011 TITLE: Chip scale resonant sensors

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Microelectronics; Quantum Science; 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: Design, fabricate and characterize a new category of optical sensors with reduced dimensions that can operate with high sensitivity and spectral selectivity using highly resonant photonic devices.

DESCRIPTION: Compact sensor chips engaging guided-mode lattice resonance effects are of high utility in quantitatively detecting biological analytes and chemical species. Compact chips with high well densities can be economically and expeditiously fabricated with nanoimprint methods. Recently discovered are new radiation properties enabled by defects in resonant photonic lattices (PL). Incorporating a defect breaks the lattice symmetry and generates radiation through stimulation of leaky waveguide modes near the non-radiant bound (or dark) state spectral location. It has been shown that the defects produce local resonant modes that correspond to asymmetric guided-mode resonances in spectra and near-field profiles. Without a defect, a symmetric lattice in the dark state is neutral, generating only background scattering. Incorporating a defect in the PL induces high reflection or transmission by robust local resonance radiation depending on the background radiation state at the bound state in the continuum (BIC) wavelengths. The sensing properties of resonance lattices incorporating defects are unexplored. The defect inclusions can be designed to host quantum states. Analogous methods have significant potential to enable new modalities of radiation control in metamaterials and metasurfaces based on defects including enablement of new sensing modalities via combined classical and quantum effects.

PHASE I: Awardee(s) will design a chip scale resonant sensor compatible with standard semiconductor nanofabrication platform:

1. Select optimal materials and chemistry for IR operation.
2. Apply detailed electromagnetic design methodology to achieve a leaky wave resonant sensor design that provides superior sensing performance.
3. Evaluate expected operational capabilities versus conventional sensors, including evaluating the efficiency and signal-to-noise ratio.
4. Develop a lithography and nanoimprint plan for a phase II effort which would involve building the sensor.

The sensor developed in this effort will demonstrate the feasibility of directly integrating these sensors into current and future DoD systems for operational and cost improvements.

PHASE II:

1. Build grating based sensor processing line specifically for resonant fabrication. Perform experimental verification of the proposed materials in the appropriate spectral regime. This would include testing and quality control on all steps of the lithography and chemical depositions processes to verify the range of realizable sensitivity.

2. Refine/update and further optimize the designs using experimentally derived material properties and numerically verify the designs using full-wave electromagnetic modeling software.
3. Fabrication of three or more of the optimized designs. Multiple fabrication rounds will be performed to optimize the fabrication of the sensors.

PHASE III DUAL USE APPLICATIONS: Partner with a DoD prime contractor to develop a fabrication process that is compatible with their current (or planned) IR sensors. Integration will demonstrate the SWaP-C compared to conventional systems. A statement of work and deliverables will be identified in conjunction with AFRL and prime partner.

REFERENCES:

1. Ko YH, Magnusson R. Radiation control by defects in dark-state resonant photonic lattices. Opt Lett. 2023 Jun 15; 48(12):3295-3298. doi: 10.1364/OL.493721. PMID: 37319085.
2. S. Noda, K. Kitamura, T. Okino, D. Yasuda and Y. Tanaka, "Photonic-Crystal Surface-Emitting Lasers: Review and Introduction of Modulated-Photonic Crystals," in IEEE Journal of Selected Topics in Quantum Electronics, vol. 23, no. 6, pp. 1-7, Nov.-Dec. 2017, Art no. 4900107, doi: 10.1109/JSTQE.2017.2696883.
3. Azzam, S. I., Kildishev, A. V., Photonic Bound States in the Continuum: From Basics to Applications. Adv. Optical Mater. 2021, 9, 2001469. https://doi.org/10.1002/adom.202001469
4. Dominic Bosomtwi, Viktoriia E. Babicheva, Beyond Conventional Sensing: Hybrid Plasmonic Metasurfaces and Bound States in the Continuum, Nanomaterials, 10.3390/nano13071261, 13, 7, (1261), (2023).

KEYWORDS: Bound in continuum; sensor; nanophotonic; leaky wave; resonant; grating

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AF242-0013 TITLE: Outer Mold Line Material Condition Probe

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

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

OBJECTIVE: This topic seeks to develop and commercialize a capability for assessing the material condition of aircraft outer mold line (OML) topcoat paint systems, in the form of a handheld, lightweight, and easy-to-use measurement probe.

DESCRIPTION: The Department of Defense is interested in exploring technology solutions to inform fleet-level decisions on repainting schedules for air vehicles, in accordance with a transition from traditional schedule-based maintenance to condition-based maintenance (CBM) for the visual appearance of air vehicles. The work to be accomplished under the SBIR funding includes the development and commercialization of a handheld, lightweight, and easy-to-use measurement probe for assessing the material condition of aircraft outer mold line (OML) topcoat paint systems. The topic seeks to develop this capability in order to provide data to inform air vehicle repainting schedule decisions. Proposed technology solutions must be rugged and easy to operate in a flightline and/or hangar environment with minimal training/re-training and qualification requirements. Ideally, self-calibration or user calibration is highly desirable and much preferred over periodic factory calibration. Solutions based primarily on colorimetric (color and gloss) measurements are particularly sought, although other modalities for assessing condition/quality of painted coatings are also acceptable. Other modalities might include but are not limited to: mechanical durability, surface roughness, surface energy, contact angle. High repeatability and low variability (gauge R&R) are key performance metrics, along with measurement acquisition speed and broad applicability across many different types of coatings, including different colors, and both matte and gloss finishes. It is anticipated that the work will generate considerable quantities of experimental data. Technical proposals should therefore equally emphasize the development of algorithms for interpreting these large experimental data sets, including but not limited to multi-dimensional datamining and/or machine learning (ML) based approaches. Technology solutions will be required to achieve Occupational Safety and Health Administration (OSHA) Class 2 Division 1 electrical compliance certification in order to be used in the shadow of the aircraft. This Phase I topic is expected to deliver at least one working prototype to develop further for field trials in the follow-on Phase II effort. The successful Phase I effort will conclude with a coupon-level demonstration of the prototype technology in a lab environment.

PHASE I: The Phase I effort shall include determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential, i.e. Phase I will take the form of a feasibility study. Sufficient work must be completed in the Phase I in order to validate the product-market fit between the proposed solution and a potential AF stakeholder (program office). The offeror shall define a clear, immediately actionable plan with the proposed solution and the AF customer at the beginning of the Phase I effort. The feasibility study should include; (i) identification of the prime potential AF end user(s) for the non-Defense commercial offering, and how the offered product has been modified to solve the AF need; (ii) description of perceived integration cost(s) and feasibility of integration with current mission-specific products such as existing OML topcoat systems; (iii) a

description of how the product can be used by other DoD or Governmental customers. General Size Weight and Power (SWaP) requirements will be supplied by the relevant AF stakeholders along with electrical and other certifications necessary for successful technology transition to the warfighter.

PHASE II: Under the Phase II effort, the awardee(s) shall sufficiently develop the technical approach and prototype system in order to conduct a small number of relevant demonstrations at the customer organization's facilities (Ogden Air Logistics Center (OO-ALC), Hill AFB, UT and/or NAVAIR Fleet Readiness Center - East (FRC-E), Cherry Point, NC. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs and aircraft availability should be documented under the Phase II effort. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution. Expected Technology Readiness Level (TRL) at end of Phase II is TRL 7 - System prototype demonstration in an operational environment.

PHASE III DUAL USE APPLICATIONS: The awardee(s) can expect to 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 such as OEM's and government customers such as Program Offices will be provided. Opportunities will be made available to the small business to receive Phase III awards for providing the government direct procurement of products and services developed in coordination with the program. Phase III activities will include obtaining various approvals from OEM and program office, including program support equipment endorsements, electrical safety certifications, etc. Expected TRL at Phase III entry is TRL 7 - System prototype demonstration in an operational environment.

REFERENCES:

1. Arthur D. Broadbent, Colorimetry, Methods, Editor(s): John C. Lindon, George E. Tranter, David W. Koppenaal, Encyclopedia of Spectroscopy and Spectrometry (Third Edition), Academic Press, 2017, Pages 321-327, ISBN 9780128032244, https://doi.org/10.1016/B978-0-12-803224-4.00014-5;

KEYWORDS: Outer Mold Line; OML; Topcoat; Colorimetry; Degradation

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SF242-0014 TITLE: Into the Wild-Transitioning Basic Rsh Algs to Ops

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

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OBJECTIVE: Transition basic research algorithms developed previously with AFOSR 6.1 dollars into operations. These algorithms were developed to improve space domain awareness (SDA) to monitor the satellites in earth orbits. AFOSR is working with the Space Systems Command (SSC) TAP lab and with the Space Operations Command (SpOC) to transition and test these algorithms.

DESCRIPTION: AFOSR under collaboration with USSF Delta Operators identified several research algorithms that have the potential to improve space domain awareness (SDA) for USSF operational community. These algorithms were developed by academic researchers at many universities, tested on various platforms using many different data sources. These algorithms are in the area of orbit prediction and uncertainty quantification, change detection, characterization, tracking, and tasking. This effort will take those algorithms and mature them to perform on a single platform and test/evaluate the algorithms on relevant operational data. Algorithms that show promise to improve SDA for USSF will be matured further for potential transition to operations. A support letter from USSF is available upon request from AFWERX. Reference papers for some of the subject algorithms are shown in the reference cell. AFOSR is working collaboratively with SSC and SpOC on this effort. We have transition paths already identified. AFOSR only has 6.1 funds and cannot mature these algorithms. The SBIR program is perfect to provide the maturation of these algorithms for transition to operations.

PHASE I: Phase I will test the previously developed algorithms on operational data in collaboration with the SSC TAP lab. Testing results will be used to identify algorithms maturity and individual algorithm transition plan. Testing will also be used to mature and improve algorithm performance. A common platform where the algorithms will be integrated into in phase I will be identified, such as AFSIM, and a plan developed for how the algorithms will be integrated into the platform and how it will pull data. A common data format will be identified. Phase I output will be testing data, identification of a common platform to access data and run the algorithm, and a plan for algorithm integration.

PHASE II: Phase II will be a software effort to put all subject algorithms onto a single platform (such as AFSIM), tested with relevant data provided by USSF, conduct wargaming scenarios to evaluate the algorithms, identify strengths and weaknesses of subject algorithms. The results of Phase II will be used to identify which algorithms should be transitioned to operational support for USSF.

PHASE III DUAL USE APPLICATIONS: Phase III will be an operational hardened software package with these new SDA algorithms that will be transitioned to SpOC and SSC for space operations.

REFERENCES:

1. "Hao Peng and Xiaoli Bai, Imrpoving Orbit Prediction Accuracy through Supervised Machine Learning, Advances in Space Research (2018);

2. S. Fedeler, M. J. Holzinger, W. Whittacker, Tasking and Estimation for Minimum-Time Space Object Search and Recovery, Journal of the Astronautical Sciences, Vol. 69, pp. 1216-1249, July 2022;
3. S.N. Paul, B. Little, C. Frueh, Detection of Unknown Space Objects Based on Optimal Sensor Tasking and Hypothesis Surfaces Using Variational Equations, Journal of Astronautical Sciences, 10.1007/s40295-022-00333-z, July 2022;
4. Balducci, M., and B.A. Jones, “Probability of Collision Estimation and Optimization Under Uncertainty Utilizing Separated Representations”, Journal of the Astronautical Sciences, Vol. 67, No. 4, pp. 1648-1677, 2020.";

KEYWORDS: space domain awareness; space domain awareness algorithms; data to decision; orbit determination; satellite tracking; satellite characterization

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SF242-0015 TITLE: Programmability of Regional and/or Local Multi-Source PNT for Joint All-Domain Operations

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

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OBJECTIVE: Develop programmability aid techniques, tools, and processes to enable broad adoption of external PNT sources for resilient and assured position, velocity and timing (PVT) solutions, including ranging and relative time synchronization to precisions when GPS is degraded or not presented to address emergent needs for joint all-domain missions, including Mobility & Logistics, and Space Security, among others.

DESCRIPTION: The Air Force seeks solutions to enable broad adoption of emerging time-keeping technologies and network synchronization protocols for a multi-source PNT capability that is essential to regional and/ or local areas of interest composed of cooperative remote platforms with continuity of information synchronization and command and control for joint all-domain campaigns. An integrated multi-source PNT capability will be determined to be regionally and/or locally capable if it collectively maintains accurate PNT information over the limited time required by a specific mission and cooperatively provides remote platforms with the best possible realization of Universal Coordinated Time (UTC), in addition of other aids of local atomic clocks, GPS receivers, etc. required over the limited area when global PNT information may not be available. Specifically, regional and/or local PNT sources are those which are available from remote attritable platforms over a limited geographical area or are available at mission-essential levels of precision for a limited time because of phase and frequency offsets, unknown phase jumps, short-term noises, etc. which in turn require recalibration. As potential complements to GPS as part of a resilient integrated PNT architecture, these cooperative remote platforms providing regional and/or local PNT service coverages are enabled by wireless communications and data networks. Very often, all the remote platforms need to have a common Universal Coordinated Time (UCT) reference. Consequently, innovative standards and protocols pertaining to networked time transfer and synchronization for regional and/or local sources of PNT information are necessary.

Prospective solutions should consider: i) Complex ad-hoc networks, including tree-structure based, cluster-structure based, and fully distributed; ii) Network synchronization with asynchronous communications with reliability and bandwidth requirements; iii) Two-way time transfers against asymmetric propagation delays, Sagnac effects, and hardware operations; and iv) Convergence rates, robustness, stability, and scalability subject to network sizes and member source qualities. Furthermore, challenges and the need for further research and development – related to programmability may include but are not limited to: greater use of artificial intelligence and autonomous agents, human hierarchical guidance or in-the-loop decision, and translation of inevitable uncertainty and variability associated with individual PNT sources to achieve specific common network time synchronization accuracy and resilience metrics.

PHASE I: The awardee(s) will develop necessary plans and concepts illustrating a proof-of-concept design. The feasibility study should include such information:

1) describing how networked time transfer and synchronization technologies would enable missions in cislunar space;
2) resulting networked time transfer and synchronization requirements traced back to specific use cases;
3) describing necessary network-controlled protocols, interfaces, resilience measures, etc. and
4) modeling and simulation tools which would enable USSF force design decisions for the need for over-the-air demonstrations.

PHASE II: Awardee(s) will finalize the design of a demonstration prototype. Awardee(s) will plan and coordinate one or more demonstrations to provide proof of concept determination. Awardee(s) will perform experiments and analyze results to establish the adequacy of the solution approach and minimize transition risk. Awardee(s) will contact potential customers and establish a transition plan with partners supporting Phase III activities. Awardee(s) will provide regular communication to the government sponsor to ensure understanding of risk mitigation.

PHASE III DUAL USE APPLICATIONS: Focus on maturing the prototype technologies and processes developed in Phase II into commercial technologies. Integrate with prospective follow-on transition partners. The contractor will transition the solution of networked time transfer and synchronization to provide improved operational capability to a broad range of potential Government and civilian users and alternate mission applications, e.g., cislunar mission services.

REFERENCES:

1. Department of Defense, “Goal 2: Enhance the Delivery, Diversity, and Resilience of Position, Navigation, and Timing (PNT) Information”, DoD C3 Modernization Strategy, Sept 2020. https://dodcio.defense.gov/Portals/0/Documents/DoD-C3-Strategy.pdf;
2. Breakiron, Lee A., et al. "The accuracy of two-way satellite time transfer calibrations." Proceedings of the 36th Annual Precise Time and Time Interval Systems and Applications Meeting. 2004;
3. K. D. Pham, “Systems and Methods of Resilient Clock Synchronization in Presence of Faults,” US Patent #11,509,451, November 03, 2022;

KEYWORDS: Remote Platforms; Regional and/or Local Multi-Source PNT; Universal Coordinated Time; Networked Time Transfer and Synchronization; Resilience Metrics; Programmability

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SF242-0016 TITLE: Neuromorphic Camera for Space Domain Awareness

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

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OBJECTIVE: Neuromorphic or event camera technology can be applied to space domain awareness and offers the possibility of collecting data continuously, allowing an object's angle and rate to be determined instantaneously and significantly reducing initial orbit determination time. This topic seeks to develop a neuromorphic camera for the low signal-to-noise and low photon environments seen in space domain awareness that is capable of detecting and tracking satellites in geosynchronous orbit.

DESCRIPTION: This topic seeks to produce a neuromorphic camera for space domain awareness. A camera will be designed and manufactured that is capable of observing and tracking satellites in geosynchronous orbit. The low signal-to-noise environment consistent with astrometric observations will be considered, along with the overall capability of the sensor such as focal plane size, pixel count, read noise, and detection threshold. The camera will be designed so that it can be used for both bench-top and on-sky testing with a one meter class telescope system.

PHASE I: In Phase I a design will be created for the camera. A sensor will be designed using a combination of in-house and procured components, and a design up to PDR will be produced that includes estimated performance information when coupled with a one meter class telescope. Specific consideration should be given to the sensor's size, read noise, detection threshold, and uniformity. The design should include a comparison to other available cameras, including both U.S. and foreign produced.

PHASE II: In Phase II a prototype will be created based off the design produced in Phase I. The prototype should be deliverable to the government for bench-top testing and evaluation. Post-delivery the sensor will be characterized by the government and compared to other similar cameras.

PHASE III DUAL USE APPLICATIONS: In Phase III the Department of the Air Force will consider ordering several of the produced prototypes, with or without modification, for research and operational space domain awareness sensors. The results of the prototype evaluation will be shared with the customer base and the decision to purchase additional units will be left to the various customer program managers.

REFERENCES:

1. Bacon, Joseph G. Jr., "Satellite Tracking with Neuromorphic Cameras for Space Domain Awareness" (2021). Theses and Dissertations. 4968.;

KEYWORDS: Space Domain Awareness; Neuromorphic Cameras

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SF242-0017 TITLE: Cover glass solutions

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

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

OBJECTIVE: Improve space-based photovoltaic power generation through alternatives and modifications to space-qualified cover glass and encapsulants that increase insolation capture and conversion efficiencies of integrated photovoltaic cells. Solutions should demonstrate the ability to increase power generation from systems utilizing state-of-practice photovoltaic devices.

DESCRIPTION: Space Systems Command (SSC), located at Los Angeles Air Force Base, is responsible for developing, equipping, fielding, and sustaining lethal and resilient space capabilities for warfighters. Historically, SSC requires each mission block to have 3-5% more power. This is critical for the United States to maintain space dominance over its adversaries. Unfortunately, efficiency improvements in III-V solar cells have begun to plateau and obtaining 3-5% more power due exclusively through cell efficiency gains is becoming increasing unlikely. In order to reach the goals set by SSC, increased power generation must come from non-traditional improvement methods, including advances in cover glass technology. Cover glass is critical to protect solar cells from the harsh environment of space in Earth's orbit. Since it is a necessity to have in the system, finding a way to utilize cover glass beyond just a protective barrier can lead to increased performance in the solar module system. There are several approaches to obtain this goal. First, there has been success in literature in texturing cover glass to improve non-normal incident light transparency. By increasing transparency, more light will reach the solar cell to be converted to useful energy that would otherwise be lost. Second, down-shifting molecules absorb harmful UV photons and convert/reemit them in the visible wavelength. This increases the concentration of useful energy reaching the solar cells while simultaneously decreasing the amount of UV light that can degrade them. Last, there is room for improvement in traditional, chemically applied anti-reflective coatings (ARCs). Wider bandgap, less expensive ARCs is another way to increase the amount of light that reaches the solar cells to increase their total power conversion efficiency. Mitigating losses is becoming crucial to keep up with the demands of the increasing more complex and power-hungry spacecrafts fielded by the U.S. Space Force.

PHASE I: Awardee(s) will demonstrate materials capable of increased throughput of photons with wavelengths relevant for state of art photovoltaics for space assets. Approaches should aim to modify or replace space-grade cover glass without impacting the durability and usability of the material in a space environment. Candidate technologies include textured cover glass surfaces, doped cover glass or films capable of wavelength shifting non-useable photons, or high-efficiency, low cost anti-reflective coatings.

PHASE II: Awardee(s) will develop and demonstrate higher power generation by integrating space-qualified solar cells to the technology advancements demonstrated in Phase 1. Performance should be tested in relevant parameters to the space environment, including electrical characterization and stress testing. Results should be compared to relevant, state of art PV systems.

PHASE III DUAL USE APPLICATIONS: Awardee(s) will develop robust manufacturing method(s) and demonstrate consistency and reliability through statistical process control and relevant characterization. Awardee(s) will develop licensing or partnerships to transition technology to established vendors of space-grade photovoltaics. Awardee(s) will perform relevant qualification and validation testing through flight-like articles to advance TRL from 4 to 6 or higher.

REFERENCES:

1. https://www.nrel.gov/docs/fy01osti/28264.pdf
2. https://www.sciencedirect.com/science/article/pii/S0038092X23004061
3. https://ieeexplore.ieee.org/abstract/document/654284
4. https://www.sciencedirect.com/science/article/abs/pii/S0927024809000762
5. USSF Power & Energetics CCT Tech Need 857 – Space Photovoltaic Cell and CIC Efficiency;

KEYWORDS: cover glass; texturing; down-shifting molecules; anti-reflective coating; reflective loss; space solar; power systems

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SF242-0018 TITLE: Neon recovery and reliquefication for low temperature characterization of infrared focal plane arrays

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

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

OBJECTIVE: The primary objective is to develop commercial products that specifically permit infrared detector characterization lab users to recover, purify and reliquefy neon gas, at the small scale (<10 liters per day of liquid neon), back into a cryogenic liquid intended for use in pour fill cryogenic dewars, and, thereby, reducing the burden of acquiring additional liquid neon.

DESCRIPTION: Characterizing infrared focal plane arrays is ideally done with the test part in a pour fill dewar that uses liquid cryogens, rather than a closed-cycle system which potentially contributes noise to the test system and limits ones ability to perform focal plane array characterization at a remote facility such as a radiation source. Liquid neon is a near ideal liquid cryogen for this role. It boils at 27.5 K, which is well below liquid nitrogen and, more specifically, below where typical high performance infrared sensors operate, including long wave infrared detectors. Liquid neon also has over 40 times the refrigerant capacity per unit volume than liquid helium.[1] During a detector characterization, these two properties translate into fewer liquid cryogen transfers into the dewar using liquid neon, leaving more time for characterization. This is an absolutely indispensable advantage in the highly unique circumstance of a remote focal plane array radiation tolerance experiment, where access to the radiation source is strictly limited, rarely available and expensive, and the part must be kept cold for over a week at a time. Unfortunately, due to some unusual circumstances, liquid neon is very expensive and difficult to come by. This is because 70% of the neon produced in the world is used in the growing semiconductor chip manufacturing industry, where argon-flourine-neon excimer pulsed lasers are the workhorse source for deep ultraviolet lithography and the ultra-high purity neon (~99.9999%) used in them must be replenished every two weeks. Additionally, neon production occurs mainly as a byproduct of nitrogen generation via cryogenic distillation of air, a technique that happened to be perfected in the Ukraine where grain production requires large amounts of nitrogen for fertilizer. Given the current difficulties in the Ukraine and its diminished production capacity and the growing use of neon in semiconductor manufacturing, the price of liquid neon has risen to roughly $3000/liter, a 600% increase since 2014. Furthermore, there is currently a single domestic distributor of liquid neon, Linde Corp. However, there is a straightforward path to alleviating some of the hardship associated with the use of liquid neon for characterizing focal plane arrays.

The technology to recover and liquefy certain gases, such as helium, at the small scale (~25 liters per day) has been commercially available for nearly a decade and has had a major impact on research and medical institutions ability to experiment, or run their instruments, at cryogenic temperatures. For example, Quantum Design North America, located in San Diego, CA, already offers a complete line of helium liquifiers and helium recovery, storage and purification systems, which allows users to recover and liquefy the exhausted helium gas currently being lost from the normal boil off and helium transfers to cryogenic instruments.[2] This technology alleviates the user's dependence on cryogen suppliers and lessens the impact of rising costs and undependable supply, as well as helps preserve a precious natural

resource which is vital to scientific research and medical treatment. With some modification, a similar approach can now likely be adopted for the small scale (<10 liters per day) recovery and reliquefication of neon used in scientific research. In fact, reliquefication of exhausted neon gas was already demonstrated at the laboratory scale (~3 liters per day) in the early 1990s, but the technique was never adopted, likely due to cost and availability of liquid neon.[3]

PHASE I: Awardee(s) will perform initial technical feasibility study and develop plans for a system to recover, purify and reliquefy neon gas at the small scale for use in a detector characterization lab, or semiconductor device fa. System should be similar to existing helium reliquefiers that are currently commercially available (e.g. Quantum Design ATL160L, etc.) but with a smaller capacity of no more than 50 liquid liters and with the capability to be transportable to remote experiments. Feasibility study should also consider recovery and purification of neon from contaminated lasing gas discharged by excimer lasers used for semiconductor processing.

PHASE II: Awardee(s) will build, characterize and deliver a prototype system to recover, purify and reliquefy neon gas at the small scale for use in a detector characterization lab. System should be similar to existing helium reliquefiers that are currently commercially available (e.g. Quantum Design ATL160L, etc.) but with a smaller capacity of no more than 50 liquid liters and with some capability to be transportable to remote experiments. System characterization should show any applicability to recovery and purification of neon from contaminated lasing gas discharged by excimer lasers.

PHASE III DUAL USE APPLICATIONS: If a successful prototype is developed, then prototype will be commercialized to improve availability of liquid neon in DOD focal plane characterization laboratory and similar domestic laboratories across the US.

REFERENCES:

1. Hammond, C. R. "The Elements, in Handbook of Chemistry and Physics, 81st edition.", CRC press, p. 19, ISBN 0849304814.;
2. Quantum Design Inc. "Helium Liquefiers, Purifiers and Recovery Systems." Mar 2023, https://qdusa.com/products/helium_liquefiers.html;
3. Francavilla et al., Simple apparatus for the liquefaction of neon directly into a research Dewar, Rev. Sci. Instrum. 64, 2023, 1993.;

KEYWORDS: neon, cryogenics, recovery, purification, reliquefication, infrared detectors, excimer lasers

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SF242-0019 TITLE: Hydrogenation for defect passivation in (Si)GeSn alloys

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

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

OBJECTIVE: The objective of this topic is to evaluate the extent to which the background carrier concentration and the minority carrier lifetime of (Si)GeSn semiconductor alloys can be improved by post growth hydrogenation.

DESCRIPTION: Incorporation of Sn into either Silicon or Germanium semiconductors causes a reduction of the bandgap and indirect/direct transition around 8% Sn for GeSn alloys. Tunability of the material system has shown coverage of the short- to mid-wave infrared wavelength spectrum (2.0 to 8.0 micrometers). Couple the tunability with large area substates (8 inch Silicon) and mature CMOS processing technology; the ingredients for high performance, high manufacturability photodetection are available. As of this year the minority carrier lifetime has been shown to be short (~3 ns) with a high background carrier concentration as a limiter to device performance [1].

This recent demonstration of minority carrier lifetime in GeSn/SiGeSn quantum well is significant because the lifetime reflects how long charge excited by incoming infrared radiation can transport in the material before it can no longer be collected by the EO/IR system, i.e. the likelihood that the photon is seen. Long lifetime lead to efficient collection of charge and low dark currents, two key attributes of an efficient, high signal-to-noise image sensor. While other measures of performance are associated with the material's fundamental nature (e.g. mobility, absorption, ect.), lifetime is fundamentally a measure of concentration of defects in the material and thus the lifetime is improved by innovation and advances in material synthesis (i.e. defects add to the background carrier concentration).

As discussed in greater detail in Ref.1, the challenge to further improving (Si)GeSn for infrared-sensing applications is that low growth temperatures increase the incorporation of defects and higher growth temperatures significantly inhibit the incorporation of Sn. Increasing the growth temperature shortens the maximum cutoff of the materials as Sn, the element responsible for reducing the bandgap, incorporates less efficiently. The path forward for (Si)GeSn will require either a novel growth approach that enables more effective incorporation of Sn in (Si)GeSn at higher growth temperatures where the background carrier concentration/minority carrier lifetime can be optimized, or a means of passivating defects present in (Si)GeSn alloys grown at lower growth temperatures wither Sn incorporates more efficiently.

This topic seeks to evaluate post-growth hydrogenation as a means to passivate defects and improve the background carrier concentration/minority carrier lifetime in low-temperature grown (Si)GeSn alloys. Hydrogenation is commonly used to passivate defects in a multitude of semiconductor materials that suffer from defects. Given that the lifetime has been shown to depend on the growth conditions utilized to synthesize the material, it is possible that the defects introduced at lower growth temperatures can be passivated, leading to lower background carrier concentrations and longer minority carrier lifetimes in (Si)GeSn alloys with sufficient Sn mole fraction to effectively cover the short- to mid-wave infrared spectrum.

PHASE I: Awardee(s) will develop a hydrogenation recipe and test plan. Materials to be tested will be provided by the TPOC at AFRL/RVSU. Other materials suffering from non-optimal growth temperature constraints identified by the proposers may be included as well.

PHASE II: Awardee(s) will execute hydrogenation experiments. Hydrogenated materials will be returned to AFRL/RVSU for background carrier concentration/minority carrier lifetime testing and evaluation. An iterative process to optimize the hydrogenation technique will be performed.

PHASE III DUAL USE APPLICATIONS: If a successful hydrogenation recipe is identified, the process may be commercialized and utilized to improve (Si)GeSn and other optoelectronic materials that suffer from non-optimal growth conditions constraints.

REFERENCES:

1. P.C. Grant, P.T. Webster, R.A. Carrasco, C.P. Hains, N. Gajowski, S.-Q. Yu, B. Li, C.P. Morath, D. Maestas,"Auger Limited Minority Carrier Lifetime in GeSn/SiGeSn Quantum Well" Appl. Phys. Lett. (under review, Nov. 2023);

KEYWORDS: Hydrogenation; GeSn; SiGeSn

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SF242-0020 TITLE: Exploring Proliferated Warfighter Space Architecture (PWSA)

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

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

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

PHASE I: The focus of Phase I is to identify and demonstrate the feasibility of novel technologies aimed at bolstering the PWSA. The emphasis should be on using analytical or computational methods to move beyond first principles and document proposed advancements, culminating in a demonstrative product that establishes the approach's viability and enables Phase II planning. While a complete production-level simulation may not be necessary, the computational intensity of the effort necessitates an unequivocable demonstration of the proposed methods, even if access to supercomputing resources is limited. This phase's goal is to affirm the potential and practicality of the outlined technological approaches, validating their computational foundations to efficiently create new warfighting capabilities enabled by a set of interoperable resilient, global, proliferated low Earth orbit spaceborne constellations.

PHASE II: Phase II of this research initiative builds upon the validated technological approaches from Phase I to develop a tangible prototype aimed at bolstering the Proliferated Warfighter Space Architecture (PWSA). This phase focuses on refining and translating the established computational foundations into a well-defined prototype. Objectives include prototype development, iterative technical refinement, rigorous testing to validate performance parameters, and assessing scalability and adaptability. Success criteria involve demonstrating functionalities aligned with PWSA objectives, passing comprehensive performance tests, ensuring compatibility within the PWSA architecture, and verifying scalability across segments. This phase aims to bridge the gap between conceptual validation and implementation, culminating in a prototype showcasing the practicality and potential of these technologies in enhancing PWSA capabilities within low Earth orbit spaceborne constellations.

PHASE III DUAL USE APPLICATIONS: Phase III represents the transition of the validated prototype developed in Phase II into practical applications for both military and commercial use, leveraging non-SBIR funds for further development and integration. The expected Phase III effort involves advancing the prototype to a Technology Readiness Level (TRL) suitable for operational deployment and widespread commercial adoption. At Phase III entry, the TRL is expected to be at a high level of maturity where the technology is ready for operational deployment or commercialization. Transition planning, utilizing non-

SBIR funds, will focus on scaling up production, integrating the technology into operational systems, conducting field trials for validation in real-world environments, and pursuing certification for commercial applications. Collaboration with industry partners and government agencies will be integral to ensure seamless integration into both military and civilian space applications. The Phase III dual-use effort aims to maximize the technology's impact by facilitating its transition from the prototype stage to widespread deployment.

REFERENCES:

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

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

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VERSION 2

DEPARTMENT OF AIR FORCE (DAF)
24.2 SMALL BUSINESS INNOVATION RESEARCH (SBIR) DIRECT-TO-PHASE-II (D2P2)
PROPOSAL SUBMISSION INSTRUCTIONS

The DAF intends these proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Firms must ensure proposals meet all requirements of the 24.2 SBIR 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.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the DAF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "24.2 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 24.2 SBIR BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
  Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

General information related to the AF Small Business Program can be found at the AF Small Business website, http://www.airforcesmallbiz.af.mil/. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

DIRECT TO PHASE II

15 U.S.C. §638 (cc), as amended by the SBIR AND STTR EXTENSION ACT OF 2022, allows DoD to make a SBIR Phase II award to a small business concern with respect to a project, without regard to whether the small business concern was provided an award under Phase I of an SBIR program with respect to such project. DAF is conducting a "Direct to Phase II" implementation of this authority for these 24.2 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.

VERSION 2

DIRECT TO PHASE II PROPOSAL SUBMISSION

The DoD SBIR 24.2 Broad Agency Announcement, https://www.dodsbirsttr.mil/submissions/login, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic's requirements.

The complete proposal must be submitted electronically through DSIP. Ensure the complete technical volume and additional cost volume information is included in this sole submission. The preferred submission format is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. **VIRUS-CHECK ALL SUBMISSIONS.**

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

On April 4, 2022, the DUNS Number was replaced by the Unique Entity ID (SAM). The Federal Government will use the UEI (SAM) to identify organizations doing business with the Government. The DUNS number will no longer be a valid identifier. If the proposing small business concerns has an entity registration in SAM.gov (even if the registration has expired), a UEI (SAM) has already been assigned. This can be found by signing into SAM.gov and selecting the Entity Management widget in the Workspace or by signing in and searching entity information. For proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the Small Business Concern profile with the UEI (SAM) as soon as possible.

For new proposing small business concern registrations, follow instructions during SAM registration on how to obtain a Commercial and Government Entry (CAGE) code and be assigned the UEI (SAM). Once a CAGE code and UEI (SAM) are obtained, update the Small business concern's profile on the DSIP at https://www.dodsbirsttr.mil/submissions/.

INTRODUCTION: 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 24.2 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.

VERSION 2

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

Phase II proposals require a comprehensive, detailed description of the proposed effort. AF D2P2 efforts are to be proposed in accordance with the information in these instructions. Commercial and military potential of the technology under development is extremely important. Proposals emphasizing dual-use applications and commercial exploitation of resulting technologies are sought.

All D2P2 research or research and development (R/R&D) must be performed by the small business and its team members in the United States, as defined in the DoD SBIR 24.2 BAA. The Principal Investigator's (PI's) primary employment must be with the small business concern at the time of awardand during the entire period of performance. Primary employment means more than one-half the PI's time is spent in the small business' employ. This precludes full-time employment with another entity. 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.

(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 24.2 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) **Direct Cost Materials:** Costs for materials, parts, and supplies must be justified and supported. Provide an itemized list of types, quantities, prices, and, where appropriate, purpose. If computer or software purchases are planned, detailed information such as manufacturer, price quotes, proposed use, and support for theneed will be required.

c) **Other Direct Costs:** This includes specialized services such as machining or milling, special test/analysis, and costs for temporary use/lease of specialized facilities/ equipment. Provide usage (hours) expected, rates, and sources, as well as brief discussion concerning the purpose and justification. Proposals including leased hardware must include an adequate lease versus purchase rationale.

d) **Special Tooling, Special Test Equipment, and Material:** The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness to the work proposed. Special tooling and special test equipment purchases must, in the CO's opinion, be advantageous to the Government and relate directly to the effort. These toolings or equipment should not be of a type that an applicant would otherwise possess in the normal course of business. These may include such items as innovative instrumentation and/or automatic test equipment.

e) **Subcontracts:** Subcontract costs must be supported with copies of subcontract agreements. Agreement documents must adequately describe the work to be performed and cost bases. The agreement document should include a SOW, assignedpersonnel, hours and rates, materials (if any), and proposed travel (if any). A letter from the subcontractor agreeing to perform a task or tasks at a fixed price is not considered sufficient. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-half of the total contract price, unless otherwise approved in writing by the Contracting Officer.

The prime contractor must accomplish price analysis, including reasonableness, of the proposed subcontractor costs. If based on comparison with prior efforts, identify the basis upon which the prior prices were determined reasonable. If price analysis techniques are inadequate or the FAR requires subcontractor cost or pricing data submission, provide a cost analysis. Cost analysis includes but is not limited to, consideration of materials, labor, travel, other direct costs, and proposed profit rates.

f) **Consultants:** For each consultant, provide a separate agreement letter briefly stating the service to be provided, hours required, and hourly rate, as well as ashort, concise resume.

g) **Travel:** Each effort should include, at a minimum, a kickoff or interim meeting. Travel costs must be justified as required for the effort. Include destinations, numberof trips, number of travelers per trip, airfare, per diem, lodging, ground transportation, etc. Per Diem and lodging rates may be found in the Joint Travel Regulation (JTR),Volume 2, www.defensetravel.dod.mil.

h) **Indirect Costs:** Indicate proposed rates' bases, e.g., budgeted/actual rates per FY, etc. The proposal should identify the specific rates used and allocation bases to which they are applied. Do not propose composite rates; proposed rates and applications per FY throughout the anticipated performance period are required.

i) **Non-SBIR Governmental/Private Investment:** Non-SBIR Governmental and/or private investment is allowed. However, it is not required, nor will it be a proposal evaluation factor.

NOTE: If no exceptions are taken to an 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 24.2 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 (EXCEPT AF242-D008, AF242-D014, AF242-D016, AF242-D019), 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.
    a. *Topics AF242-D008, AF242-D014, AF242-D016, and AF242-D019 **ONLY**: the

certified and completed DD Form 2345, Military Critical Technical Data Agreement, must be included with the initial proposal submission. Proposals that do not include this document will be disqualified.

2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 24.2 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 24.2 BAA for technical data rights information.
5. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated.

FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)

Note that the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DAF does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals submitted in response to DAF topics should not include TABA.

METHOD OF SELECTION AND EVALUATION CRITERIA

D2P2 proposals are evaluated on a competitive basis by subject matter expert 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 24.2 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 Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may choose to either 1) create a plan to mitigate the risk(s) or 2) DAF may decide not to select the proposal for award based upon a totality of the review.

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).

VERSION 2

Department of Air Force SBIR 24.2 D2P2 Topic Index

Topic Number	Topic Name	Maximum Value*	Maximum Duration**
AF242-D001	High Impact LED Defense Aid	$1,800,000.00	24
AF242-D002	Detection and Geolocation of Signals of Interest Given Distributed End-User Devices	$1,800,000.00	24
AF242-D003	Exoskeleton Augmentation for Flightline and Airfield Operations	$1,800,000.00	15
AF242-D004	Waterjet Vision System	$1,800,000.00	24
AF242-D005	Continued enhancement of Additive Manufactured Foundry-grade Sand Molds	$1,800,000.00	24
AF242-D006	Chemical-Free Robotic Vegetation Control for Base Facilities and Runways	$1,250,000.00	24
AF242-D007	Machine-Assisted Electronic Protection	$1,800,000.00	24
AF242-D008	Affordable AESA for Multi-function Seeker	$1,800,000.00	24
AF242-D009	Exum Massbox: semi-nondestructively material characterization of small parts to aid in reverse engineering.	$1,800,000.00	24
AF242-D010	Co-Bot Robotic Arm (COBRA) Range	$1,800,000.00	24
AF242-D011	Segment Anything For Extended Reality	$1,800,000.00	24
AF242-D012	Humanoid Mobile Robot Manipulation Behavior Development	$1,800,000.00	24
AF242-D013	AI/ML Maintenance On-Prem Platform	$1,800,000.00	24
AF242-D014	Wide Field of View Lensing Spatially Variant Photonic Crystals	$1,800,000.00	24
AF242-D015	Mapping Complex Sensor Signal Processing Algorithms onto Neuromorphic Chips	$1,800,000.00	24
AF242-D016	High Voltage Fireset/Electric Gun System Development	$1,800,000.00	24
AF242-D017	High Resolution Low SWaP Attritable EO/IR Sensors for Stratospheric Operations	$1,800,000.00	24
AF242-D018	Development of Advanced Surface Treatments for Astroquartz Fibers	$1,800,000.00	24
AF242-D019	Seeker for Low-Cost Base Defense Munition	$1,800,000.00	24
AF242-D020	Treatments for Crack Propagation in Metal Aircraft Parts	$1,800,000.00	24
AF242-D021	Trusted, Generative AI for Acquisition Process Acceleration	$1,800,000.00	24
SF242-D022	Uncertainty Management for Space Domain Awareness of Non-Standard Threats	$1,800,000.00	24
SF242-D023	Small Satellite Swarms for ISR	$1,800,000.00	24
SF242-D024	ICED-T – Innovative Cargo Exoatmospheric Delivery Technology	$1,800,000.00	24
SF242-D025	DEMISE - DEploy Material Into Space Experiments	$1,800,000.00	24

SF242-D026	FLOATS - Floating and Loitering Ocean Advanced Technology Sensing	$1,800,000.00	24
SF242-D027	ROC STAR - ROcket Cargo System Technologies And Research	$1,800,000.00	24
SF242-D028	Strategic Advancements in Resilient Space Technologies for PWSA Enhancement	$1,800,000.00	24
SF242-D029	Space Based Environmental Monitoring (SBEM)	$3,000,000.00	24

*Proposals that exceed this amount will be disqualified.

**Proposals that exceed this duration will be disqualified.

VERSION 2

AF242-D001 TITLE: High Impact LED Defense Aid

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

OBJECTIVE: Developing and implementing less-lethal technologies such as the light-emitting diode (LED) weapon is crucial to ensuring the safety of both law enforcement officers and civilians during potentially violent interactions. The objective of this initiative is to provide officers with non-lethal alternatives that minimize the risk of injury or death to both suspects and bystanders while also being effective in stopping potential threats. In recent years, there has been a growing awareness of the need for less-lethal options in law enforcement and military operations. Lethal force should only be used as a last resort, and officers must have effective alternatives that can be used when lethal force is unwarranted or could cause unnecessary harm. Less-lethal options like LED weapons have proven effective in incapacitating or disorienting suspects while minimizing the risk of serious injury or death.

DESCRIPTION: The Air Force Security Forces Center has identified a critical need for a less-lethal weapon that can incorporate incapacitating LED lights and be deployed by throwing it into a room before entry. This weapon will provide security forces with an effective tool to minimize the risk of injury or death to all parties involved during operations that require non-lethal force. The proposed weapon will also be designed to meet the unique needs and requirements of the Air Force. It will undergo rigorous testing and evaluation to ensure its effectiveness and safety. The development of this weapon aligns with the Air Force's commitment to modernizing its equipment and enhancing the capabilities of its security forces to carry out their missions effectively and efficiently. The weapon must meet the following characteristics. 1. Lightweight and compact; The weapon should be small and easy to carry and not add significant weight to the equipment of security forces. 2. Durable; The weapon should withstand the impact of being thrown into a room or against a hard surface without breaking or malfunctioning. 3. LED lights; The weapon should feature bright, flashing LED lights capable of temporarily incapacitating individuals, causing confusion, and disorienting the target. 4. Non-lethal; The weapon should be designed to minimize the risk of serious injury or death, both to the target and to bystanders in the area. 5. Accuracy; The weapon should be designed to enable accurate throwing so that security forces can aim it at specific targets and minimize the risk of hitting innocent bystanders. 6. Reusability; The weapon should be designed to be reusable so that security forces can deploy it multiple times in a single operation if necessary. 7. Safety; The weapon should undergo rigorous testing and evaluation to ensure it does not pose a significant risk of injury or death to security forces or targets. 8. Compatibility; The weapon should be compatible with other equipment and technology security forces use and easily integrate into existing operational procedures. 9. Compliance; The weapon must meet all DOD and Air Force Compliance standards

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 or ongoing SBIR/STTR funding agreement. Applicants are expected to provide feasibility documentation that addresses the following information:

1) Provide a detailed technical description of the weapon system, including its design, components, and functionality. This must include information on using LED lights and the ability to deploy the system by throwing it into a room before entry.
2) List how the weapon system will meet the requirements, such as being lightweight and compact, durable, incorporating LED lights, and designed to minimize the risk of severe injury or death.
3) Provide a detailed Development Plan for developing the weapon system, including a timeline, milestones, and estimated costs.

PHASE II: System Development, Testing, Deployment Testing and Evaluation

The testing and evaluation process for the non-lethal weapon system would involve rigorous testing to ensure its safety, effectiveness, and compatibility with other equipment and technology. The weapon would undergo various testing scenarios to simulate real-world situations to assess its performance in different environments and against various targets. The tests would evaluate the weapon's ability to withstand impact, accuracy, and its capacity to disorient or incapacitate targets. Testing would also examine the weapon's reusability, durability, and compatibility with other equipment and technology. The weapon would also be evaluated for safety, ensuring it does not pose a significant risk of injury or death to security forces or targets.

Deployment
Implementing the non-lethal weapon system would involve integrating it into existing operational procedures. This would require training and education for security forces to ensure they understand the capabilities and limitations of the weapon and can use it effectively and efficiently. Logistical and operational considerations would also need to be addressed, including how to distribute the weapon and how to handle any malfunctions or issues that may arise during deployment.

PHASE III DUAL USE APPLICATIONS: Awardee(s) will be expected to expand the capability of a non-lethal system by conducting further research and development to identify additional features or improvements that could be made to enhance its effectiveness and versatility. This could include exploring different types of non-lethal technology, such as sound-based or electric-based incapacitating devices and integrating them into the system. Additionally, expanding the system's capability would require ongoing testing and evaluation to ensure that any new features or improvements do not compromise the safety of security forces or the system's effectiveness. This testing and evaluation process could involve simulated scenarios and real-world testing under controlled conditions. Finally, expanding the capability of the non-lethal system would also require ongoing training and education for security forces to ensure that they are equipped with the knowledge and skills necessary to use the system in various situations effectively. This could involve regular training exercises and simulations, as well as incorporating the system into the standard training curriculum for security forces.

REFERENCES:
1. AFI 31-117, Arming and Use of Force by Air Force Personnel;
2. DoD Instruction 5200.08, Defense Law of War Program;
3. DoD Instruction 3150.08, Application of Laser and Directed Energy Weapons.;

KEYWORDS: Non-lethal weapons; Security forces; Military operations; Law enforcement; Incapacitating devices; Research and development; Light Emitting Diode: LED; Less than Lethal

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VERSION 2

AF242-D002 TITLE: Detection and Geolocation of Signals of Interest Given Distributed End-User Devices

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

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

OBJECTIVE: Air Force Research Lab (AFRL) is developing a protocol to leverage the sensing capacity of general-purpose end-user devices distributed on the battlefield, considering factors such as device duty cycle, power and resource constraints, sensor capability, and geographic and relative position. The objective of this SBIR topic is twofold: 1. to develop client-side algorithms to exploit the sensors available on a modern smartphone (such as the Samsung Tactical Edition commonly used as an Android Tactical Assault Kit (ATAK) end-user device) to detect signals of interest and/or anomalous signals such as GPS jammers/spoofers, small unmanned aerial systems (sUAS), cell signal jammers, gunshots, Wi-Fi, or Bluetooth and 2. to develop server-side (or distributed) algorithms to fuse reports from client devices in order to accurately geolocate the source of identified signal or signals.

DESCRIPTION: Modern smartphones are powerful, general-purpose compute devices that provide low-level access to an array of sophisticated sensors for connecting to radio-frequency (RF) systems, reporting on movement, recording audio/video, and other modalities. Increasingly, these devices are positioned on the battlefield and have immediate access to operationally relevant data and signals. This topic aims to capitalize on this underutilized potential, prompting the development of client capabilities to better sense the environment and server capabilities to better reason over edge sensor reports. New development under this SBIR will tie directly into AFRL's effort to develop a distributed sensor tasking protocol to enable such technologies. Awardees under this topic will be given access to beta releases and supporting data for the new protocol, as well as APKs, SDKs, documentation, supporting frameworks, and developer expertise for the Tactical Assault Kit (TAK) ecosystem, including ATAK, iTAK, and TAK Server.

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 or ongoing SBIR/STTR funding agreement. Applicant(s) are expected to provide detail and documentation in the proposal that demonstrates feasibility via achievement of a "Phase I-type" effort for client and/or server-side sensing or geolocation of signals of interest.

PHASE II: Applicants should include development, installation, integration, demonstration and/or test and evaluation of proposed client and/or server software. This demonstration should evaluate the proposed solution against beta releases of AFRL's protocol for tasking distributed client sensors. Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: Successful Phase II technology effort reaching suitable TRL (6-7) will be candidates for additional Phase III development, including potential for transition to the Tactical Assault Kit (TAK) ecosystem in partnership with the TAK Product Center (TPC). In addition,

Phase III efforts will focus on delivering client sensing and server localization capabilities to potentially a broader spectrum or series of diverse customers for operational use in a relevant commercial/ civilian, or government/military working environment.

REFERENCES:

1. https://tak.gov;
2. https://www.ion.org/publications/abstract.cfm?articleID=15546;
3. https://navi.ion.org/content/69/3/navi.537;

KEYWORDS: distributed sensing; end-user devices; signals of interest; GPS jamming/spoofing

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VERSION 2

AF242-D003 TITLE: Exoskeleton Augmentation for Flightline and Airfield Operations

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

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

OBJECTIVE: Develop longitudinal data that shows an exoskeleton system appropriate for airmen performing airfield and flightline operations such as Aerial Port, Fuels, and Transportation Management is both effective and reliable in an operational environment.

DESCRIPTION: Airmen performing flightline and airfield operations suffer from a wide range of acute and chronic musculoskeletal injuries that arise from heavy physical strain put on the personnel while performing their duties. These injuries afflict the joints of the body head-to-toe including the ankles, knees, hips, lumbar vertebra, shoulders, elbows, and wrists. A career of moving heavy loads, climbing ladders and stairs, jumping from elevated platforms, and maneuvering over uneven terrain and surfaces leaves these airmen debilitated with any combination of afflicted joints. This has the potential to take them out of the fight earlier in their career and contributes to personnel staffing and retention problems. Austere airfields only compound this problem. Austere environments can be expected to include non-paved surfaces, rolling terrain, poor access to local material handling equipment, poor access to local energy sources including suitable fuel, and tight access to airfields and aprons. Flightline and airfield crews may also be minimally staffed, not having enough personnel to fulfill all the necessary roles. This leaves airmen pulling double duty or completing their job with fewer than optimal personnel and without some of the necessary equipment used to do their job. The mindset of aerial porters and other operators is to get the job done with what is available, and this often puts them at increased risk of injury to complete their mission and increases the strain on their bodies.

Without the logistical power these airmen provide, the Air Force cannot operate within Agile Combat Employment (ACE) concepts as intended. The inadequate personnel staffing, injury, and equipment problems described above affecting our airmen severely limits our ability to operate at the accelerated tempo and with the reduced logistical footprint needed to win a near-peer fight.

However, wearable exoskeletons may provide some relief for airmen in flightline and airfield operations. These devices can offload a percentage of the load put on airmen when performing their duties and can potentially augment their strength and stamina. Exoskeletons may be an important force multiplier capability that can enable our airmen to perform their duties safely and within ACE concepts even in the face of inadequate manning and unavailable equipment. Although exoskeleton technologies have been developed that address the aerial porter job 4, there is still a critical need to address the problem of proving effectiveness and reliability of these systems in an operational environment. To date, there are no statistically-relevant data that shows these exoskeleton systems are effective at meeting the user requirements of airfield and flightline AFSCs in operationally relevant environments or that the systems are reliable and safe for airmen to use over the course of their careers. Without this information, commanders and end user confidence in exoskeletons remains skeptical, adoption of new assistive technologies will continue to suffer, and these problems facing our airmen will persist.

In order to solve these problems, appropriate exoskeleton systems must be proven against a list of end-user-derived requirements under a protocol that will produce statistically-relevant results.

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 or ongoing SBIR/STTR funding agreement.

Applicant(s) must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Applicant(s) must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to meet the capabilities of the stated objective. Applicant 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: Awardee(s) will develop a wearable exoskeleton to meet user requirements in flightline and airfield operations. Awardee(s) will test the system to ensure it meets capability and reliability requirements.

i. Develop and demonstrate wearable exoskeleton to augment strength and/or stamina of airmen and reduce risk of musculoskeletal injury when performing flightline and airfield operations in their duty tasks.
ii. Develop and demonstrate wearable exoskeleton to operate in austere locations with a minimum IP rating of IP57W, with an ideal rating of IP68W.
iii. Develop and demonstrate wearable that can operate in a temperature environment of -40 to 125 degrees F.
iv. Ensure the system meets all other identified end user capability requirements . These include but are not limited to:
    a. 8-12 hour run time between recharge/refuel.
    b. Assist lifting boxes >51 lbs. when building/disassembling pallets.
    c. Maintain maneuverability and not snag when working with nets/chains/tie downs.
    d. Assist lifting items (135+ lbs) from ground to height of 80" and vice versa.
    e. Assist handling dunnage.
    f. Maintain maneuvering ability when carrying a load.
    g. Assist pushing pallets to/from the aircraft using the arms pushing forward or the back pushing backwards.
    h. Maintain ability to climb up and down vehicles, highline docs, containers, etc.
    i. Assist pulling fuel hoses 300 ft.
    j. Assist unfolding and moving 50k gallon fuel bladders.
    k. Ability to tune force output quickly and intuitively.
    l. Incorporate emergency shutdown to protect the user if unsafe conditions arise.
    m. Incorporate graceful failure modes to abort lifts in event of system failure or shutdown.
v. The system should not require the user to doff the system when operating any vehicle employed in flightline and airfield operations.
vi. Develop meaningful performance metrics and gather statistically relevant-data on system performance
vii. Awardees are expected to participate in a Military User Assessment with end users to ensure the system meets capability requirements.
viii. Awardees are expected to participate in a long-term MUA to ensure the system meets reliability requirements.

ix. Awardees should be prepared to deliver up to five (5) systems in order to adequately test the systems in an operationally relevant environment .
    a. Cargo area of a C-130 or C-17
    b. Operate in and around airfield and aircraft snag hazards without snagging.
    c. Uneven terrain and non-smooth surfaces found in austere airfields.
    d. Maneuver through tight quarters between cargo loads or aircraft walls as tight as an 8" clearance.
    e. Laying supine under rolling stock.
    f. Wearable while operating vehicles and Material Handling Equipment (MHE).

x. Document all methods and results in a final report.

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to flightline and airfield operations. Solutions may have application to commercial air cargo operations, warehouse material handling operations, and construction.

REFERENCES:

1. Department of the Air Force Operational Imperatives, https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf
2. Lt.Col. P Lucas; 72469 USAFSAM PHR Report – AMC 2T2 Consult Memo, 2017
3. Lt.Col. P Lucas; 78627 USAFSAM PHR Cargo Mvmt – AMC 2T2 Consult Memo, 2018
4. Giardina, Gina M; Take the load off: Exoskeleton to enhance safety, retention for aerial porters, others. - https://www.afrl.af.mil/News/Article-Display/Article/3187272/take-the-load-off-exoskeleton-to-enhance-safety-retention-for-aerial-porters-ot/, 2022;

KEYWORDS: Contested Logistics, austere operations, austere environment, aerial port, logistics, cargo handling, exoskeletons, material handling equipment (MHE), flightline operations, airfield operations, Agile Combat Employment

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VERSION 2

AF242-D004 TITLE: Waterjet Vision System

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: This project will focus on the development of a system to produce AI generated one-off robotic programming. The programming should use visual data collected and assessed in an autonomous manner. An optimized physical system should be delivered and integrated into the Depot environment.

DESCRIPTION: Water Jet is one of the optimal choices for coating removal due to its low stock loss on parent material. Ageing weapon systems have lead to each repair becomes its own snowflake (one of a kind) item, thus small spots of the coatings are often not removed and require sections of the program to be reran. Vision systems are being developed for several different types of technology for determining areas that need to be processed. the system develops the path planning to successfully process the part. Building on vision system technology, this project would make recommendations to complete the coating removal and speed up the unique rework loop.

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 or ongoing SBIR/STTR funding agreement. The applicant should be able to prove a firm understanding and ability to demonstrate an ability to meet the requirements of the project. Specifically, they should have some working relationship with vision systems and/or water jet stripping technology. The vendor must be able to provide sufficient data for the government to determine feasibility.

PHASE II: This will be a SBIR D2P2 with a 24 month Period of performance. This project will be the application and development of a machine vision system for Depot level waterjet cleaning and material removal. The applicant should advance the previous AFRL MANTECH associated work using similar technologies for sanding processes. The scope of the project will evaluate through an applicant developed system that will be integrated with existing an existing Depot waterjet. The system will be optimized for propulsion parts to include the scale of size and geometric complexity. An optimized demonstration of the physical system is expected as part of the deliverable.

PHASE III DUAL USE APPLICATIONS: Following successful SIBR prototyping, the ALC will dedicate CIP funds to upgrade all 11 of the water jet stripping systems to have this vision system.

REFERENCES:

1. https://www.fanucamerica.com/products/robots/vision-products;
2. https://www.progressivesurface.com/waterjetcleaning.htm;

KEYWORDS: Waterjet; Vision; AI; Artificial Intelligence; Cleaning; Depot; Machine Vision

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VERSION 2

AF242-D005 TITLE: Continued enhancement of Additive Manufactured Foundry-grade Sand Molds

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

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

OBJECTIVE: Advance the use of Lost-PLA to be able to achieve aerospace grade aluminum castings. Upon completion of the project, Tinker will be able to cheaply deploy investment casting type capabilities within REACT within an easily scalable workflow.

DESCRIPTION: -Deploy PLA manufacturing systems within REACT that are compatible with the ATO.
-Establish digital workflow to go from a reverse engineered part to a PLA print capable of operating as a casting positive
-Establish process controls and facility requirements for the investment and set up of the casting
-Perform sufficient testing to demonstrate AMS 2175 quality of Class B or

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 or ongoing SBIR/STTR funding agreement. Applicant(s) must be able to demonstrate ability to use evaporative casting methodologies (e.g. lost-PLA or lost-foam) previously. PLA or foam tooling manufacturing must be of additive/digital variety. The applicant(s) must be able to provide sufficient data for the government to determine feasibility.

PHASE II: -Deploy PLA manufacturing systems within REACT that are compatible with the ATO.
-Establish digital workflow to go from a reverse engineered part to a PLA print capable of operating as a casting positive
-Establish process controls and facility requirements for the investment and set up of the casting
-Perform sufficient testing to demonstrate AMS 2175 quality of Class B or higher

PHASE III DUAL USE APPLICATIONS: Output from Phase II will result in a low cost (~$15k-30k) ability for Tinker to expand to lost-PLA casting. Other bases with the ability to melt (e.g. Rock Island Arsenal in the US Army). The ALC will purchase technology using organization (working capital) funds.

REFERENCES:

1. AMS 2175;

KEYWORDS: Casting; Investment Casting; Lost PLA; Aluminum

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VERSION 2

AF242-D006 TITLE: Chemical-Free Robotic Vegetation Control for Base Facilities and Runways

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

OBJECTIVE: Explore and develop innovative technology solutions to automate base maintenance equipment that reduces manpower, maintains high readiness, and reduces toxic chemical environmental impact from maintenance operations.

DESCRIPTION: Weeds and invasive vegetation control is a critical foreign object debris (FOD) prevention activity. The National Association of FOD Prevention Inc. reports that FOD costs the aviation industry US$13 billion per year in direct plus indirect costs. Vegetation attracts wildlife, introducing a bird/wildlife aircraft strike hazard (BASH).

At many Air Force bases, entomologists conduct critical weed and invasive vegetation control activities to reduce the flightline FOD risk and keep aircraft safe and operational. This time-consuming manual activity relies on inordinate amounts of manpower, and exposes airmen to the toxic herbicides used to remove weeds. Herbicide exposure requires Airmen to don protective gear. Airmen undergo medical examinations every six months to check for hazardous chemicals in their bloodstream. These Integrated Pest Management Program activities are expensive and puts Airmen health at risk.

Agricultural and ground management operations have been disrupted by labor shortages and shortages of critical agricultural inputs, including synthetic fertilizers (Russia a leading supplier) and chemical herbicides (China sole component supplier). Recent global events have also highlighted global food supply vulnerabilities, either from malicious actions of foreign adversaries, unsecure technology, or climate change. Risks of worsening disruptions can be mitigated by developing vegetation management technologies that reduce dependency on herbicides and synthetic fertilizers, which, if deployed on a large scale, would simultaneously reduce greenhouse gas emissions, and help reverse catastrophic climate change trends. The same agricultural technologies could reduce cost to maintain or reduce invasive species, ensuring warfighters have a food supply at least as safe and reliable as that expected by the consumer.

This topic seeks solutions the DAF can use to automatically maintain vegetation near the flightline, reducing manpower and cost, while eliminating the use of chemicals. Specifically, the DAF is seeking solutions that provide autonomous, chemical-free control of vegetation growing in hard-to reach locations such as along fence lines and building foundations. It is expected the solution also provides a means for enabling increased adoption of regenerative agriculture practices, mitigating the impact of input scarcity while assuring agricultural output sufficient to feed warfighter and the free population alike.

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 or ongoing SBIR/STTR funding agreement. Applicant(s) must include in its response to this topic "Phase I-type" feasibility documentation that substantiates the scientific and technical merit and "Phase I-type" effort such as developed a concept for a workable prototype or design to address, at a minimum, the basic requirements as described above. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results for establishing the scientific and economic feasibility of the proposed work. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI).

VERSION 2

PHASE II: Phase II will be a continuation of research and development already performed in a "Phase I-type" effort. The focus in this phase should finish refinements of system design concepts, building and testing of a field-scale prototype, and prototype validation based on field usage and base demonstration. Proposals should include development, installation, integration, demonstration and/or test and evaluation of the proposed solution prototype system.

These activities should focus specifically on:

- Evaluating the adapted solution against the proposed objectives and measurable key results.
- Describing in detail how the installed solution differs from the non-defense commercial offering to solve the Air Force and/or Space Force need(s), as well as how it can be scaled for wide adoption, i.e., modified for scale.
- Identifying the proposed solution's clear transition path, taking into account input from affected stakeholders, including but not limited to, end users, engineering, sustainment, contracting, finance, legal, and cyber security.
- Specifying the solution's integration with other current and potential future solutions.
- Describing the solution's sustainability, i.e., supportability. Identifying other specific DoD or Governmental customers for the solution.

PHASE III DUAL USE APPLICATIONS: Military Application: Automated equipment that enables widespread adoption of sustainable vegetation management agricultural practices, reducing operational costs and ensuring food supply to warfighters and US allies. Similar equipment supports the rapid deployment of mobile bases, in a wide variety of terrains and environmental conditions, as well as routine base maintenance.

Commercial Application: Agricultural equipment that enables widespread adoption of sustainable agricultural practices, profitably, across a variety of agricultural conditions.

REFERENCES:

1. The National Association of FOD Prevention Inc. reports that FOD costs the aviation industry US$13 billion per year in direct plus indirect costs. https://fodprevention.com/fod-prevention-information/
2. Gillezeau C, van Gerwen M, Shaffer RM, Rana I, Zhang L, Sheppard L, Taioli E. The evidence of human exposure to glyphosate: a review. Environ Health. 2019 Jan 7; 18(1):2. doi: 10.1186/s12940-018-0435-5. PMID: 30612564;
3. PMCID: PMC6322310.
4. Pesticide Supply Outlook: Pesticide Shortages, High Prices Unlikely to Ease in 2022 https://www.dtnpf.com/agriculture/web/ag/crops/article/2022/02/08/pesticide-shortages-high-prices-ease;

KEYWORDS: Biotechnology; Directed Energy (DE); weed abatement; Autonomous maintenance; Vegetation control; Robotics; Herbicide reduction; Regenerative agriculture; Dual-Use;

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VERSION 2

AF242-D007 TITLE: Machine-Assisted Electronic Protection

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

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

OBJECTIVE: The objective of this Small Business Innovation Research (SBIR) Direct to Phase II topic is to develop an innovative system for Opportunistic Selection and Waveform Adaptation (OSWA) to resist adversary jamming. OSWA will use cognitive radar utilizing machine learning to intelligently select and adjust resistant waveforms during real-world operation response.

DESCRIPTION: Cognitive radar has shown some capability to automate intelligent radar responses to the electronic environment. This includes being able to quickly identify and react to electronic attacks such as jamming or deception. Phase I developed the OSWA to make this technology feasible. Therefore, this SBIR phase II prototype shall be able but not limited to improve cognitive intelligence in radar functionality. (i.e., it will develop Opportunistic Selection and Waveform Adaptation for electronic warfare (EW).) Phase II will also seek to increase signal processing and EW hardware systems for radar technology. This phase II seeks efficient prototype development that will be operationally used in the Air Force.

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 or ongoing SBIR/STTR funding agreement.

This topic aims to develop an advanced Opportunistic Selection and Waveform Adaptation (OSWA) system, leveraging AI and ML, particularly in cognitive electronic warfare. The OSWA system will enhance modern radar systems' resilience against electronic attacks like barrage noise and deceptive jamming by dynamically selecting and adjusting jam-resistant waveforms using real-time feedback on effectiveness and adversary behavior. Phase I focused on demonstrating continual adaptation of waveforms to counter electronic attacks, combining expert rules and reinforcement learning, integrating cutting-edge machine learning algorithms with signal processing and electronic warfare hardware proficiency. This technology is currently at an acceptable stage to award a D2P2.

PHASE II: For this phase II, the proposals should include development, installation, integration, demonstration, test and evaluation of the proposed solution prototype system enhancement of their Phase I like prototype equivalent solution. This Phase II will seek to implement and demonstrate a realistic case scenario of cognitive EW successfully resisting adversary jamming with radar. Moreover, this SBIR phase II prototype shall be able but not limited to successfully resist adversary jamming through cognitive radar.

PHASE III DUAL USE APPLICATIONS: Phase III efforts will focus on transitioning operationally ready technology to a commercial sector or DoD environment. The offeror will identify transition partners. TRL should be at a minimum of a TRL 6. The AI technology will have a well-developed radar

functionality to deliver the realization of such technology to the war fighter or commercial sector. Once this technology hits the required rightness level, then it will be integrated in the ARTS V3 ground radar program.

REFERENCES:

1. https://www.sbir.gov/node/2328925;
2. https://ieeexplore.ieee.org/document/9035657;
3. https://ieeexplore.ieee.org/document/9446140;

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

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VERSION 2

AF242-D008 TITLE: Affordable AESA for Multi-function Seeker

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: The objective of this effort is to enhance the manufacturability and reduce the unit cost of scalable AESA front-end RF electronics apertures for SWAP-constrained munitions platforms and other small unmanned airborne platforms.

DESCRIPTION: Seekers for evolving weapon platforms require affordable wide-band front-end RF electronics to enable long-range, all-weather, GPS-denied precision strike. This topic will address this need by developing and maturing an affordable, scalable AESA front-end for SWaP-constrained munitions platforms. Critically, the effort should address improvements in manufacturability, reliability, testability, producibility, and maintainability aspects of the AESA design that are key drivers for overall component affordability. To achieve these goals, it is expected that the proposer will have significant previous design, engineering, and development experience with AESA front-end apertures and, likely, an existing basic AESA design consistent with application to munitions platforms. The ultimate end-product of this effort will be a functional prototype AESA front-end that has been tested and demonstrated in a realistic laboratory environment. The effort must include DFx analyses (e.g., design for manufacturability, design for reliability, design for testability, design for producibility, design for maintainability, design for cost, etc.) that support the cost objective.

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 or ongoing SBIR/STTR funding agreement. Applicant(s) will demonstrate feasibility be describing previous design, engineering, and development experience with AESA front-end RF electronics apertures for SWAP and cost constrained tactical airborne platforms.

PHASE II: With a keen focus on design-for-affordability and manufacturability, the awardee(s) will develop, refine, and prototype a high-performance, wideband AESA and front-end electronics solution using next-gen beam-forming integrated circuits. The targeted unit volume production cost is $15,000. The awardee(s) will demonstrate performance by integrating with back-end support electronics to create a functional RF system prototype and conduct laboratory testing. The awardee(s) will also perform Design For (X) (DFx) to ensure the design is ready for transitioning to targeted tactical airborne platforms; including volume manufacturing, reliability, testability, cost-effectiveness, quality, and maintainability efforts, with the results folded into the final design.

PHASE III DUAL USE APPLICATIONS: Phase III will focus on productization of the system developed during the Phase II. AFLCMC/EBDA has expressed interest in funding Phase III maturation of this technology in response to ACC requirements.

REFERENCES:

1. Active Electronically Scanned Arrays: Fundamentals and Applications, Brown, Arik, D., IEEE Press, 2021.
2. Phased Array Antenna Handbook, 3rd Ed., Mailloux, Robert, J., Artech House, 2017.
3. Beam Steering and Beam Stabilization of Active Electronically Scanned Array (AESA) Seeker for Missile Guidance, Patel, Vikas and Madhukar, H. 2021 International Conference on Control, Automation, Power, and Signal Processing (CAPS), IEEE, Dec 2021.;

KEYWORDS: Active electronically scanned array; AESA; tightly coupled dipole array; stand-off attack munition; wideband array; beamforming integrated circuits; system-in package

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VERSION 2

AF242-D009 TITLE: Exum Massbox: semi-nondestructively material characterization of small parts to aid in reverse engineering.

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

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

OBJECTIVE: There is a strong demand within the AFCS to accurately and quickly perform material identification on parts, specifically with the purposes of reverse engineering and rapid prototyping. The current practices for material identification are often prohibitive due to cost, time, and need for skilled operators. The current deficit in material testing means that many projects are completed without pertinent material information, or they are simply canceled due to the inability to complete the material testing requirements. The goal of this award would be to perform a detailed trial run of Exum's novel Massbox technology alongside conventional testing methods to determine if it is a suitable replacement for conventional testing, and ultimately implementing it as a more cost/time affective solution where applicable.

DESCRIPTION: To meet the AFCS material testing needs, the outcome of this SIBR should include testing a variety of common aerospace materials (i.e., aluminum, titanium, steel, nickel) with a focus on comparing the data generated by the Exum Massbox with that of conventional material testing methods. To meet the objective of implementing the Massbox as an alternative to the cost prohibitive conventional testing, the test results must show that the Massbox produces comparable data, specifically with the light elements that XRF struggles with and at a lower cost than the current methods employed.

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 or ongoing SBIR/STTR funding agreement. The applicant(s) must feasibility by demonstrating the ability to provide data generated from a working Massbox indicating that the instrument is currently operational and capable of deployment for a feasibility study.

PHASE II: An operational Massbox will be delivered to REACT for evaluation of the capabilities. Over the course of 2 years, Exum will work jointly with REACT to develop machine parameters that allow for the material identification of a majority of all alloys regularly used in the aerospace industry (i.e. standard aluminum alloys,
nickel alloys, iron, copper, cobalt, titanium, etc.). The final data output from the Massbox must be comparable or better than that generated by a standard OES machine.

PHASE III DUAL USE APPLICATIONS: The expected TRL at Phase III entry is a TRL 7 or TRL 8. If Phase II proves successful and economically viable, Phase III efforts will include technology transfer to other ALC Bases.

REFERENCES:

1. Digital Material ID;

VERSION 2

KEYWORDS: Exum; Massbox

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VERSION 2

AF242-D010 TITLE: Co-Bot Robotic Arm (COBRA) Range

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Human-Machine Interfaces; 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: System should be fully automated with an integrated approach to radome testing. Should utilize co-bot and radio frequency (RF) software and include a user friendly interface. New system should reduce the testing time for the end item, increase reliability and sustainability of the test system and increase the security of personnel operating the equipment.

DESCRIPTION: Would like for project to deliver an upgraded robot, upgrade operating system to windows 10 or newer and upgraded software and hardware. Rewrite of software should include redefined scan patterns to help improve efficiency. New user interface should integrate robot motion scan patterns and RF measurement collection to a single platform to fully automate the testing process. New system should use commercial off the shelf parts to guarantee supportability of the equipment for years to come. Lastly will need to include the development of a range check-out procedure for verification and calibration of range by the user.

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 or ongoing SBIR/STTR funding agreement.

Collaborative Robots (Co-bots) are widely used in the manufacturing industry to collect measurements, probe, scan and successfully perform repetitive functions. Co-bots have demonstrated that they can be safely integrated for the use in non-destructive inspections (NDI) in many facets of the manufacturing industry. By arming the cobots with the correct hardware we can expand their usability and show they can be used to perform the electrical testing of various aircraft radomes. Equipping these co-bots with RF antenna probes and or standard gain horns will enable them to successfully create a two horn interferometer for the collection of RF measurements. This application should facilitate and improve the radome testing capabilities substantially if integrated with the use of proximity sensor and scanning technology.

PHASE II: The expected outcome of Phase II is for the vendor to develop, deliver, install, and commission: two co-bots capable of performing the required inspections and prove the motion synchronization and alignment system. Phase II should also lead to the production of the positioners required for the installation of the co-bots. Should demonstrate the system's ability to perform the required testing for B-1B radomes, which includes the tail cone, wing gloves and scuppers. This phase should also lead to the production of the necessary hardware required to mount the antennas to the end-of-arm of the co-bots. These mounts should make it easy for end user to change the required antennas on both co-bots. Vendor will also be required to develop, deliver and demonstrate the operating system and software necessary for the operation of the robots. Software delivered should have the ability to port

existing scan patterns and allow end users to train co-bots. Software should also provide the ability for the editing and development of new patterns by allowing the users to manually guide co-bots. Software should also demonstrate that it is cable to execute the position based triggering necessary to fully automate testing procedures and allow for the collection of RF measurements and for the processing of the data collected during test.

PHASE III DUAL USE APPLICATIONS: Upon entry of Phase III, the project will be a minimum of TRL 7 with a target of meeting TRL 9. Once the system has been proven to work the plan is to perform developmental test and evaluate the system to ensure it meets design specifications. Ensure that the system is operational in its final configuration under the environmental condition it is expected to operate in and assess any problems and develop plans to resolve problems before finalizing the design. Verify system's actual application in its final form and under mission conditions. If the Phase II is successful in developing the needed technology, the ALC can/will purchase technology using organization working capital funds.

REFERENCES:

1. https://research.aimultiple.com/cobot/;

KEYWORDS: Co-bots; interface; radio frequency; radome testing; probe antenna; standard gain horn; antenna; positioner

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VERSION 2

AF242-D011 TITLE: Segment Anything For Extended Reality

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

OBJECTIVE: there is a clear AFSC and DoD need to automate sustainment processes in order to improve safety, quality, capacity, and readiness. Our near peers are automating at an alarming rate, and we should be developing technologies that keep us as many steps ahead as possible. The purpose of this topic is to research, evaluate, and implement Artificial Intelligence (AI) based 3D spatial mapping techniques using COTS XR (Commercial Off The Shelf Extended Reality) devices for fast and precise detection of multiple known and unknown objects without the additional need of AI training. This data will enable other automated systems to understand their environment quickly and easily while empowering the human to add value and oversight.

DESCRIPTION: recent advances in AI-based 2D image segmentation methods such as Segment Anything Model (SAM) has enabled automatic detection and precise segmentation of any object in a 2D image without additional AI training. Additionally, this image segmentation can be customized based on the environment by points, areas, and size of objects in the 2D image. The segmentation AI models transfer over a range of different data sets and environments with a high accuracy, making it robust to changes in environments and objects in that space.
The use of mobile industrial robots in sustainment and depot environments has grown significantly over the years and provides great improvements in safety, quality, agility, and throughput metrics. A key challenge for mobile robots is to have an accurate 3D spatial map of dynamically changing environments in order to reach the target workpieces without accidentally colliding into other 3D objects or humans in the environment.
Using COTS XR devices to capture 3D images and applying and extending the 2D SAM models toward captured 3D images can enable real time 3D spatial mapping and segmentation of all objects in a dynamic operational environment. This segmentation information and precise localization of various objects in 3D space can be automatically transferred into robotic controls for precise path planning without collision. The desired process will be seamless for the operator, who can confirm on XR devices the accuracy of the segmentation in real time, practically eliminating error and making mobile robotic systems faster and more agile.

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 or ongoing SBIR/STTR funding agreement. Applicant(s) will demonstrate feasibility by describing the ability to accurately and precisely detect various objects of interest in an aircraft sustainment depot in an operational environment.

PHASE II: Awardee(s) will develop a working prototype to detect multiple known and unknown 3D objects using an XR device and provide precise 3D segmentation of the objects in real time in a dynamic operational environment. The prototype will interface with a robotic controller software to automatically transfer the segmentation masks with 3D localization data in the world coordinate space.

PHASE III DUAL USE APPLICATIONS: If the Phase II is successful in developing the needed technology, WR-ALC will purchase additional systems using organization (working capital) funds. The procurement will include the refinement the AI and XR systems to increase accuracy and reliability. Achieve production-ready state for marketing to the Air Force, other related federal agencies, and private industry.

VERSION 2

REFERENCES:

1. Alexander Kirillov, et. al., "Segment Anything", IEEE/CVF International Conference on Computer Vision (ICCV), 2023.
2. Chao-Yuan Wu, et. al., "Multiview Compressive Coding for 3D Reconstruction", Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2023.
3. A. Mirzaei, et. al., "SPIn-NeRF: Multiview Segmentation and Perceptual Inpainting With Neural Radiance Fields", Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2023.;

KEYWORDS: Extended Reality 3D Segmentation

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VERSION 2

AF242-D012 TITLE: Humanoid Mobile Robot Manipulation Behavior Development

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

OBJECTIVE: There is a clear AFSC and DoD need to automate our sustainment processes in order to improve safety, quality, capacity, and readiness. Our near peers are automating at an alarming rate, and we should be developing technologies that keep us as many steps ahead as possible. One limiting factor in the continued scaling/proliferation of automation/robotics is that we have shaped our world to fit the human form factor. And with that, single or dual arm industrial robots stationary or mobile are limited in the number of applications they can support without significant facility or process modifications. These modifications are expensive and often intrusive to process flow, slowing our ability to automate and compete.

DESCRIPTION: Recent developments in the broad capabilities of humanoid general-purpose robotics for item manipulation have positioned these systems to make increasingly significant impacts in sustainment and depot environments by helping to automate human-like activities. These systems can provide improvements in safety, quality, agility, and throughput metrics, allowing overnight or lights-out operation as well as working collaboratively alongside people. For these robotic systems to scale, they must address an ever-growing range of items presented in a vast range of poses and configurations.

One advantage of the humanoid form factor is the ability to adjust the robot's manipulation workspace, the three-dimensional bubble containing all the points it can touch. In this way, legged mobility critically amplifies bi-manipulation to produce a generalized platform. This platform can then be utilized in an almost unlimited number of ways and applications.
The desired manipulation behaviors are closed-loop to improve their fluidity and robustness, meaning they should be dynamically updated based on real-time multi-modal sensor information (position, torque, vision, etc.) to increase the manipulation speed to near that of what a human normally achieves. The desired manipulation behaviors may require coordination of two arms, including bracing one hand on a surface to enable a long reach or picking up an object using both arms to increase the payload the robot is capable of handling, and utilization of the full body, such as squatting to pick up an object from the ground or leaning back to counterbalance a carried load.

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 or ongoing SBIR/STTR funding agreement. To demonstrate feasibility, applicant(s) must describe its ability to control humanoid robotic hardware systems to perform a baseline mobile manipulation-based box/item pick. The firm should demonstrate physically, in simulation, or in principle the foundational control algorithms or behavior structures needed to develop workspace configurations for high, low, and far reach.

PHASE II: The objectives of this topic are to develop a working prototype to show increased capability of item picking within a variable workspace; and maximize the efficiency of the robotic system by allowing the robot to operate in a real-world depot environment with items arranged in various locations and positions.

PHASE III DUAL USE APPLICATIONS: If the Phase II is successful in developing the needed technology, WR-ALC will purchase additional systems using organization (working capital) funds. The procurement will include the refinement of hardware and software to increase accuracy and reliability and

achieve a production-ready state for procurement by the Air Force, other federal agencies, and private industry.

REFERENCES:

1. Jorgensen, S. J., Lanighan, M. W., Bertrand, S. S., Watson, A., Altemus, J. S., Askew, R. S., ... & Mehling, J. S. (2019, October). Deploying the nasa valkyrie humanoid for ied response: An initial approach and evaluation summary. In 2019 IEEE-RAS 19th International Conference on Humanoid Robots (Humanoids) (pp. 1-8). IEEE.;
2. Jorgensen, S. J., Wonsick, M., Paterson, M., Watson, A., Chase, I., & Mehling, J. S. (2022). cockpit interface for locomotion and manipulation control of the NASA valkyrie humanoid in virtual reality (VR) (No. NASA New Technology Report (NTR): MSC-27278-1).;
3. Sleiman, Farshidian, and Hutter (2023, August).Versatile Multi-Contact Planning and Control for Legged Loco-Manipulation. https://arxiv.org/pdf/2308.09179.pdf;
4. Chi, Feng, Du, Xu, Cousineau, Burchfiel, and Song. ColumbiaUniversity, Toyota Research Institute (TRI), and MIT. (2023, June). Diffusion Policy: Visuomotor Policy Learning via Action Diffusion. https://arxiv.org/pdf/2303.04137.pdf, https://diffusion-policy.cs.columbia.edu/;
5. Thibault, Chavez, and Mombaur (2022, November). Standardized Benchmark for Humanoid Whole-Body Manipulation. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10000141;

KEYWORDS: Humanoid Mobile Manipulation Robotics; Humanoid Robotics Tool Manipulation

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VERSION 2

AF242-D013 TITLE: AI/ML Maintenance On-Prem Platform

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

OBJECTIVE: A stand-alone, scalable asset management software providing interactive local logic memory (LLM) knowledge base capability and AI/ML module for guided troubleshooting and maintenance of critical IPE (Industrial Plant Equipment).

DESCRIPTION: A real-time, dynamic, and interactive knowledge base capability for efficient technical data management and interaction is sought in this initiative. The capability developed here should provide for custom database generation allowing the underlying software to process and vectorize content using an AI/ML algorithms. The transformation of static textual data into a dynamic LLM database here should yield guided troubleshooting 'wizard' capability to decrease maintenance touch-time for critical/complex DIPE (Depot Industrial Plant Equipment). The software in this instance should also be able to link textual part data with 3D images for the purpose of streamlining procurement capability.

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 or ongoing SBIR/STTR funding agreement. Applicant(s) will demonstrate the ability to automatically analyze commercial/technical manuals for IPE assets (CNC/Robotics) to identify specific maintenance & operational procedures in response to user inquiries. They must demonstrate the accuracy and completeness of findings to appropriately answer inquiries.

PHASE II: The objectives of this D2P2 is varied. Development of a stand-alone maintenance platform version allowing software to run on CPU/tablets with limited connectivity in industrial facilities is desired. Also, development of the capability for user to create multiple instances or databases to be processed through AI algorithm for LLM interactive capability is sought. Further, development and enablement of capture of custom SOP (standard operating procedures) for procedures not defined in existing COTs manuals or database which can then be uploaded and vectorized through AI/ML algorithm is being pursued. Still further, development, maturation, and integration of LLM AI modules into software providing an interactive 'chatbot' experience for guided troubleshooting capability of complex/critical IPE is needed. Additionally, development of a capability to link textual part data with 3D images of IPE subcomponents is sought after. Lastly, development of the capability to provide all associated materials and tools required for maintenance/operational procedures derived from user inquiries is needed

PHASE III DUAL USE APPLICATIONS: In the event the D2P2 is successful, WR-ALC leadership is committed to providing support to commercialize this capability. Further development will refine analysis to increase accuracy and reliability of maintenance procedure predictions/inquiries.

REFERENCES:

1. William Z. Bernstein and David Lechevalier Volume 124, Article No. 124011 (2019) https://doi.org/10.6028/jres.124.011 Journal of Research of National Institute of Standards and Technology - A Reference Schema for the Unit Manufacturing Process Information Model.
2. Izabela Rojek, Małgorzata Jasiulewicz-Kaczmarek, Mariusz Piechowski and Dariusz Mikołajewski, Appl. Sci. 2023, 13(8), 4971; https://doi.org/10.3390/app13084971 - An Artificial Intelligence Approach for Improving Maintenance to Supervise Machine Failures and Support Their Repair.

3. Mohammed Misbahuddin, Abul Kashem Mohammed Azad, Veysel Demir College, College of Engineering and Engineering Technology, Northern Illinois University, DeKalb, USA. https://doi.org/10.4236/ait.2023.134008 - Machine-to-Machine Collaboration Utilizing Internet of Things and Machine Learning;

KEYWORDS: AI/ML; LLM; Guided troubleshooting; interactive knowledge base

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VERSION 2

AF242-D014 TITLE: Wide Field of View Lensing Spatially Variant Photonic Crystals

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: Design, fabricate, and characterize photonic crystals offering wide field-of-view lensing capabilities at short-wave and middle-wave infrared wavelengths.

DESCRIPTION: Novel three-dimensional (3D) devices are sought that are based on spatially variant photonic crystals and which support energy focusing across an ultrawide field of view and operation across a wide range of the infrared spectrum. The devices must be based on a 3D photonic-crystal architecture with an embedded lensing or focusing capability. Structural features of the devices should have a size which permits practical and scalable microfabrication. The designs must support a variety of structural geometries that are not limited to canonical shapes like cubes, shells, or rods. The design process should be intuitive and easy to replicate and/or modify, therefore designs based on optimization algorithms or inverse-design are generally not desired. The designs must also include structures that are internally connected and self-supporting (i.e., no support material). The devices should be comprised of practical materials, and not exotic high-index- or negative-index materials, metal, or other media that are lossy, difficult to fabricate, or costly to procure. The successful team will use open-source tools to perform simulation, design, and analysis that explore a variety of designs and provide proof of concept.

Related devices based on transformation optics, gradient index, and optimization algorithms typically fail to meet one or more of the criteria listed above. An alternative, novel approach is sought to overcome these limitations. The successful team will (1) demonstrate a novel design approach to meet the criteria, (2) perform simulations/analyses to provide a proof-of-concept for the proposed devices, and (3) fabricate functional devices operating across various infrared wavelengths.

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 or ongoing SBIR/STTR funding agreement. In the “Phase I-type” effort, , the applicant shall have developed open-source software tools that offer the user the capability to model the following scenarios with spatially variant photonic crystals: embedded lenses, multiplexing similar or dissimilar wavelengths, beam collimation through sharp bends with minimal energy loss, sidelobe suppression, and frequency dependent surfaces. These models should facilitate focusing and beam control over a relatively wide field of view within the SWIR and MWIR bands. Basic fabrication and characterization of such structures are highly desired.

A D2P2 award is requested because of the demonstrations the sponsoring organization has observed during lab evaluations of the candidate technology. Lens-embedded spatially variant photonic crystals have been successfully demonstrated to achieve focusing over a relatively wide FOV. The entire structure comprised only a single low-index material, and the focal length and angular FOV could be tuned. Awarding a Phase 2 SBIR would allow for the development of photonic crystals with increased WFOV

capabilities using appropriate materials for the SWIR and MWIR ranges. Great potential in this technology has been identified and we wish to expand its application to better fit our customers' needs.

PHASE II: Awardee(s) will fabricate the most promising lens-embedded designs that are agreed upon with the topic's principal investigator and that meet the criteria of Phase 1 above. The fabricated devices will undergo inspection and electromagnetic characterization to validate a wide field of view, sufficient bandwidth, polarization insensitivity, and related performance metrics. Explore fabrication with various materials to support a wide range of the infrared spectrum. Identify applications where these devices would offer improvements in size, weight, power, complexity, and efficiency. A device operating in relevant environments is expected to be successfully demonstrated at AFRL at Eglin AFB.

PHASE III DUAL USE APPLICATIONS: Energy directing devices are used for many commercial applications including aerospace, automotive, land, and remote sensing applications. Devices meeting the desired criteria, including reduced weight and complexity, would provide a considerable improvement to existing solutions and would find widespread commercial applications in these areas.

REFERENCES:

1. M. Noori, M. Soroosh and H. Baghban. "Self-collimation in photonic crystals: Applications and opportunities." Ann. Phys. 2018, 530, 1700049-1 - 1700049-21, https://onlinelibrary.wiley.com/doi/epdf/10.1002/andp.201700049.
2. M. Li, W. Li, H. Huang, J. Wang, Y. Li, A. Wu, Z. Sheng, X. Wang, S. Zou and F. Gan. "All-Angle Quasi-Self-Collimation Effect in a Rod-Type Silicon Photonic Crystal." IEEE Photonics Journal 2015, 7(1), 1-8.
3. B. B. Oner, M. Turduev and H. Kurt. "High-efficiency beam bending using graded photonic crystals." Opt. Lett. 2013, 38(10), 1688-1690, http://ol.osa.org/abstract.cfm?URI=ol-38-10-1688;

KEYWORDS: spatially variant photonic crystals; lens embedded; wide field of view; SWIR; MWIR; low-index material

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VERSION 2

AF242-D015 TITLE: Mapping Complex Sensor Signal Processing Algorithms onto Neuromorphic Chips

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Microelectronics; 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 an efficient workflow and approach for mapping complex RF and radar signal processing algorithms onto neuromorphic hardware. The neuromorphic hardware can be a limited research prototype or a commercial product. The signal processing algorithms encompass processing of RF signals to decode communication waveforms, Multiple-Input Multiple-Output (MIMO) adaptive beamforming, Space-Time Adaptive Processing (STAP), Ground Moving Target Indicator radar, and generating Synthetic Aperture Radar (SAR) images from raw in-phase and quadrature data. The goal is to outline a versatile approach that can translate algorithms as specified in the Matlab or Python software environment into a neuromorphic model implemented in physical hardware.

DESCRIPTION: The ubiquity of embedded RF devices and the Internet of Things (IoT) has motivated approaches to process data with less latency and power consumption [1]. Neuromorphic integrated circuit (IC) hardware has enabled new ultra-low power embedded RF and radar signal processing applications implemented through deep learning neural network (DLNN) models [2-4]. Neuromorphic hardware provides an advantage of a factor of 100 in power consumption per inference relative to emulation using a traditional Graphics Processing Unit (GPU) [5].

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 or ongoing SBIR/STTR funding agreement. The required feasibility demonstration must include successfully developing advanced AI-based radio frequency (RF) algorithms and successfully porting them to a neuromorphic chip, with the final chip performing very well.

PHASE II: Using a HWIL approach, awardee(s) will measure the response of the neuromorphic hardware to RF and radar signals in real time. Awardee(s) will validate the performance of the neuromorphic hardware in terms of power consumption and timing latency. Awardee(s) will confirm that the outputs are deterministic and compare favorably to the expected values from the M&S environment.

PHASE III DUAL USE APPLICATIONS: The awardee(s) will identify potential commercial and dual use neuromorphic applications for the IoT such as MIMO adaptive beamforming.

REFERENCES:

1. C. Xiao, J. Chen, and L. Wang, "Optimal Mapping of Spiking Neural Network to Neuromorphic Hardware for Edge-AI," Sensors, vol. 22, no. 19, p. 7248, 2022.
2. A. Baietto, J. Boubin, P. Farr, T. J. Bihl, A. M. Jones, and C. Stewart, "Lean neural networks for autonomous radar waveform design," Sensors, vol. 22, no. 4, p. 1317, 2022.

3. P. Farr, A. M. Jones, T. Bihl, J. Boubin, and A. DeMange, "Waveform design implemented on neuromorphic hardware," in 2020 IEEE International Radar Conference (RADAR), 2020, pp. 934-939: IEEE.
4. M. Barnell, C. Raymond, M. Wilson, D. Isereau, and C. Cicotta, "Target classification in synthetic aperture radar and optical imagery using loihi neuromorphic hardware," in 2020 IEEE High Performance Extreme Computing Conference (HPEC), 2020, pp. 1-6: IEEE.
5. C. D. Schuman, S. R. Kulkarni, M. Parsa, J. P. Mitchell, P. Date, and B. Kay, "Opportunities for neuromorphic computing algorithms and applications," Nature Computational Science, vol. 2, no. 1, pp. 10-19, 2022.
6. (2023). RFView Family of Digital Engineering Tools. Available:
7. https://www.islinc.com/products/rfview;

KEYWORDS: AI; Neuromorphic computing; Low C-SWAP; Embedded processing

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VERSION 2

AF242-D016 TITLE: High Voltage Fireset/Electric Gun System Development

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; 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 a super low inductance HV Fire-set System which focuses on enhancing performance for CDU Switches & HV capacitors subsystem technology components with very low ESR, high peak current (1MA to 2 MA) capability with ultra-fast di/dt current rates with operating ranges from 5 kV to 60 kV to drive 1in Flyer plates.

DESCRIPTION: Both the DoD and DoE explosive research community heavily rely upon HV Fire-set and Pulsed Power Systems to conduct detonation transfer reliability research to characterize the performance of explosive trains for future AF weapon systems. In addition, the described research is strongly tied to developing high fidelity hydro-code numerical models of detonation trains which provides tremendous cost-savings when it comes to weapon and experimental design implementations.

Furthermore, HV Fire-set systems are used for initiation studies to discharge large amounts of energy at ultra-fast di/dt current rates into Explosive Foil Initiators (EFI's) to quantify detonation transfer performance of various flyer materials, geometries, and thicknesses into insensitive munition (IM) booster materials. Within the Air Force Research Lab, it has been discovered with their current HV fire-set systems that HV CDU capacitance & CDU switch performance is a critical technology base that needs refined development, and is a significant contributor to the overall performance reliability and repeatability of these systems. More importantly, the available energy, energy transfer efficiency, and peak current transfer rate of the HV Fireset system allows for optimum flyer velocities to be achieved. The advancement of CDU switch, HV Capacitor, & trigger technologies may vastly expand the DoD's and DoE's capability to conduct more robust experiments in controlling the resolution of achieving various flyer velocities. As a result, higher fidelity data sets can be attained to improve our understanding for detonation train performance and foster robust and reliable designs for future DoD weapon systems.

Key HV Fireset System design problems are prevalently associated with deficiencies in inductance, energy density transfer, and di/dt rates within the overall electrical performance limited by CDU switch performance & HV capacitor parasitic inductance. Development efforts should focus on leveraging both existing HV Pulsed Power switch & capacitor technologies. Switch technologies considered for Fireset integration may include spark gaps, rail gaps, and surface planar discharge gap switches that are either electrically or optically triggered, but not limited to other state of the art. Additionally, the proposers are encouraged to investigate the various cathode, anode, potting, and dielectric insulating materials, implemented for future designs to significantly decrease inductance, increase the life cycle, and ease of maintenance for both switch & capacitor technology. A suite of HV Capacitor & CDU switch design solutions to cover various ranges of operating voltages are acceptable with the goal to achieve the widest range as possible to achieve super high peak current outputs at very di/dt current transfer rates. Ideally, the proposers should have extensive expertise in HV pulsed powered system & capacitor design.

VERSION 2

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 or ongoing SBIR/STTR funding agreement.

The applicant must substantiate the technology maturity level of the pulse power design and system is robust and adequate to integrate into a functional lab tool. Proposals involving nascent technologies (e.g. switch design, pulse power trigger methods, etc.) may be considered based on the proposers proof of the reliability and performance of the device. The overarching goal will be to provide a completely functional fireset system that is operational within the provided design requirements and maintainable by lab technicians.

PHASE II: Develop and construct a fireset system ready per AFRL requirements for lab use. Perform laboratory bench level experiments to demonstrate the performance of the fireset system design. Establish operating voltage range along with the entire systems lump sum R, L, & C parameters including the output load representative to an EFI. In addition, provide ring down and load current waveforms at the various operating voltages.

PHASE III DUAL USE APPLICATIONS: The DoE and DoD will benefit from the utilization of highly optimized fireset systems, which will advance capabilities to test EFIs beyond conventional energy levels. As a result, extensive experimentation may be performed for advanced detonation transfer studies of novel IM and EFI technologies.

REFERENCES:

1. H. Chau, G. Dittbenner, W. Hofer, C. Honodel, D. Steinberg, J. Stroud, R. Weingart and R. Lee, "Electric Gun: A versatile tool for high-pressure shock-wave research," Review of Scientific Instruments, vol. 51, no. 12, pp. 1676-1680, 1980.
2. R. C. Weingart, R. K. Jackson and C. A. Honodel, "Shock Initiation of PBX-9404 by Electrically Driven Flyer Plates," Propellants and Explosives 5, pp. 158-162, 1980.;

KEYWORDS: HV Pulsed Power; HV Pulsed Power Discharge Capacitor; HV Fireset; HV Electric Gun; Capacitor Discharge Unit

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VERSION 2

AF242-D017 TITLE: High Resolution Low SWaP Attritable EO/IR Sensors for Stratospheric Operations

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

OBJECTIVE: The objective of this topic is to develop a high resolution, low Size, Weight, and Power (SWaP), 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 4 or higher from platforms operating in the stratosphere.

DESCRIPTION: The Air Force (AF) is currently pursuing Intelligence, Surveillance, and Reconnaissance (ISR) sensors to support high altitude, sustained flight for long periods (months) within designated operational airspace between 50,000-75,000 feet Mean Sea Level (MSL) that could participate in AF or Joint exercises, demonstrations, and/or test events in the Fiscal Year (FY) 2026-2030 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 stratosphere. These applications would directly support AF Operational Imperative 3 [1] by both detecting critical targets and distinguishing targets from decoys.

Sensor Capabilities:

- All sensors should have the capability to be operational within the 50,000 – 75,000 feet altitude band.
- All sensors should be prepared to supply their own heating or cooling solution to withstand extreme temperature conditions within the above altitude band.
- All sensors should be low power (less than 100 W continuous 500 W instantaneous)
- 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).
- Sensor must be able to detect and identify targets with a NIIRS value of 4 or higher and a Ground Sampling Distance (GSD) not to exceed 1 meter at the stated operating range.
- Total system weight is not to exceed 80 lbs.
- Some jitter is expected. Payloads requiring pointing will need to provide their own gimballing or steering solution.
- Total system needs to fit withing a 14 (3.5 ft x 2 ft x 2 ft) cubic foot volume.
- Sensor systems need to be able to operate over an area of interest at altitude for several months at a time.
- Sensors are expected to be able to support both day/night operations.

Previous SBIR projects have pushed the envelope or this technology but there is an urgent need to minimize the power required to operate sensors within the given altitude band. Previous efforts have focused on larger power requirements; additional work needs to be completed to fit within the power constraints of the problem set [2].

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 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. 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.

PHASE II: Under the Phase II effort, the awardee(s) shall sufficiently develop a ruggedized ground-based EO/IR sensor system based off the defined requirements listed in the topic description. The sensor system should be capable of being tested on a high-altitude attritable system if testing opportunities become available.

PHASE III DUAL USE APPLICATIONS: 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 up to 75kft 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 Imperative (https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf) *Stratollites for Persistent ISR | SBIR.gov (https://www.sbir.gov/node/1937185)
2. AFMC-Guidebook-for-Implementing-MOSA-in-Weapon-Systems_V2.0_Distro_A.pdf (https://guide.dafdto.com/wp-content/uploads/2023/11/AFMC-Guidebook-for-Implementing-MOSA-in-Weapon-Systems_V2.0_Distro_A.pdf)
3. Reference Implementation Guide for the SOSA™ Technical Standard (https://publications.opengroup.org/standards/sosa);

KEYWORDS: Stratosphere; SWaP; EO/IR; High Altitude; Attritable; Sensor

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VERSION 2

AF242-D018 TITLE: Development of Advanced Surface Treatments for Astroquartz Fibers

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

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

OBJECTIVE: The objective of this project is to develop advanced coupling agents and surface treatments for Astroquartz fibers in order to increase the environmental and thermal durability of various Polymer Matrix Composite systems, which include a range of resin matrices from 350 degree Fahrenheit-curing epoxies to advanced polyimides.

DESCRIPTION: Astroquartz-reinforced Polymer Matrix Composites (PMCs) are widely utilized on aircraft in radome applications due to excellent dielectric properties compared to other variants of glass and carbon fiber reinforcements. Although the mechanical performance requirements for these applications are not as demanding as other structural PMC components that utilize carbon fiber reinforcement, the environmental and thermal durability can limit their service life and significantly impact maintainability. Recent testing performed on various PMC systems with resin matrices ranging from 350 degree Fahrenheit-curing epoxies to advanced polyimides have exhibited extensive disbonds at the fiber-matrix interface after moisture and thermal conditioning. The objective of this project is to develop advanced coupling agents and surface treatments for Astroquartz fibers in order to increase the environmental and thermal durability of various Polymer Matrix Composite systems of interest. This SBIR should seek to identify key contributing factors for the limited durability in PMC systems of interest, develop optimized surface treatment processes for woven Astroquartz reinforcements, and develop tailored coupling agents that offer increased durability over the current state-of-the-art systems.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the 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 applicant(s) must show evidence of previous efforts demonstrating their capability to perform and develop advanced surface treatments for glass materials and/or aerospace fiber reinforcements, and to tailor coupling agents/fiber finishes to a wide range of polymer matrices.

PHASE II: In the Phase II effort, the awardee(s) shall execute a comprehensive root cause analysis (RCA) to identify the key factors contributing to decreased mechanical performance in Astroquartz PMCs. Results from the RCA should inform either the development of optimized surface treatment processes to remove residual chemicals applied during the weaving process, or development of a tailored coupling agent to offer increased durability over the current state-of-the-art systems. The PMCs of interest shall include phenylethynyl-terminated polyimide and/or a 350 degree Fahrenheit-curing epoxy system.

PHASE III DUAL USE APPLICATIONS: The awardee(s) can expect to pursue commercialization of the technology developed in Phase II by either partnering with an aerospace-grade weaver or prepreg supplier. 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. In Phase-III, the awardee(s) must scale up the prototype technology, integrate it within the current supply chain, and perform a series of full-scale production runs. Lastly, the contractor must generate qualification data on the final Astroquartz fabric PMC.

REFERENCES:

1. Cloth, Quartz Finished for Resin Laminates, ASM3846-D, SAE international, 2022;

KEYWORDS: Astroquartz; fiber sizing; fiber finish; fiber-resin interface; coupling agents; polymer matrix composites; epoxies; polyimides; thermosets;

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VERSION 2

AF242-D019 TITLE: Seeker for Low-Cost Base Defense Munition

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

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

OBJECTIVE: Develop and demonstrate a low-cost passive imaging infrared seeker for a 70mm rocket, demonstrating effective performance against C-UAS targets in a rapid-launched or simultaneous-launched swarming scenario.

DESCRIPTION: Low cost UAS weapons are being put to effective use by US adversaries. US weapons to defeat these threats are effective, but not feasible at scale due to limited quantities and high cost. Commonly, multi-$M munitions are used to defeat targets that cost <$10K. A kinetic option is needed to defeat C-UAS and other threats at the same order of magnitude cost of the threat. Furthermore, an option is needed that can be produced, deployed, and launched at scale. This new capability must be delivered to the battlefield quickly, on a relevant timeframe. Therefore, it is necessary to consider low-cost options that are already in high rate of production and fielded on many platforms, have a reasonable cost, and can be readily modified to achieve the desired launch rate.

The scope of this topic includes not only imaging infrared (IIR) seeker hardware, but also algorithms needed to detect aerial or other threats, as well as any infrastructure needed to accomplish the fast-launching mission, such as hardware data links and collaborative ATR algorithms. Proposals may focus on one specific portion of the need, or aim to achieve a minimum viable product as quickly as possible. The topic will show preference to those who demonstrate a path to achieve a fieldable result within the cost/schedule of the program.
Proposers should be familiar with the C-UAS mission, and show that their imager has performance to detect a small object at a relevant range, within a field-of-view that the target has a high probability of detection in a lock-on-after-launch scenario. Lock-on-before-launch can also be assumed, so long as an existing fire-control solution or other CONOPS is identified that establishes feasibility of the concept. The imager should be able to identify plumes of friendly interceptor as non-targets.

One specific area of Air Force interest in an APKWS modification, which would require interaction and teaming with BAE, the prime contractor for APKWS. Other approaches will be considered, but may be competitive against APKWS.
The following approximate specs should be considered as rough order-of-magnitude needs, but strict adherence is not required.

1) Weapon cost <$50K
2) Seeker cost <$10K
3) Detection range > 2 KM
4) Identification range > 1 KM
5) Field of view > 10 degrees
6) Launch rate > 1 per second
7) Overkill of target < 20%

8) Probability of hit > 70%
9) Probability of false lock on friendly interceptor < 5%

Of equal interest is any unknown component of such a system that ought to be designed, or optimized, in participation with a system-level Prime contractor to achieve the above objectives/mission. The topic authors do not wish to overly prescribe a specific solution, and other solutions – even beyond sensors, are appropriate for this topic insofar as they achieve a meaningful capability for this requirement on the battlefield.

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 or ongoing 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 efforts should include modeling and simulation to show feasibility of performance of a imaging infrared seeker (or other low cost seeker) versus C-UAS targets and/or other faster aerial threats. Manufacturing, cost, timeline factors should all be established to build confidence that the final product can be fielded in a short-term, relevant, timeframe. Early laboratory or field tests showcasing hardware and/or software (sensing capabilities and algorithm detection capabilities) are expected.

PHASE II: Phase II efforts should include all-up-round guided free flight testing of the rocket versus C-UAS targets at a TRL 6. Prior to this point, significant integration work is expected to result in a manufacturable and fieldable design. The hardware should be plug-and-play with the fieldable interceptor solution. Weapon metrics mentioned previously, including the seeker subsystem, will be evaluated competitively against other solutions to assess useability for a Phase III.

PHASE III DUAL USE APPLICATIONS: Phase III will include both smaller quantities <100 of prototypes for experimentation, and quantities of >1000 if selected for inclusion within a program of record. PEO Customers include AFLCMC/EB, Army PEO M&S TAGM, Navy PMA-242, and SOCOM. Due to broad tri-service interest, it is expected that rapid fielding/production will begin in large quantities of multiple thousands if specification goals and met and proven in flight testing.

REFERENCES:

1. https://www.baesystems.com/en/article/apkws--laser-guidance-kits-successfully-tested-by-u-s--counter-drone-office
2. https://defensescoop.com/2023/11/03/ukraine-to-get-more-laser-guided-munitions-to-kill-drones/
3. https://www.reuters.com/world/europe/ukraine-downs-41-russian-drones-major-overnight-attack-2023-12-06/;

KEYWORDS: Base defense; APKWS; 70mm rocket; low-cost interceptor; infrared imaging seeker; fire-and-forget seeker; LWIR; SWIR; laser guidance

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VERSION 2

AF242-D020 TITLE: Treatments for Crack Propagation in Metal Aircraft Parts

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

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

OBJECTIVE: Develop and demonstrate ground support equipment capable of performing in-place repair of structural components with stress-induced cracks without removing component from aircraft.

DESCRIPTION: The lifetime of metal aircraft parts is limited by stress-induced crack initiation and propagation of these cracks until part failure results. Often these parts are difficult to replace, and methods to extend the useable service life of aircraft parts would be advantageous. Research on treatments to inhibit growth of cracks after initiation has shown promise. Practical applications of this research are sought to extend aircraft part lifetime while maintaining dimensional tolerances and mechanical properties of the components.
The ability to perform crack arrest repairs on parts without removing them from the aircraft will drastically reduce depot visits and increase aircraft availability. As such, the technology sought must be portable, and enable application of the repair in space-constrained areas of the aircraft. The desired characteristics of the developed technology include: (1) ability to apply repair with the part in a loaded (stressed) state, (2) maintains the designed functionality of the treated part without adversely impacting its lifetime in any other manner (e.g., must not induce galvanic corrosion due to application of dissimilar metal), (3) minimizes pre-repair part conditioning (e.g., as much as possible, leave protective coatings in place), (4) does not generate sparks, (5) must not have wireless emissions (no WIFI, Bluetooth, etc.), and (4) minimized repair time. Repair of aluminum alloys are of primary interest, but also steel. The successful technology must not require line power exceeding common voltages (120/240 V) and must minimize hazmat footprint.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the 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. To demonstrate that the technology is ready for a D2P2, the applicant must be able to show they have a plan, or technology, that can repair the cracks in a rapid-repair capacity. This will show the technology is ready for prototype to fit the specific military needs based on aircraft parts, metals, and environments.

PHASE II: Awardee(s) will develop and demonstrate a prototype system that meets topic objective. The prototype demonstration should illuminate the ability of the technology to rapidly repair stress-induced cracks without removal from the aircraft, and address other desired characteristics (either in practice, or with a plan for future modification/development). Finally, effort will provide cost projection data to substantiate the design, performance, acquisition, and life cycle costs.

PHASE III DUAL USE APPLICATIONS: This topic is provided by AFGSC's Commercial Capabilities Integration and Transition Branch at the AFGSC/A5N branch. This branch is deliberately resourced and

staffed exclusively to ensure R&D efforts are integrated into AFGSC programs of record and have senior leader sponsorship and POM/Programming advocacy among AFGSC corporate processes. There are resources set aside to effectively transition this effort into a Phase 3 follow on if the Phase 1 and Phase 2 efforts are successful.

REFERENCES:

1. C.M. Barr, T. Duong, D.C Bufford, et al. “Autonomous healing of fatigue cracks via cold welding.” Nature 620, 552–556 (2023). https://doi.org/10.1038/s41586-023-06223-0
2. J. Huang, and H. Cardenas. “Fatigue Crack Arrest in Mild Steel via Iron Electroplating. Materials Sciences and Applications,” 12, 484-503, 2021. doi: 10.4236/msa.2021.1211032.
3. C. R. Fisher, H. B. Henderson, M. S. Kesler, et al. “Repairing large cracks and reversing fatigue damage in structural metals,” Applied Materials Today, Volume 13, 2018, Pages 64-68, ISSN 2352-9407
4. R. Jones, A.A. Baker, N. Matthews, V. Champagne. Aircraft Sustainment and Repair, Butterworth-Heinemann, 2017, ISBN 008100544X, 9780081005446
5. R. Jones, A. A. Baker, Bonded Repair of Aircraft Structures, Springer, Netherlands, 2012. ISBN:9789400927520, 9400927525
6. H. J. Gover, “Fatigue of Aircraft Structures,” Defense Technical Information Center, AD0660529. 1966. https://apps.dtic.mil/sti/pdfs/AD0660529.pdf";

KEYWORDS: crack mitigation; crack propagation; crack arrest; aircraft fatigue failure; crack closure

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VERSION 2

AF242-D021 TITLE: Trusted, Generative AI for Acquisition Process Acceleration

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: AFRL faces the challenge of current acquisition and contracting methods being rooted in manual processes and failing to deliver at the speed of need as a result of misalignment, errors, and inconsistencies. To keep up with the rapidly changing technological landscape and new threat dynamics, streamlined, AI-assisted acquisition processes are essential. The objective of this effort is to improve operational efficacy to enable better strategic positioning via a customizable, AI-assisted software tool.

DESCRIPTION: A trusted, vetted AI-assisted, automated acquisition workflow for FAR contracting should include the following aspects to meet the stated objective: (1) must include automation of repetitive tasks reserving human resources for decisional and/or complex tasks; (2) must be able to attain DoD Authorization to Operate (ATO) at sufficient security levels to meet contracting needs (Controlled Unclassified Information/Impact Level-5); (3) must standardize document preparation with built-in compliance for regulatory requirements to reduce errors and inconsistencies in acquisition document preparation; (4) must have scalable, modular architecture and be customizable to meet the growing demands of multiple organizations with unique needs; (5) must quantifiably speed up the acquisition process by reducing time-to acceptance, by reducing rework rate, and by reducing overall person-hours spent in pre-contracting document preparation; (6) must track critical timeline events and allow for workflow interruption/reprioritization; and (7) must include simple, user-friendly, adaptable interfaces for program managers, contracting officers/buyers, and management.

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 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 offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility demonstration should have; (1) Demonstrated a Phase I-like/prototype software tool that uses customizable, trusted AI; (2) 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; (3) Demonstrated ability to attain DoD ATO on similar products; and (4) Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Under the phase II effort, the awardee(s)shall sufficiently develop the technical approach, product, or process in order to conduct a two relevant demonstrations using distinct contracting action types. Identification of business model modifications required to further improve product or process relevance to improve efficiency, compliance, and consistency 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 awardee(s) can expect to 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. https://dl.dod.cyber.mil/wp-content/uploads/cloud/pdf/DoD_Cloud_Authorization_Process.pdf;

KEYWORDS: Trusted AI; Generative AI; natural language processing; workflow automation

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VERSION 2

SF242-D022 TITLE: Uncertainty Management for Space Domain Awareness of Non-Standard Threats

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

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

OBJECTIVE: The objective of this topic is to develop algorithms and methodology to allow for better uncertainty propagation of beyond-GEO trajectories, which are subjected to more highly nonlinear dynamics, stochastic excitation, and uncertain initial conditions than typical GEO-and-below trajectories.

DESCRIPTION: One of the significant technical challenges in space domain awareness is the accurate and consistent propagation of uncertainty for objects governed by highly nonlinear dynamics with stochastic excitation and uncertain initial conditions. This challenge is even greater in the beyond-GEO region where three-body gravity becomes significant, resulting in the dynamics being more nonlinear. Additionally, the increased distance between an Earth-based sensor and the object reduces the apparent motion between them, resulting in little independent information to initialize an orbit. The initial uncertainties in xGEO orbits are therefore highly non-Gaussian, which inhibits the effectiveness of traditional propagation and filtering methods. Orbits within this area of regard enable low-cost options for spacecraft to rapidly alter course and threaten terrestrial and space-based assets. Being able to accurately understand and propagate the uncertainty of objects within this area is necessary to assess whether they pose a threat.

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 or ongoing SBIR/STTR funding agreement. Applicant(s) must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility to meet the capabilities of the stated objective. The documentation provided must substantiate that the proposer's technology is currently at an acceptable stage to be funded at the D2P2 level. Documentation may include reports demonstrating prior work demonstrating feasibility, results of prior efforts, success criteria of a prototype, or any other relevant documentation as applicable. GFE will not be provided.

PHASE II: Awardee(s) will develop algorithms and methodology to characterize uncertainty propagation, including contribution of higher-order moments, of xGEO trajectories. Awardee(s) will identify uncertainty propagation behavior in presence of variety of mission profiles, including low-thrust, long-duration maneuvers, quasi-periodic trajectories, and Lyapunov and transfer orbits. Awardee(s) will evaluate uncertainty propagation across sensor exclusion and occultation geometries and assess impact of maneuvers in this space. Awardee(s) will identify sensor network placement and tasking strategies to maximize information gain of xGEO objects and satisfy object custody requirements. Identify and develop estimation techniques applicable to the identified uncertainty distributions. Awardee(s) will evaluate the resultant uncertainty from initial orbit determination as well as catalog maintenance (filtering) algorithms. GFE will not be provided.

PHASE III DUAL USE APPLICATIONS: Develop a strategy to transition prototype residual capabilities and incremental proliferation based on operational USSF requirements.

REFERENCES:

1. T. Wolf, E.M. Zucchelli and B. A. Jones, "Multi-Fidelity Uncertainty Propagation for Objects in Cislunar Space," AIAA 2022-1774. AIAA SCITECH 2022 Forum. January 2022;
2. C. Freuh, K. Howell, K.J. DeMars, S. Bhadauria, and M. Gupta, "Cislunar Space Traffic Management: Surveillance Through Earth-Moon Resonance Orbits," 8th European Conference on Space Debris, ESA Space Debris Office, Darmstadt, Germany, Apr. 2021;
3. M.R. Thompson, N.P. Re, C. Meek, and B. Cheetham, "Cislunar Orbit Determination and Tracking via Simulated Space-Based Measurements," Advanced Maui Optical and Space Surveillance Conference, Maui, HI, Sept. 2021;

KEYWORDS: beyond-GEO, xGEO, cislunar, space traffic management, space domain awareness, uncertainty propagation, orbit determination, space sensor tasking

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VERSION 2

SF242-D023 TITLE: Small Satellite Swarms for ISR

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

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

OBJECTIVE: Develop methods that are capable of using swarm-based architectures in the orbital domain for performing both Earth Observation and Space Domain Awareness tasks for support to multi-domain operations.

DESCRIPTION: Recent improvements to commercially-available hardware and software platforms have given rise to a proliferation of highly capable satellite platforms. Ongoing improvements in manufacturing processes are also reducing the size and costs of space-capable hardware. Not only is it more economical and feasible to launch platforms into space, but more platforms can be deployed to orbit at a lower cost. These trends, combined with comparable trends in the air domain regarding the commercial proliferation of unmanned aerial system (UAS) technology, suggest that orbital swarms are on the horizon. Swarm-based architectures and operations provide benefits to resiliency and scalability and are synergistically capable of handling some complex tasks beyond what fewer and larger independently-controlled drones may accomplish. These additional benefits come with the need to manage the health and coherency of the swarm, ensure that swarm members do not collide with others in nearby space, and that commands issued to the swarm are effectively communicated to all members. Such challenges are exacerbated as swarms begin operating in the orbital domain.

This topic seeks solutions that explore the use of swarm-based architectures in the orbital domain for performing Earth Observation (EO) and Space Domain Awareness (SDA) tasks in support of multi domain operations. Responses are sought that explore the potential for using and orchestrating orbital swarms to observe orbital and/or terrestrial objects through one or more sensor modalities. Areas of interest in proposed solutions include, but are not limited to: synergistic sensing effects from swarm-based sensors; unique swarm-enabled capabilities; orchestration schemes for command and control of individual swarms and/or multiple swarms working on concert; orbital swarm formation management; swarm space-based awareness and proximity-sensing capabilities; swarm orbital deployment and initialization schemes; low-observable swarms; and swarm collaboration schemes with other on-orbit assets.

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 or ongoing SBIR/STTR funding agreement.

Applicant(s) must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective. Applicant must show, as appropriate to the proposed effort, a demonstrated technical feasibility to meet the capabilities of the stated objective. The documentation provided must substantiate that the proposer's technology is currently at an acceptable stage to be funded

at the D2P2 level. Documentation may include but not be limited to reports demonstrating prior work demonstrating feasibility, results of prior efforts, success criteria of a prototype, or any other relevant documentation as applicable. GFE will not be provided.

PHASE II: Awardee(s) will develop methods to use and orchestrate orbital swarms to observe orbital and/or terrestrial objects through one or more sensor modalities. Areas of interest in proposed solutions include, but are not limited to: synergistic sensing effects from swarm-based sensors; unique swarm-enabled capabilities; orchestration schemes for command and control of individual swarms and/or multiple swarms working on concert; orbital swarm formation management; swarm space-based awareness and proximity-sensing capabilities; swarm orbital deployment and initialization schemes; low-observable swarms; and swarm collaboration schemes with other on-orbit assets. GFE will not be provided.

PHASE III DUAL USE APPLICATIONS: Awardee(s) will mature prototype capabilities developed under Phase II. This topic promotes dual-use opportunities using the swarm operations paradigm as an alternative to provide orbital commercial services including but not limited to: Earth observation, Space observation, weather and climate assessment, water quality evaluation, land use management, communications networks and imagery products.

REFERENCES:

1. Yoan Grégoire, Hervé Guillon, Clément Dudal, David Valat, and Bernard Pontet; "Communication, Localization and Synchronization of Spacecraft for Swarm Missions"; in the Proceedings of the AIAA/USU Conference on Small Satellites (SmallSat), 2023
2. Maxwell Joyner and Laura Plice; "Active Swarm Resiliency in the HelioSwarm Mission"; in the Proceedings of the AIAA/USU Conference on Small Satellites (SmallSat), 2023
3. James Staley, Kerri Lu, Elaine Schaertl Short and Evana Gizzi; "A Framework for Multi-Agent Fault Reasoning in Swarm Satellite Systems"; in the Proceedings of the AIAA/USU Conference on Small Satellites (SmallSat), 2023
4. James Llinas; "Reexamining Information Fusion—Decision Making Inter-dependencies"; 2014 IEEE International Inter-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision Support (CogSIMA).
5. W. Pottenger, E. Blasch, J. Nagy, C. Janneck, C. Kelly, J. Okoth and R. Mann, "Fully-automated multi-INT Fusion, Pattern of Life and Anomaly Detection," in National Security Sensor and Data Fusion (NSSDF) Symposium, Gaithersburg, MD, 2018.;

KEYWORDS: small satellite swarms; swarm systems, air platform swarms, swarm command and control

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VERSION 2

SF242-D024 TITLE: ICED-T – Innovative Cargo Exoatmospheric Delivery Technology

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials; Sustainment & Logistics; 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: This topic seeks to perform concept exploration, prototype development, sub-scale experiments, test and evaluation of technology that enables up to 100 tons of containerized cargo from exoatmospheric altitudes surviving earth re-entry.

DESCRIPTION: The AFRL Rocket Cargo Vanguard Program is developing technologies that can deliver large payloads (shipping container sized) around the globe with speed in support of global logistics and the USSF logistics mission sets. The Rocket Cargo Vanguard is responsible for leading a test campaign to enable up to 30 tons of cargo to be delivered anywhere on the planet within tactical timelines. The goal is to demonstrate this speed through integrated demonstrations with the DOD logistics train, including responsive mission planning, rapid cargo logistics and ground launch operations, and coordination with commercial airspace.

Launch vehicles are limited in down-mass capacity during earth re-entry which limits the overall mass of delivered payloads. The AFRL Rocket Cargo Vanguard Program seeks technologies which will support payload re-entry independent of the launch vehicle after the launch vehicle has reached the desired orbit for separation. Technology includes the capability to decelerate the large payloads to survive re-entry and delivery to desired location with cargo remaining intact.
The main deliverables will be sub-scale experiments, tests, and demonstrations that advance the operational imperative.

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 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 offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I type efforts should include the assessment of emerging operational imperatives and how they show a measurable value and operational impact. The result of Phase I type efforts is to assess and demonstrate whether commercial systems can support the furtherance of the operational imperatives.

Eligibility for a D2P2 award is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, experimentation and evaluation of operational imperatives to enable future concepts. Prototypes, M&S and experimentation should explore a

wide range of integrating commercial capabilities to support the operational imperatives. These capabilities should consider areas that are unique to military operations, logistics, mission planning, mission execution, base sustainment and logistics.

PHASE II: A goal is for Phase II efforts to conduct sub-scale experiments and provide test articles for further test and demonstration. Experiments should address military-unique requirements that may not be otherwise met by commercial capabilities.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, T&E results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES:

1. Seong-Hyeon, P. * "Re-entry analysis of critical components and materials for design-for-demise techniques", ScienceDirect, 2021;

KEYWORDS: Heat Shield; thermal protection systems; high temperature materials; re-entry

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VERSION 2

SF242-D025 TITLE: DEMISE - DEploy Material Into Space Experiments

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials; Sustainment & Logistics; 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: This topic seeks to perform concept exploration, prototype development, sub-scale experiments, test and evaluation of technology to standardize containerization of cargo to survive the vacuum of space and deploy material into space.

DESCRIPTION: The AFRL Rocket Cargo Vanguard Program is developing technologies that can deliver large payloads (shipping container sized) around the globe with speed in support of global logistics and the USSF logistics mission sets. The Rocket Cargo Vanguard is responsible for leading a test campaign to enable up to 30 tons of cargo to be delivered anywhere on the planet within tactical timelines. The goal is to demonstrate this speed through integrated demonstrations with the DOD logistics train, including responsive mission planning, rapid cargo logistics and ground launch operations, and coordination with commercial airspace.

The AFRL Rocket Cargo Vanguard Program seeks standardized container technologies that can deploy material into space. Launch vehicles are limited in down-mass capacity during earth re-entry which limits the overall mass of delivered payloads. Commercial shipping containers are not adequately designed to survive exoatmospheric conditions which would allow the container to be separated in space prior to launch vehicle re-entry. The AFRL Rocket Cargo Vanguard Program seeks technologies which will support a container design that will adequately allow payload prolonged exposure in exoatmospheric conditions and re-entry independent of the launch vehicle after the launch vehicle has reached the desired orbit for separation.

The main deliverables will be sub-scale experiments, tests, and demonstrations that advance the operational imperatives.

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 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 offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing.

Phase I type efforts should include the assessment of emerging operational imperatives and how they show a measurable value and operational impact. The result of Phase I type efforts is to assess and demonstrate whether commercial systems can support the furtherance of the operational imperatives.

Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, experimentation and evaluation of operational imperatives to enable future concepts. Prototypes, M&S and experimentation should explore a wide range of integrating commercial capabilities to support the operational imperatives. These capabilities should consider areas that are unique to military operations, logistics, mission planning, mission execution, base sustainment and logistics.

PHASE II: A goal is for Phase II efforts to conduct sub-scale experiments and provide test articles for further test and demonstration. Experiments should address military-unique requirements that may not be otherwise met by commercial capabilities.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, T&E results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES:

1. Seong-Hyeon, P. "Re-entry analysis of critical components and materials for design-for-demise techniques", ScienceDirect, 2021;

KEYWORDS: Space Container; space environment;

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VERSION 2

SF242-D026 TITLE: FLOATS - Floating and Loitering Ocean Advanced Technology Sensing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Mission Readiness & Disaster Preparedness; Sustainment & Logistics

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

OBJECTIVE: This topic seeks to perform concept exploration, prototype development, sub-scale experiments, test and evaluation of technology that is able to deliver low-cost persistent grid sensors technologies with the ability to station keep providing atmospheric and maritime research data

DESCRIPTION: The Air Force and Department of Defense struggle to provide domain awareness across millions of square kilometers of ocean in INDOPACOM, CENTCOM, SOUTHCOM, EUCOM and even on its own test ranges in NORTHCOM. There are limited manned and unmanned Intelligence, Surveillance and Reconnaissance (ISR) aircraft to patrol these geographies. Space-based ISR assets are also limited in number, provide episodic coverage and often focused on higher priority operational tasks beyond domain awareness. While the DAF and wider DOD have relied for 20+ years on uncontested ISR coverage to make critical decisions, a peer adversary will very likely immediately challenge all ISR coverage in pursuit of an anti-access and area denial (A2/AD) strategy.

The DAF needs new ISR capabilities which are easy to emplace, operate and recover; are inexpensive and quick to manufacture; persist in the same geography for weeks or months at a time; easily integrated into existing and future data processing architectures; scale to enormous geographies; can be operated nearly autonomously or with limited human input; and are not vulnerable to adversary weapons; and in a limited fashion can both avoid adversarial discovery and seizure, while remaining small and difficult to find.

The AFRL Integrated Capabilities Directorate seeks low-cost persistent grid sensors technologies with the ability to station keep providing atmospheric and maritime research data from the surface down to 50 meters. The main deliverables will be sub-scale experiments, tests, and demonstrations that advance the operational imperatives.

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 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 offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing.

Phase I type efforts should include the assessment of emerging operational imperatives and how they show a measurable value and operational impact. The result of Phase I type efforts is to assess and demonstrate whether commercial systems can support the furtherance of the operational imperatives.

VERSION 2

Eligibility for a D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, experimentation and evaluation of operational imperatives to enable future concepts. Prototypes, M&S and experimentation should explore a wide range of integrating commercial capabilities to support the operational imperatives. These capabilities should consider areas that are unique to military operations, logistics, mission planning, mission execution, base sustainment and logistics.

PHASE II: A goal is for Phase II efforts to conduct sub-scale experiments and provide test articles for further test and demonstration. Experiments should address military-unique requirements that may not be otherwise met by commercial capabilities.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, T&E results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES:

1. Warren, D. "Marines Use Sensor Buoys to Better Understand Ocean Battlespace"; Office of Naval Research; 2020
2. Mignerey, P., Emokpea, L., Schindall, J. "Experimental Demonstration of an Autonomous Distributed-Consensus Network for Underwater Passive-Acoustic Detection"; Office of Naval Research; 2022;

KEYWORDS: Mesh sensors; grid sensing; atmospheric data collection;

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VERSION 2

SF242-D027 TITLE: ROC STAR - ROcket Cargo System Technologies And Research

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment & Logistics; Mission Readiness & Disaster Preparedness

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

OBJECTIVE: This topic seeks to perform systems engineering, concept exploration, analysis, modeling and simulation, test and evaluation of point-to-point rocket transport of cargo.

DESCRIPTION: The commercial rocket industry is expected to have an evaluation of $1B over the next five years and the Department of the Air Force is interested in examining how this new emerging market can be utilized for point to point transport of cargo. Rocket transport of cargo opens up a new capability by enabling the delivery of goods to any point on the earth within 90 minutes or less. While this capability provides a transformation in cargo transport, many challenges remain in making cargo transport via rocket a reality. A specific focus is how the Government can take advance of commercial capabilities without taking sole ownership or creating a unique aspect that is Government only, thereby driving up life cycle cost. Another aspect of interest to the Government is the ability to influence designs early on so that if there are unique Department of Defense (DoD) requirements, they can be incorporated into the commercial product enabling dual-use aspect.

The Department of the Air Force is exploring rocket transportation capability for DoD logistics and the Air Force Research Laboratory (AFRL) is currently assessing emerging rocket capability across the commercial vendor base, and its potential use for quickly transporting DoD materiel to ports across the globe. The U.S. commercial launch market is building the largest rockets ever, at the lowest prices per pound ever, with second-stages that will reenter the atmosphere and be reused. These advances in the U.S. commercial launch market are presenting the need for assessment and maturation of system-of-systems concepts of rocket transportation for DoD (Department of Defense) logistics by the United States air Force and Space Force (USAF/USSF). A large trade space exists for the potential of rocket cargo for global logistics, to include improvements in delivery cost and speed compared to existing air cargo operations.

The goal of this effort is to investigate concepts, and yet to be develop concepts for rock cargo to determine technical feasibility and risk, programmatic costs, and schedule. The information, test and evaluation (T&E) under this effort will be used to influence and guide rocket cargo efforts. While the goal is to enable up to 100 tons of cargo to be delivered anywhere on the planet within tactical timelines, there may be optimization techniques and process with smaller amounts of cargo and transportation modes other than rockets that can provide rapid delivery of materials.
An objective of this effort is to grow AFRL's Rocket Cargo industrial base. This topic is intended to reach companies capable of completing a feasibility study and prototype validated concepts under accelerated Phase I and II type schedules. This topic is aimed at later stage research and development efforts rather than "front-end" or basic research/research and development.

VERSION 2

The focus is on emerging commercial capabilities to minimize cost and enable agile logistics through the entire span of responsive mission planning, rapid cargo logistics, ground launch operations and coordination with commercial airspace.
The main deliverables will be modeling and simulation (M&S), T&E of concepts that advance the viability and utility of using commercial rockets and associated systems for Department of Defense global logistics to expanding capabilities of the USSF for combatant commanders.

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 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 offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I type efforts should include the assessment of emerging operational imperatives and how they show a measurable value and operational impact. The result of Phase I type efforts is to assess and demonstrate whether commercial systems can support the furtherance of the operational imperatives.

Eligibility for a D2P2 award is predicated on the offeror having performed a "Phase I-type" effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, experimentation and evaluation of operational imperatives to enable future concepts. Prototypes, M&S and experimentation should explore a wide range of integrating commercial capabilities to support the operational imperatives. These capabilities should consider areas that are unique to military operations, logistics, mission planning, mission execution, base sustainment and logistics.

PHASE II: A goal is for Phase II efforts to conduct sub-scale experiments and provide test articles for further test and demonstration. Experiments should address military-unique requirements that may not be otherwise met by commercial capabilities.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, T&E results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES:

1. S. Sankar, " The Supply Chain Revolution: Innovative Sourcing and Logistics for a Fiercely Competitive World", American Management Association, 2017.
2. L. Lei, L. DeCandia, R. Oppenheim, Y. Zhao, "Managing Supply Chain Operations", World Scientific Publishing Co., 2017.
3. E. Harden, "Just-in-Time Logistics: Does it Fulfill the Surface Navy's Repair Parts Requirements to Support the National Military Strategy?", Creative Media Partners, LLC, 2012.
4. O. Yakimenko, "Precision Aerial Delivery Systems: Modeling, Dynamics, and Control", American Institute of Aeronautics and Astronautics, 2015.
5. *WHO, "Qualification of shipping containers, Technical supplement to WHO Technical Report Series, No. 961, 2011", QAS/14.598 Supplement 13, 2014

6. N. N. Ahypeeb, “Reusable Rockets and Missiles, Russian Cargo Delivery to Space, USSR”, Mockba, 1975;

KEYWORDS: Agile logistics; rapid cargo logistics; ground launch operations

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VERSION 2

SF242-D028 TITLE: Strategic Advancements in Resilient Space Technologies for PWSA Enhancement

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

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

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

PHASE I: 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 or ongoing SBIR/STTR funding agreement. This phase should thoroughly assess scientific and technical merit while establishing the feasibility of ideas with commercial potential. The applicant(s) must validate the product-market fit between the proposed solution and the warfighting customer, identifying potential end-users within the Department of Defense and exploring integration feasibility and costs with current mission-specific products. The documentation presented should encompass technical reports, test data, prototype designs/models, and achieved performance results aligned with the minimum technical and scientific merit outlined in the description. The prior work demonstrating feasibility must have been substantially performed by the applicant(s) and/or the Principal Investigator.

PHASE II: The proposed D2P2 solution strategically aligns with key focus areas aimed at advancing affordable, resilient, interoperable technologies inherent or required within the PWSA. This effort to enhance space capabilities comes in response to the nation's growing reliance on space infrastructure while advancing critical services provided to joint forces, enabling truly global joint warfighting operations and all domain command and control. The D2P2 initiative is designed to address these challenges by focusing on key strategic areas:

1. Advanced Space Connectivity and Integration: This encompasses the integration of commercially-sensed data into the transport layer for the benefit of the warfighter at the tactical edge while developing advanced Optical Inter-Satellite Link (OISL) components and technologies to reduce SWaP-C, mitigate atmospheric effects, and provide all optical routing to enhance connectivity between space vehicles and/or domain agnostic terrestrial users.
2. Enhanced Space Systems and Capabilities: This involves advancing the development and application of cyber solutions, networking technologies, in-space processing capabilities, power enhancement for commoditized space vehicle buses, and generic BMC3 hardware and middleware solutions to bolster the overall resilience and capabilities of space systems. Of

particular interest are capabilities and technologies whose application would lower the overall data latency associated with moving time critical information from point of creation to point of employment on operationally relevant timelines.

3. Next-Generation Hardware and Security Measures: The focus here is on implementing seamless multi-level security, small SWaP-C cryptography, affordable cross-domain solutions, and related data and information protection measures to safeguard space assets and operations from potential threats and/or compromise.
4. Precision Timing and Spaceborne Clock Technologies: Addressing the crucial need for high-performance, low SWaP-C clocks for space, ensuring precise timekeeping in satellite operations and supporting PNT while avoiding the need for major user terminal recapitalization. This concerted effort aims to leverage previous feasibility demonstrations, driving innovative solutions that significantly augment existing PNT solutions and require minimal user resource application for success.
5. Radio Frequency Space Data Transport Solutions: Advanced hardware, software and/or firmware solutions for commoditized space vehicles across UHF, L, S, and Ka bands with multi-band transceivers for ground, sea, air, high altitude and sub-orbital platforms. Of particular interest are high duty cycle, low SWaP-C transceiver solutions enabling multi-user, multi-band operations from a single vehicle or set of cross-linked interoperable vehicles.

Successful Phase-II proposals within these strategic areas will culminate in comprehensive end-to-end capability demonstrations in relevant operational laboratory environments. Such demonstrations should substantially improve the Technical Readiness Level(s) of any developing technologies. Subsequently, initial field testing may be conducted to confirm the readiness of proposed capabilities for limited production and operational deployment, aligning with the imperative to enhance the warfighting capability of the joint force.

PHASE III DUAL USE APPLICATIONS: The Phase III transition plan for this initiative involves advancing the technology developed in Phase II towards operational integration, emphasizing its dual-use potential for both military and commercial applications. Building on the proven capabilities and advancements achieved in Phase II, Phase III focuses on refining the technology for seamless integration into operational environments within the Space Force while exploring its applications in commercial sectors. Rigorous testing, validation, and evaluations are conducted to ensure the technology's readiness for integration into established Space Force systems while simultaneously identifying commercial use cases and potential markets. Engagement with government transition programs and commercial stakeholders is pivotal to facilitate the technology's seamless integration across both defense and civilian domains. The overarching objective of Phase III is to transition the technology into operational use within the Space Force, ensuring enhanced security, resilience, and operational efficiency for space-based architectures while exploring its potential for broader commercial utilization.

REFERENCES:

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

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

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VERSION 2

SF242-D029 TITLE: Space Based Environmental Monitoring (SBEM)

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

OBJECTIVE: To develop and implement cutting-edge Space Based Environmental Monitoring (SBEM) technologies aimed at enabling the Space Systems Command to establish a comprehensive, real-time, and globally responsive environmental monitoring system from space. The end state is to create an integrated network of satellites capable of delivering accurate and actionable environmental data for enhanced situational awareness, resource management, and informed decision-making in both military and civilian sectors.

DESCRIPTION: The Space Systems Command (SSC) is spearheading an ambitious initiative focused on advancing Space Based Environmental Monitoring (SBEM) capabilities to revolutionize global environmental data collection and analysis from space. This endeavor aims to develop and deploy a constellation of state-of-the-art satellites equipped with cutting-edge sensors and instrumentation. The primary objective is to establish a comprehensive, real-time, and responsive environmental monitoring system, delivering high-resolution data on various ecological parameters worldwide.

The project encompasses several key facets:
Technology Innovation: SSC seeks innovative solutions to enhance satellite capabilities, including sensor development, data processing algorithms, and communication systems. The emphasis is on ensuring higher precision, broader coverage, and increased data reliability.

System Integration: The integration of disparate systems into a cohesive network forms a pivotal aspect. This involves satellite constellation management, data fusion, and interoperability to create a seamless ecosystem for collecting, analyzing, and disseminating environmental data.

Data Utilization: SSC aims to harness the collected data for actionable insights. This involves the development of sophisticated analytics tools, predictive models, and decision-support systems. The goal is to enable informed decision-making across diverse sectors, including defense, disaster response, agriculture, and resource management.

Collaborative Partnerships: Collaboration with industry leaders, academia, government agencies, and international entities forms a critical element. SSC endeavors to foster partnerships to leverage expertise, resources, and diverse perspectives, accelerating innovation and global impact.

Operational Efficiency: The project seeks to ensure operational efficiency in satellite deployment, data transmission, and system maintenance. SSC aims to develop streamlined processes and resilient infrastructure for continuous and reliable SBEM operations.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the 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 "phase" should thoroughly assess scientific and technical merit while establishing the feasibility of ideas with commercial potential. The Offeror must validate the product-market fit between the proposed solution and the warfighting customer, identifying potential end-users within the Department of Defense and exploring integration feasibility and costs with current mission-specific products. The documentation presented should encompass technical reports, test data, prototype designs/models, and achieved performance results aligned with the minimum technical and scientific merit outlined in the description. The prior work demonstrating feasibility must have been substantially performed by the Offeror and/or the Principal Investigator.

PHASE II: The Phase II effort aims to advance Space Based Environmental Monitoring (SBEM) technology developed in Phase I by integrating advanced sensor technologies and data fusion algorithms to create an interconnected satellite constellation. This Phase II prototype will operate with high-resolution multispectral sensors across visible, infrared, and microwave spectrums, capturing diverse environmental indicators globally. Rigorous testing under simulated and real-world conditions, including vacuum and thermal chamber testing, ensures functionality in extreme space environments. Success criteria involve achieving a 95% accuracy rate in environmental data collection, scalability for at least six satellites, and demonstrating cost-effectiveness compared to traditional methods, enhancing its commercial viability for defense, disaster management, agriculture, and environmental sectors

PHASE III DUAL USE APPLICATIONS: The Phase III dual-use initiative aims to transition the advanced Space-Based Environmental Monitoring (SBEM) technology into commercial markets while addressing specific government and military needs. This phase focuses on optimizing the technology for commercial adoption by environmental monitoring firms, agriculture, and disaster management agencies, ensuring scalability and user-friendly interfaces. Simultaneously, it tailors SBEM technology for government and military applications, collaborating with defense agencies, emergency responders, and environmental bodies to align with operational requirements. Continuous technology refinement and field tests validate the technology's robustness in diverse settings, meeting stringent standards. A comprehensive market penetration strategy facilitates widespread commercial adoption through targeted marketing, industry partnerships, and user training programs, ensuring broader societal impact and strategic relevance

REFERENCES:

1. Z. Szajnfarber, T. Beatty, M. Petersen, A. Vasilyeva, D. White, A. Wiegel; “Defining a US Architecture for Environmental Monitoring from Space”. Massachusetts Institute of Technology

KEYWORDS: Remote Sensing; Environmental Testing; Climate Observation; Data Fusion

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