DEPARTMENT OF THE AIR FORCE
23.1 Small Business Innovation Research (SBIR) Phase I
Proposal Submission Instructions

Amendment 1

26 January 2023

This Amendment modifies the 23.1 DAF SBIR Phase I proposal submission instructions in the following manner:

1. The TPOC information for Topic AF231-0023 is changed from

   ~~TPOC-1: Joshua Mote~~
   ~~Phone: (205) 901-8980~~
   ~~Email: joshua.mote.1@us.af.mil~~
   to

   TPOC-1: James Bailey
   Phone: (781) 588-5459
   Email: james.bailey@us.af.mil

All other provisions remain unchanged as a result of this Amendment.

DEPARTMENT OF THE AIR FORCE
23.1 Small Business Innovation Research (SBIR) Phase I
Proposal Submission Instructions

The Air Force intends these Phase I proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Offerers must ensure proposals meet all requirements of the 23.1 SBIR BAA posted on the Defense SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time outlined in this document.**

Complete proposals **must** be prepared and submitted via https://www.dodsbirsttr.mil/submissions/ (DSIP) on or before the date published in the DoD 23.1 SBIR BAA. Offerers are responsible for ensuring proposals comply with the requirements in the most current version of this instruction at the proposal submission deadline date/time.

The DF recommends early submission, as computer traffic gets heavy near the proposal submission date/time and could slow down the system. **Do not wait until the last minute.** The DAF is not responsible for incomplete proposal submission due to system lag or inaccessibility. Please ensure contact information, i.e., names/phone numbers/email addresses, in the proposal is current and accurate. The DAF is not responsible for ensuring notifications are received by firms for which this information changes after proposal submission without proper notification. Changes of this nature shall be sent to the Air Force SBIR/STTR One Help Desk.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the DAF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "23.1 Address Change".

Points of Contact:

- General information related to the DAF SBIR/STTR program and proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us.
- Questions regarding the DSIP electronic submission system, contact the DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com.
- For technical questions about the topics during the pre-announcement and open period, please reference the DoD 23.1 SBIR BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
    - Mr. Daniel 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 23.1 SBIR Broad Agency Announcement, https://www.dodsbirsttr.mil/submissions/login, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic's requirements.

Limitations on Length of Proposal: The Phase I Technical Volume page/slide limits 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.

Phase I Proposal Format

Proposal Cover Sheet: 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 these sections.

Technical Volume: The Technical Volume should include all graphics and attachments but should not include the Cover Sheet, which is completed separately. Phase I technical volume (uploaded in Volume 2) shall contain the required elements. Make sure all graphics are distinguishable in black and white.

Key Personnel: Identify in the Technical Volume all key personnel who will be involved in this project; include information on directly related education, experience, and citizenship.

- A technical resume of the principal investigator, including a list of publications, if any, must be included
- Concise technical resumes for subcontractors and consultants, if any, are also useful.
- Identify all U.S. permanent residents to be involved in the project as direct employees, subcontractors, or consultants.
- Identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For all non-U.S. citizens, in addition to technical resumes, please provide countries of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project, as appropriate. Additional information may be requested during negotiations in order to verify the foreign citizen's eligibility to participate on a contract issued as a result of this announcement. **Note:** Do not upload information such as Permanent Resident Cards (Green Cards), birth certificates, Social Security Numbers, or other PII to the DSIP system.

Phase I Work Plan Outline

NOTE: The DAF uses the work plan outline as the initial draft of the Phase I Statement of Work (SOW). Therefore, **do not include proprietary information in the work plan outline**. To do so will necessitate a request for revision, if selected, and may delay contract award.

Include a work plan outline in the following format:
Scope: List the effort's major requirements and specifications.
Task Outline: Provide a brief outline of the work to be accomplished during the Phase I effort.
Milestone Schedule
Deliverables
Progress reports
Final report with SF 298

Cost Volume: 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-i below) regarding funds use if an award is received. The DSIP Cost

Volume and Itemized Cost Volume Information will not count against the specified page limit. The itemized listing may be submitted in Volume 5 under the “Other” dropdown option.

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

b. **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.

c. **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.

d. **Direct Labor**: Identify key personnel by name, if possible, or bylabor 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.

e. **Travel**: Travel costs must relate to project needs. Break out travel costs by trip, number of travelers, airfare, per diem, lodging, etc. The number of trips required, as well as the destination and purpose of each, should be reflected. Recommend budgeting at least one trip to the Air Force location managing the contract.

f. **Subcontracts**: Involvement of university or other consultants in the project’s planning and/or research stages may be appropriate. If so, describe in detail and include information in the Cost Volume. The proposed total of consultant fees, facility lease/usage fees, and other subcontract or purchase agreements may not exceed **one-third of the total contract price** or cost (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.

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 exchanges. Therefore, the offeror’s initial proposal should contain the offeror’s best terms from a cost or price and technical standpoint. If there are questions regarding the award document, contact the Phase I CO identified on the cover page. The Government reserves the right to reopen negotiations later if the CO determines doing so to be necessary.

h. **DD Form 2315**: 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 2315, 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/DD2315Instructions.aspx. DD Form 2315 approval will be required if proposal is selected for award.

NOTE: Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors TEC Solutions, Inc., APEX, Oasis Systems, Riverside Research, Peerless Technologies, HPC-COM, Mile Two, 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 Air Force Life Cycle Management Center and Space and Missiles Centers may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. Contact the DAF SBIR/STTR COs with concerns.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DAF will occasionally accept deviations from the POW requirements with written prior approval from the Funding Agreement officer. Prior approval must be uploaded to the certification question in DSIP in order to complete the submission.

Company Commercialization Report (CCR) (Volume 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

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

PHASE I PROPOSAL SUBMISSION CHECKLIST

Firms shall register in the System for Award Management (SAM) at https://www.sam.gov/, to be eligible for proposal acceptance. Follow instructions located in SAM to obtain a Commercial and Government Entity (CAGE) code and Unique Entity Identifier (UEI) number. Firms shall also verify “Purpose of Registration” is set to “I want to be able to bid on federal contracts or other procurement opportunities. I also want to be able to apply for grants, loans, and other financial assistance programs”, NOT “I only want to apply for federal assistance opportunities like grants, loans, and other financial assistance programs.” Firms registered to compete for federal assistance opportunities only at the time of proposal submission will not be considered for award. Addresses must be consistent between the proposal and SAM at award. Previously registered firms are advised to access SAM to ensure all company data is current before proposal submission and, if selected, award.

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 DAF 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, and transmission of proposal materials by way of alternative means will not constitute successful submission on the applicant’s part.

AIR FORCE PROPOSAL EVALUATIONS

The DAF will utilize the Phase I proposal evaluation criteria in the 23.1 SBIR DoD announcement in descending order of importance with technical merit being most important, followed by principal investigator's (and team's) qualification, followed by the potential for commercialization as detailed in the Commercialization Plan.

The DAF will utilize the Phase II proposal evaluation criteria in the 23.1 SBIR DoD announcement in descending order of importance with technical merit being most important, followed by the potential for commercialization as detailed in the Commercialization Plan, followed by the qualifications of the principal investigator (and team).

Proposal Status and Feedback
The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Cover Sheet will be notified by e-mail regarding proposal selection or non-selection. Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the Proposal Number and Topic Number referenced.

Automated feedback will be provided for Phase I proposals determined 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 topic by topic. Each organization operates within its own schedule for proposal evaluation and selection. Updates and notification timeframes will vary. If contacted regarding a proposal submission, it is not necessary to request information regarding additional submissions. Separate notifications are provided for each proposal.

It is anticipated all the proposals will be evaluated and selections finalized within approximately 90 calendar days of solicitation close. Please refrain from contacting the BAA 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 Brewer, Daniel.Brewer.13@us.af.mil.

AIR FORCE SUBMISSION OF FINAL REPORTS
All Final Reports will be submitted to the awarding DAF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

PHASE II PROPOSAL SUBMISSIONS
DAF organizations may request Phase II proposals while technical performance is on-going. This decision will be based on the contractor's technical progress, as determined by a DAF Technical Point of Contact review using the DoD 23.1 SBIR BAA Phase II review criteria.

Phase II is the demonstration of the technology found feasible in Phase I. Only Phase I awardees are eligible to submit a Phase II proposal. All Phase I awardees will be sent a notification with the Phase II proposal submittal date and detailed Phase II proposal preparation instructions. If the physical or email addresses or firm points of contact have changed since submission of the Phase I proposal, correct information shall be sent to the AF SBIR/STTR One Help Desk as instructed on A-1. Phase II dollar values, performance periods, and proposal content will be specified in the Phase II request for proposal.

NOTE: The Air Force primarily awards Phase I and II contracts as Firm-Fixed-Price. 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 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 at any time that will improve management of the DAF SBIR Program.

DAF SBIR 23.1 Phase I Topic Index

Topic Number	Topic Name	Maximum Value	Maximum Duration (in months)	Technical Volume Page Limit
AF231-0001	APTU Combustion Health Monitoring	$180,000	9	20
AF231-0002	High Temperature and Pressure Mass Flow Rate Measurement System for Liquid and Supercritical Phase Fluids	$180,000	9	20
AF231-0003	Remote Emissivity Measurement System for Spacecraft Materials Testing	$180,000	9	20
AF231-0004	In-Situ Bidirectional Reflectance Distribution Function (BRDF) Measurement System for Spacecraft Materials Testing	$180,000	9	20
AF231-0005	Imaging Spectropyrometer for Industrial Process and Hypersonic Thermal Protection System Characterization	$180,000	9	20
AF231-0006	Optical Interface for Bright-Source Exclusion and Threat Testing in a Cryovacuum Chamber for High Power Laser Sources	$180,000	9	20
AF231-0007	Cryovacuum Slip Ring for Instrumentation and Purge / Cooling Flow	$180,000	9	20
AF231-0008	MWIR/LWIR Detector Standards for Low-Radiometric-Power Calibration to Support Space-borne Imaging Sensor Calibration, Characterization, and Hardware-in-the-Loop Testing	$180,000	9	20
AF231-0009	Flight Systems Data Acquisition via Onboard Air-Gapped Communication System	$180,000	9	20
AF231-0010	Fiber Optic Strain Sensing with Pass-through Fiber Optic Rotary Joint	$180,000	9	20
AF231-0011	Hybrid Slip Ring	$180,000	9	20
AF231-0012	ADV MMW RAM (Advanced Millimeter-Wave Radar Absorbing Materials)	$180,000	9	20
AF231-0013	MIN MMW RFSoC Tech	$180,000	9	20
AF231-0014	Static Detection System	$180,000	9	20

AF231-0015	ATC Kit	$180,000	9	20
AF231-0016	ATC for Small CTKs	$180,000	9	20
AF231-0017	New Integrated ATC	$180,000	9	20
AF231-0018	Automated Sourcing Supply	$180,000	9	20
AF231-0019	FL-MSA High-Speed Connectivity	$180,000	9	20
AF231-0020	Toolbox MX Enabler Suite	$180,000	9	20
AF231-0021	MR Glasses - Aircraft MX	$180,000	9	20
AF231-0022	Mobile Asset Management system	$180,000	9	20
AF231-0023	Multi-Mission Blue UAS	$180,000	9	20
SF231-0024	Cislunar Navigation	$180,000	9	20
AF231-0026	Meshed Radar Network to Achieve Extended Coverage and Improved Performance from a Small, Lightweight, Low Power AESA for ATC in an Expeditionary Environment	$180,000	9	20
AF231-0027	Decentralized Command and Control of Autonomous Systems	$180,000	9	20
AF231-0028	Universal Neural Information Acquisition Architecture for Cognitive Augmentation	$180,000	9	20

AF231-0001 TITLE: APTU Combustion Health Monitoring

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

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

OBJECTIVE: Develop a nonintrusive diagnostic health-monitoring system for real-time detection of combustor hardware failure.

DESCRIPTION: The Aerodynamic and Propulsion Test Unit (APTU) at the Arnold Engineering Development Complex (AEDC) is a hypersonic test facility that produces a true flight conditions (temperature and pressure test environment) via combustion. The high-temperature, high-pressure combustion chamber environment is severe and combustion chamber components can fail rapidly. The combustion chamber components are constructed of copper and Monel. Failures in the combustion chamber generally result in the destruction of one or more of these components. It is known from video camera recordings that fragments of these failed components are observable at the exit plane of the expansion nozzle. It is suspected, but not verified, that atomic and molecular species from the failed components will be present in the nozzle effluent. A nonintrusive, real-time, diagnostic health-monitoring system is needed for immediate detection of combustor hardware failure and shutdown of the combustor to minimize facility damage. Since damage starts in a localized part inside the combustion chamber, nonintrusive health monitoring technologies must have wide viewing angles or multiple sensors to cover the wide extent of the flow field and capture problems early.

PHASE I: Develop understanding of the APTU combustor operation and materials and the supersonic-to-hypersonic flow field at the exit of the facility nozzle. Assess nonintrusive diagnostic systems and select those that are expected to work for an APTU-type flow field. This includes high velocity flow with high total temperature and pressure, and water vapor condensation. Perform bench-top combustion studies on the response of the chosen systems to Monel and copper spectrum.

PHASE II: Develop a nonintrusive diagnostic-type health monitoring prototype and demonstrate the capability in a flow field environment to the one found at the exit of the free jet nozzle in APTU. A smaller-than-APTU scale test rig is acceptable if localized sources of material can be vaporized and detected across the full diameter of the nozzle exit.

PHASE III DUAL USE APPLICATIONS: Potential Phase III efforts include full production capability in hydrocarbon combustion chambers such as coal-fired powerplants and gas turbine engines; rocket engines; and other high-enthalpy ground test facilities such as arc heaters.

REFERENCES:

1. “Test Facility Guide–Arnold Engineering Development Complex,” [online document], URL: http://www.arnold.af.mil/Portals/49/documents/AFD-080625-010.pdf?ver=2016-06-16-100801-260 [cited 20 January 2021].

KEYWORDS: Combustion Systems Health Monitoring; Nonintrusive Diagnostics

TPOC-1: Donald Malloy
Phone: (931) 454-4112
Email: donald.malloy.1@us.af.mil

AF231-0002 TITLE: High Temperature and Pressure Mass Flow Rate Measurement System for Liquid and Supercritical Phase Fluids

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

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

OBJECTIVE: Develop and demonstrate a true mass flow rate measurement system to be used to determine the flow rate of high temperature and pressure fluids in support of Department of Defense (DoD) hypersonic flight system acquisition programs.

DESCRIPTION: The ground testing of DoD high speed and hypersonic (HS/H) propulsion systems requires supporting utility supply systems that can provide various fluids and gases to the test article at conditions similar to or in excess of those expected to be experienced while the system is in flight. Because of the extreme temperatures and pressures experienced during hypersonic flight, the fuel that is used by the propulsion system will also be used to provide cooling to flight vehicle hardware and propulsion system components before injection into and burned in the combustor. At the Aerodynamic and Propulsion Test Unit (APTU) of the Arnold Engineering Development Complex at Arnold Air Force Base in Tennessee, a Heated Fuel System (HFS) has been installed to support HS/H propulsion system testing using kerosene-based fuels. It is designed to provide fuel to the propulsion system under test at high pressures and temperatures. Once the fuel is heated to the desired test temperature the fuel may be in a supercritical thermodynamic state and endothermic reactions may have broken long-chain hydrocarbon molecules into shorter molecules. This in turn results in a large uncertainty in the density of the fuel since the actual composition of the fuel mixture after heating is unknown. A new measurement method is needed to determine the fuel mass flow rate downstream of the fuel heating system. It is desired that the measurement uncertainties of this method are on the order of the methods used to measure low temperature flows. A direct measurement of mass flow rate is preferred since requiring the conversion of a volume flow rate to mass flow rate using the fluid density is not conducive to maintaining a low measurement uncertainty.

PHASE I: Work with AEDC personnel to develop HFS operational understanding. Survey industry to assess potential solutions to the problem, including later commercialization opportunities. Develop the design of a mass flow rate measurement system up to CDR level including measurement uncertainty assessment.

PHASE II: Manufacture measurement devices and install in APTU HFS downstream of fuel heating section for testing. Iterate design as needed.

PHASE III DUAL USE APPLICATIONS: Develop mass flow rate meters for individual engine flow paths (reduced measurement range). Reduce device complexity and size for use on flight-type and flight-weight test articles. Incorporate a fuel density measurement system into the design. This technology will result in a product easily commercialized to the oil and refining industries and any other industry needing a quantitative measurement of mass flow rate at high temperatures and pressures.

REFERENCES:

1. Abernethy, R. B., et. al., and Thompson, J. W., “Handbook: Uncertainty in Gas Turbine Measurements”, AEDC-TR-73-5, February 1973, Page 1.;
2. Smith, L. and Ruesch, J. R., “Mass Flow Meters”, Chapter 10 in Flow Measurement, edited by D. W. Spitzer, part of the Practical Guides for Measurement and Control series of the Instrumentation Society of America, © 1991.;
3. ASME Standard 2004, Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi, Number ASME MFC-3M-2004, American Society of Mechanical Engineers, 2004.;
4. Holst, K., Garrard, D., and Milhoan, A., “Upgrades and Plans for Activation and Calibration of the Aerodynamic and Propulsion Test Unit Heated Fuel System,” AIAA 2014-2483, Presented at the 19th AIAA International Space Planes and Hypersonic Systems and Technologies Conference, Atlanta, GA, June 16-20, 2014.

KEYWORDS: Heated Fuel; Mass Flow Rate, High Temperature; High Pressure; Scramjet; Ground Testing; APTU

TPOC-1: Jonathan Lister
Phone: (931) 454-6150
Email: jonathan.lister.2@us.af.mil

AF231-0003 TITLE: Remote Emissivity Measurement System for Spacecraft Materials Testing

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

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

OBJECTIVE: Develop a spectral emissivity measurement system for evaluating thermal control material responses to a simulated space environment.

DESCRIPTION: The space environment can induce optical property changes in spacecraft thermal control materials. These changes must be characterized in order to evaluate system performance. A spectral emissometer is desired for integration into a cryogenic vacuum space simulation chamber. This emissometer must be capable of measuring emissivity with the samples installed inside the vacuum chamber. Current methods require attaching temperature instrumentation, which is challenging for some materials and test parameters, or require close proximity to the measurement sample. An emissometer is required that can acquire data at a distance from the samples, up to 3 meters. The system can be vacuum compatible and installed inside the chamber or installed outside the chamber with a provided window as the optical interface. The system should be able to measure spectral data from approximately 2 to 14 micrometers (µm) for samples with emissivity ranging from 0.2 to 0.95. Several systems exist in the chamber to help facilitate emissivity measurements. The chamber walls are designed for low infrared reflection and emission. An in-chamber blackbody source can be utilized as a reference. Non-contact heating of the samples is achieved with existing chamber systems. The ability to measure or estimate sample temperature can be challenging dependent on the type of material. The system should be designed to measure emissivity without knowledge of the sample temperature. Interference from other radiation sources and diagnostic systems is not expected.

PHASE I: Demonstrate a proof-of-concept system that can measure emissivity at one infrared wavelength (between 2-14 µm) on a 5 cm^2 sample at a distance of 1 meter. Feasibility of extending the measurement range to 3 meters should be considered. The demonstration should include measurements at temperatures ranging from 25 to 500 degrees Celsius). Methods to integrate the system to a vacuum chamber should be considered.

PHASE II: Demonstrate a proof-of-concept system that can measure emissivity between 2-14 µm on a 1 cm^2 samples at range of 2-3 meters. The system should have the ability to measure emissivity at a variety of elevated sample temperatures ranging from 25 to 200 degrees Celsius. The system should be integrated to a vacuum chamber for the demonstration.

PHASE III DUAL USE APPLICATIONS: Phase III may involve follow-on non-SBIR/STTR funded R&D or production contracts for products, processes or services intended for use by the U.S. Government. Military applications could include population of space situational awareness materials databases and signature models and measurement of aircraft paints and coatings. Commercial applications could include building and construction material design and solar power material performance.

REFERENCES:

1. Arnold Engineering Development Complex Test Capabilities Guide, “Space Test Branch”, pg. 8-10, https://media.defense.gov/2021/Jun/23/2002747597/-1/-1/1/2021%20TEST%20CAPABILITIES%20GUIDE.PDF;
2. J. R. Markham, K. Kinsella, R. M. Carangelo, C. R. Brouillette, M. D. Carangelo, P. E. Best, and P. R. Solomon “Bench top Fourier transform infrared based instrument for simultaneously measuring surface spectral emittance and temperature,” Rev. Sci. Instrum. 64, 2515– (1993).;
3. A. R. Ellis, H. M. Graham, Michael B. Sinclair, J. C. Verley, "Variable-angle directional emissometer for moderate-temperature emissivity measurements," Proc. SPIE 7065, Reflection, Scattering, and Diffraction from Surfaces, 706508 (29 August 2008); https://doi.org/10.1117/12.796507;
4. Adibekyan, et al., "Emissivity Measurements Under Vacuum in the Wavelength Range from 4 Microns to 100 Microns and Temperature Range from -40oC to 500oC at PTB”, AMA Conferences 2013;
5. Markham, et al., “FT-IR Measurements of Emissivity and Temperature During High Flux Solar Processing”, Journal of Solar Energy Engineering, Vol. 118, pp. 20 – 29, February 1996

KEYWORDS: Emissivity; Thermal Control; Spacecraft; Space Environment; Space Simulation

TPOC-1: Benjamin Weaver
Phone: (931) 454-6766
Email: benjamin.weaver.3@us.af.mil

AF231-0004 TITLE: In-Situ Bidirectional Reflectance Distribution Function (BRDF) Measurement System for Spacecraft Materials Testing

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

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

OBJECTIVE: Develop a high spatial resolution, multi-spectral bidirectional reflectance distribution function (BRDF) measurement system for evaluating spacecraft material responses to a simulated space environment.

DESCRIPTION: BRDF is a critical parameter for space situation awareness and signature modeling, especially since the optical properties of spacecraft materials change on orbit due to the deleterious effects of the space environment. Test facilities exist that can evaluate these changes in a simulated space environment, but they lack the capability to measure the changes in material BRDF in-situ while the materials are installed in the facility. A complete BRDF system is required that can be integrated in a cryogenic vacuum chamber that can measure multiple materials of varying composition and surface finish. The system can be vacuum compatible, residing in the chamber, or be installed outside the chamber, using provided windows as optical interfaces. The ideal system would also be able to resolve a 1 cm2 area at multiple wavelengths in the visible and infrared wavelengths. Several systems exist in the chamber to help facilitate measurements. The chamber walls are designed for low infrared reflection and emission. Reference samples can be installed in a manner that shields them from the simulated space environment. Visible and infrared transmitting windows are available for optical interface. BRDF measurements will be conducted such that there is no interference from other sources or diagnostics in the chamber.

PHASE I: Demonstrate a proof of concept system that can measure BRDF at one visible and one short wave infrared (SWIR) wavelength. The system should include an appropriate light source. The system should be able to perform the measurement at a distance of at least one meter from the measurement surface and resolve an area of 2 cm^2. Methods to integrate the system to a vacuum chamber should be considered.

PHASE II: Develop and demonstrate a prototype measurement system that can measure BRDF at least two visible and two SWIR wavelengths. The system should include an appropriate light source. The system should be able to perform the measurement at a distance range of two to three meters from the sample surface and resolve an area of 1 cm^2. The system should be integrated to a vacuum chamber for the demonstration.

PHASE III DUAL USE APPLICATIONS: Phase III may involve follow-on non-SBIR/STTR funded R&D or production contracts for products, processes or services intended for use by the U.S. Government. Military applications could include population of space situational awareness materials databases and signature models, measurement of aircraft paints and coatings. Commercial applications could include measurement of components for solar power devices, or BRDF data for 3D computer modeling of objects.

REFERENCES:

1. Karner, Konrad F., Heinz Mayer, and Michael Gervautz. "An image based measurement system for anisotropic reflection." Computer Graphics Forum. Vol. 15. No. 3. Blackwell Science Ltd, 1996.; \
2. Marschner, Stephen R., et al. "Image-based bidirectional reflectance distribution function measurement." Applied Optics 39.16 (2000): 2592-2600.;
3. Bédard, Donald, Gregg A. Wade, and Kira Abercromby. "Laboratory characterization of homogeneous spacecraft materials." Journal of Spacecraft and Rockets 52.4 (2015): 1038-1056.;
4. Hostetler, J., Cowardin, H. “Experimentally-Derived Bidirectional Reflectance Distribution Function Data in Support of the Orbital Debris Program Office.” 2019 Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS).;
5. Arnold Engineering Development Complex Test Capabilities Guide, “Space Test Branch”, pg. 8-10, https://media.defense.gov/2021/Jun/23/2002747597/-1/-1/1/2021%20TEST%20CAPABILITIES%20GUIDE.PDF

KEYWORDS: Bidirectional Reflectance Distribution Function; Spacecraft; Space Environment; Space Simulation; BRDF

TPOC-1: Benjamin Weaver
Phone: (931) 454-6766
Email: benjamin.weaver.3@us.af.mil

AF231-0005 TITLE: Imaging Spectropyrometer for Industrial Process and Hypersonic Thermal Protection System Characterization

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

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

OBJECTIVE: Produce an imaging spectropyrometer to yield high spatial resolution, highly accurate measurements of surface temperature of non-gray surfaces and accurate estimation of spectral emissivity during materials characterization testing in high-temperature laboratory facilities and high-enthalpy flow facilities such as arc-heated and inductively-coupled plasma wind tunnels.

DESCRIPTION: Development and optimization of thermal protection systems (TPS) for hypersonic vehicles rely on accurate knowledge of TPS temperature and emissivity. The requirements are driven by the Test Resource Management Center (TRMC) Hypersonic Test Requirements Roadmap and coordination with the TRMC Hypersonic Roadmap activity is encouraged to ensure the proposed approaches meet the performance and TRL level required to address the needs of the DoD hypersonic community. Current COTS instrumentation provides point measurements, but spatially resolved temperature and emissivity measurements are required to properly account for surface gradients. An imaging spectropyrometer measurement system is needed to yield high spatial resolution, highly accurate measurements of surface temperature of non-gray surfaces and accurate estimation of spectral emissivity during materials characterization testing in high-temperature laboratory facilities and high-enthalpy flow facilities such as arc-heated and inductively-coupled plasma wind tunnels. Performance characteristics needed are: temperature measurement range of 575-4250 K (threshold) and 300-6000 K (objective), temperature measurement resolution 0.1 K threshold and 0.05 K objective, temperature measurement accuracy of 0.5 threshold and 0.1 threshold (in percent of reading for non-gray targets), wavelength range of 0.5-2.0 micrometers threshold and 0.4-5.0 micrometers objective, spectral resolution 0.05 micrometers threshold and 0.01 micrometers objective, temporal resolution 0.1 sec threshold and 0.01 sec objective, and spatial resolution of 2 mm threshold and 0.5 mm objective (128x128 pixels threshold and 1024x1024 objective). Special attention should be paid to compensating the measurements for the impact of stray radiation or reflections from other sources. Additionally, the analysis technique should compensate for potential gaseous and particulate emission/absorption from the medium surrounding the test article. Because of the temporally-varying nature of the USAF application, a snap-shot data acquisition method is preferred (i.e., all spectral/spatial information is acquired in one integration time. Consideration will be given to the best balance of these performance parameters along with the analysis method.

PHASE I: The Phase I effort should perform a detailed analysis of alternatives considering different instrumental (e.g. 2-D imaging spectrometer vs push broom imaging spectrometer) and analytical approaches. This effort should culminate in a conceptual design that best satisfies the Threshold/Objective requirements with consideration given to accommodating interference from stray radiation and emission from gaseous/particulate species surrounding the test article. The Phase I design should focus on application in arc-heated facilities, but take into consideration high enthalpy facilities of other technologies.

PHASE II: The Phase II effort should produce a prototype imaging spectropyrometer system capable of meeting the Threshold/Objective requirements and be demonstrated in a USAF arc facility for comparison to non-imaging techniques currently in use.

PHASE III DUAL USE APPLICATIONS: Phase III efforts would include close coordination with the TRMC Hypersonic Roadmap activity to ensure the capabilities produced meet the performance and TRL level required to address the needs of the DoD hypersonic community. Installation in multiple facilities with varying integration requirements will require production of multiple units. Phase III efforts therefore will require both further R&D and the production of multiple units tailored for various facilities and applications. Pyrometers are widely used in industrial process such as chemical vapor deposition, investment casting, powder metallurgy, and semiconductor production. The additional spatial coverage envisioned by the proposed SBIR product would find wide application in these areas.

REFERENCES:

1. Felice, R. A., "The Spectropyrometer – a Practical Multi-wavelength Pyrometer," Temperature: Its Measurement and Control in Science and Industry; Volume Seven, Eighth International Temperature Symposium held 21-24 October 2002 in Chicago, Illinois. Edited by Dean C. Ripple. AIP Conference Proceedings, Vol. 684. New York: American Institute of Physics, 2003., p.711-716. https://doi.org/10.1063/1.1627211;
2. Taunay PCR, Choueiri EY. Multi-wavelength pyrometry based on robust statistics and cross-validation of emissivity model. Rev Sci Instrum. 2020 Nov 1;91(11):11490; 2. https://doi.org/10.1063/5.0019847;
3. H. Madura, H., Kastek, M., Sosnowski, T., and Orżanowski, T., "Pyrometric Method of Temperature Measurement with Compensation for Solar Radiation," Metrology and Measurement Systems, Volume 17, page 77-86, 2010. Index 330930, ISSN 0860-8229, http://journals.pan.pl/dlibra/publication/122789/edition/107041/content;
4. Madura, H., Kastek, M., and Piątkowski, T., "Automatic compensation of emissivity in three-wavelength pyrometers," Volume 51, Issue 1, July 2007, Pages 1-8. https://doi.org/10.1016/j.infrared.2006.11.001;
5. Nian, W., Shen, H., Zhu, R., " Constraint optimization algorithm for spectral emissivity calculation in multispectral thermometry," Measurement, Volume 170, January 2021, 108725, https://doi.org/10.1016/j.measurement.2020.108725

KEYWORDS: Pyrometry; multi-spectral; hyperspectral; thermal protection systems; hypersonics

TPOC-1: Donald Malloy
Phone: (931) 454-4112
Email: donald.malloy.1@us.af.mil

AF231-0006 TITLE: Optical Interface for Bright-Source Exclusion and Threat Testing in a Cryovacuum Chamber for High Power Laser Sources

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

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

OBJECTIVE: Develop a Cryovacuum Optical Interface for High-Power Laser Radiation Delivery.

DESCRIPTION: The effects on performance and robustness of airborne and space-borne imaging sensors when subjected to high levels of radiation is a critical parameter in system design. Such incident irradiance could be due to nearby bright objects such as the sun, moon, impact flash, or potential threats. A Cryovacuum Interface for High-Power Laser Radiation Delivery is needed to facilitate meeting test requirements. The Space Systems Test Facility at AEDC recently implemented a capability in a space simulation cryochamber which provides collimated beams of radiation that represents the solar and lunar apparent in-band irradiance levels in visible and IR bands. The radiative power of bright sources needs to be projected up to the angular extent of the sun or moon (~0.53°) as well as point sources with collimated low-divergence output that can be introduced into a cryovacuum chamber and deliver high-level irradiances to a system under test (SUT). Needs also include the projection of bright sources to represent: 1) fast-moving resolved targets with a 2-D scene, 2) off-axis (out of FOV) unresolved objects for exclusion testing, 3) off-axis and/or on-axis threat (out and in FOV) radiation for "operate-through" testing of imaging sensors with a 2-D scene, and 4) projection of on-axis (in FOV) threat radiation to establish system-level damage thresholds. The delivery system must enable a high throughput of laser energy through the vacuum and cryoliner with minimal losses of radiant power that could be damaging to facility support hardware. An in-situ means of adjusting (from outside the vacuum chamber) and monitoring the optical alignment to mitigate power losses is needed as a part of this system. The basic configuration must accommodate laser wavelengths from visible through the LWIR spectral range, though component variations would be acceptable for different spectral bands to make use of fibers or hollow-core waveguides appropriate for those spectral bands.

PHASE I: Demonstrate a proof-of-concept cryovacuum optical interface (ambient to temperatures ~ 80 K) for transfer of infrared (NIR through LWIR) laser power levels of up to 200 W from sources external to the vacuum chamber which provides the means to facilitate alignment and monitor optical throughput for use with silicon fibers, infrared fibers, and hollow-core waveguides.

PHASE II: Develop and demonstrate a prototype cryovacuum optical interface (ambient to temperatures ~ 20 K) for transfer of laser power levels of up to 500 W (spectral ranges: UV through LWIR) which provides the means to facilitate alignment and monitor optical throughput for use with silicon fibers, infrared fibers, and hollow-core waveguides.

PHASE III DUAL USE APPLICATIONS: This technology will support enhanced test capability for military airborne and space-borne sensors. This Phase III may involve follow-on non-SBIR/STTR funded R&D or production contracts for products, processes or services intended for use by the U.S. Government.

REFERENCES:

1. Nicholson, R.A., Mead, K.D., Rogers, J.P., Stevenson, M.L., Steely, S.L., Lowry, H.S., and Schwer, D.J., ""EKV Sensor Off-Axis Rejection Test in the AEDC 7V Chamber Test Facility,"" AEDC-TR-19-S-7, February 2019. Distribution C.;
2. Abraham, E.R.I and Cornell, E.A., “Teflon feedthrough for coupling optical fibers into ultrahigh vacuum systems,” Applied Optics, Vol. 37, No. 10, pp. 1762ff, 1 April 1988.;
3. Miller, D.L. and Moshegov, N.T., “All-metal ultrahigh vacuum optical fiber feedthrough,” Journal of Vacuum Science and Technology A 19, 386, (2001); https://doi.org/10.1116/1.1322649.;
4. Nelson, M.J., Collins, C.J., and Speake, C.C., “A cryogenic optical feedthrough using polarization maintaining fibers,” Review of Scientific Instruments 87, 033111 (2016); https://doi.org/10.1063/1.4943678.;
5. Davidson, I.A., Azzouz, H., Hueck, K., and Boourennane, M., “A highly versatile optical fibre vacuum feedthrough,” Review of Scientific Instruments 87, 053104 (2016); https://doi.org/10.1063/1.4948394.

KEYWORDS: cryovacuum; lasers; laser damage; laser threat; solar exclusion; optical interface; vacuum chamber

TPOC-1: Benjamin Weaver
Phone: (931) 454-6766
Email: benjamin.weaver.3@us.af.mil

AF231-0007 TITLE: Cryovacuum Slip Ring for Instrumentation and Purge / Cooling Flow

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

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

OBJECTIVE: Develop a Cryogenic/Vacuum Rated Slip Ring capable of supplying Electrical and Fluid Flow channels through a rotating interface.

DESCRIPTION: Cable management within a thermal-vacuum chamber is critical to the safe and efficient operation of mobile equipment during test activity. Rotating equipment especially has this challenge as space is limited within the test cell for cable trays to support the necessary cabling and piping. A Cryogenic/Vacuum Rated Slip Ring capable of supplying Electrical and Fluid Flow channels through a rotating interface is needed to alleviate these concerns. The Space Systems Test Facility at AEDC recently implemented a capability in a space simulation cryo-vacuum chamber which provides continuous rotation of a test article on its axis. This requires around 20 electrical connections that can survive < 200 rpm, as well as the vacuum and cold environment. Other needs include the Positioner system in the AEDC 7V Chamber, which supports the test article through 180 degrees of roll motion and supply/return or input/output gas lines to the test article's electronics cooling system. The desired slip ring configuration would require constant electrical contact with low-noise during rotation; as well as gas-fluid channels that provide uninhibited flow through this interface with a very small leak rate. The slip ring system should be self-contained and capable of receiving an input source fitting for gas and transfer through the roll mechanism to the output source fitting; to be used directly in the cryo-vacuum environment.

PHASE I: Demonstrate a proof-of-concept cryo-vacuum slip ring (ambient to temperatures ~ 80 K) for transfer of 20-30 electrical connections (60-100V, 5-10A) as well as at least one gas channel (< 100 psig) through the slip ring, with a minimum roll rate of 100 deg/s.

PHASE II: Develop and demonstrate a prototype cryo-vacuum slip ring (ambient to temperatures ~ 80 K) for transfer of a minimum of 50 electrical connections (60-100V, 5-10A) as well as at least two gas channels

PHASE III DUAL USE APPLICATIONS: This technology will support enhanced test capability for military airborne and space-borne sensors. This Phase III may involve follow-on non-SBIR/STTR funded R&D or production contracts for products, processes or services intended for use by the U.S. Government.

REFERENCES:

1. "Test Facility Guide–Arnold Engineering Development Complex," [online document], URL; //www.arnold.af.mil/Portals/49/documents/AFD-080625-010.pdf?ver=2016-06-16-100801-260 [cited 20 January 2021].;
2. https;//en.wikipedia.org/wiki/Slip_ring; 3. https;//www.sae.org/publications/technical-papers/content/770976/; 4. https;//www.mclennan.co.uk/product/vacuum-rated-systems;

KEYWORDS: Cryo-vacuum; slip ring; vacuum chamber

TPOC-1: Benjamin Weaver
Phone: (931) 454-6766
Email: benjamin.weaver.3@us.af.mil

AF231-0008 TITLE: MWIR/LWIR Detector Standards for Low-Radiometric-Power Calibration to Support Space-borne Imaging Sensor Calibration, Characterization, and Hardware-in-the-Loop Testing

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: Development of cryo-vacuum compatible low-power detectors (single-element or arrays) with intrinsic radiometric high-accuracy in the MWIR/LWIR range to provide NIST-traceable radiometric calibration and characterization of infrared space sensor systems.

DESCRIPTION: Cryo-vacuum compatible low-power detectors (single-element or arrays) with intrinsic radiometric high-accuracy in the MWIR/LWIR range are needed to provide NIST-traceable radiometric calibration and characterization of infrared space sensor systems on an on-demand basis and at lower operational cost. The characterization of infrared sensors requires a well-known radiometric source to provide accurate levels of irradiance at the sensor aperture. Typically this is performed with a detector that is not intrinsically calibrated, in conjunction with a blackbody source that is radiometrically calibrated to a NIST-traceable standard. This process necessitates a complex test configuration with a potential source of stray radiation and a transfer calibration process, with infrequent and high cost NIST-traceable recalibrations. The calibration process would be much simpler, lower cost, and available on-demand using an intrinsically- or self-calibrated detector that has SI traceability. An array of such detectors would be highly desired that can be used as an in-situ scene projection monitor. Fast time response (0.1 sec) is desired, but not necessary for standard calibration activities. For use as an intrinsic detector standard, detector drift must be minimized. A flat, extremely well characterized and stable spectral response is preferred, but well-known spectral characterization will be considered.

PHASE I: Provide a proof of principle design capable of providing a 1% radiometric calibration in the MWIR through LWIR (a flat response from 2 to 20 μm) with a per detector/pixel dynamic range of 1 pW to 50 nW and a 0.1% noise equivalent power. The detector package must designed to be suitable for use within the cryo-vacuum environment.

PHASE II: Develop and demonstrate a prototype detector system capable of providing 0.1% radiometric calibration in the MWIR through LWIR (a flat response from 2 to 20 μm) with a per detector/pixel dynamic range of 1 pW to 50 nW and a 0.1% noise equivalent power. The detector package must be suitable for use within the cryo-vacuum environment.

PHASE III DUAL USE APPLICATIONS: This technology will support enhanced test capability for military airborne and space-borne sensors. This Phase III may involve follow-on non-SBIR/STTR funded R&D or production contracts for products, processes or services intended for use by the U.S. Government.

REFERENCES:

1. 1. Nicholson, R.A., Mead, K.D., and Lowry, H.S., “Radiometric Calibration and Mission Simulation Testing of Sensor Systems in the AEDC 7V and 10V Chambers,” SPIE Proceedings, Vol. 6208-46 (2006).;
2. Ryan, R., et.al., “Methods for LWIR Radiometric Calibration and Characterization,” http://www.isprs.org/commission1/proceedings02/paper/RRyan_ISPRS2002.pdf;
3. T. R. Gentile, J. M. Houston, J. E. Hardis, C. L. Cromer, and A. C. Parr, “National Institute of Standards and Technology high accuracy cryogenic radiometer,” Appl. Opt. 35, 1056 – 1068 (1996).;
4. Podobedov V.B., Eppeldauer G.P.; Larason T.C.,” Evaluation of optical radiation detectors in the range from 0.8 µm to 20 µm at the NIST infrared spectral calibration facility” Proc. SPIE 8550, (2012);
5. Adriaan C. Carter, Steven R. Lorentz, Timothy M. Jung, and Raju U. Datla, “ACR II: Improved absolute cryogenic radiometer for low background infrared calibrations,” Appl. Opt. 44, 871 – 875 (2005)

KEYWORDS: cryo-vacuum; infrared calibration; infrared detectors; imaging sensors; sensor testing; space simulation

TPOC-1: Benjamin Weaver
Phone: (931) 454-6766
Email: benjamin.weaver.3@us.af.mil

AF231-0009 TITLE: Flight Systems Data Acquisition via Onboard Air-Gapped Communication System

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

OBJECTIVE: Identify strategies in increasing data quality for customer tests by eliminating instrumentation bridging across the force-balance via an air-gapped communication solution.

DESCRIPTION: Increased demand in performance from next generation vehicles, coupled with the ever-diminishing development timelines, puts strong emphasis in maximizing test campaign efficiency. This has driven an increase in instrumentation onboard test models to combine a multitude of test techniques into a single phase. A new system for communication to these ancillary instruments is needed in order to reduce the adverse impacts and reduced data quality from instrumentation bridging across the force balance. For example, in the von Karman Facility (VKF) of the Arnold Engineering Development Complex (AEDC) at Arnold Air Force Base, Tennessee, some test models less than 4 inches in diameter may have an Electronically Scanned Pressure Module, QFLEX, Auxiliary Fin Balances and Remote Drive Systems, Thermocouples, and Kulites all onboard the model, bridging the metric model to the non-metric support system. Alone, the interference is insignificant, but when combined the cabling can significantly reduce data quality and increase risk to programs and their development. A compact telemetry system is needed that can be mounted internal to the model and allow for robust transmission of data to a receiver outside of the tunnel and thus minimize bridging across the balance. Additionally, the telemetry system must be integrated into the existing facility data system.

PHASE I: Phase 1 effort should leverage existing technologies to develop a compact system capable of achieving the desired reduction in main balance interference. The approach should be low-risk, and produce a robust telemetry system capable of handling the many test techniques of the facility. Demonstrate the capability of 10 channels at 1 kHz data rates which can operate in wind tunnel models to be tested in the AEDC Propulsion Wind Tunnels, including reception with multipath interference.

PHASE II: Develop and demonstrate a prototype system with 50 channels at 10 kHz data rates which can operate in wind tunnel models to be tested in PWT and VKF, including reception with multipath interference. The telemetry system must be able to be integrated into the existing data system for checkout and demonstration.

PHASE III DUAL USE APPLICATIONS: The expansion of similar systems into other government and commercial testing facilities.

REFERENCES:

1. 1. Test Capabilities Guide - https://media.defense.gov/2021/Jun/23/2002747597/-1/-1/1/2021%20TEST%20CAPABILITIES%20GUIDE.PDF

KEYWORDS: telemetry; air-gapped communications

TPOC-1: Kevin Schoenen
Phone: (931) 454-6939
Email: kevin.schoenen@us.af.mil

AF231-0010 TITLE: Fiber Optic Strain Sensing with Pass-through Fiber Optic Rotary Joint

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

OBJECTIVE: Develop a system to acquire Fiber Optic Strain Measurements on a rotating rotor system and route the measurements to the non-rotating frame via a pass-through Fiber Optic Rotary Joint (FORJ).

DESCRIPTION: Develop a system to acquire high fidelity optical strain measurements for a full-sized helicopter main rotor blade and calculate blade tip displacements. The intent of using optical measurement systems is to reduce reliance on electrical strain gage based measurement solutions for health monitoring/research data, as well as reduce the maintenance requirements that are associated with electrical slip rings. The system will need to have these attributes: 1) display and record data from up to 8 simultaneous channels, 2) sample and acquire strain and displacement data at sampling rates greater than 500 Hz, 3) have Optic Strain sensors sized for full-scale rotors (range from 4 ft to 15 ft in radius), and 4) display rotor tip displacement at a 10 Hz update rate.

PHASE I: Demonstrate a 4 channel pilot system at 100 Hz with the ability to obtain fiber optic strain measurements in a rotating high vibratory environment.

PHASE II: Develop and demonstrate a prototype system that meets the specifications given in the description with a small ruggedized footprint.

PHASE III DUAL USE APPLICATIONS: Phase III may involve production contracts with US Army to support the Future Long-Range Assault Aircraft (FLRAA) or Future Attack Reconnaissance Aircraft (FARA) program. A system like this could be used as a safety of flight recorder on coaxial rotor systems [1] to prevent blade tip collisions at high forward flight speeds.

REFERENCES:

1. 1. S.B. Kim, D. Geiger, P.O. Bowles, C.G. Matalanis, B.E. Wake; “Tip displacement estimation using fiber optic sensors for X2 technology TM rotor blades” AHS International 72nd Annual Forum, 16-19 May, West Palm Beach, Florida, USA 3 (2016), pp. 1914-1923

KEYWORDS: Fiber Optic Strain Measurement; FLRAA; FARA; X2-IBC

TPOC-1: David Wang
Phone: (650) 604-3326
Email: david.wang.2@us.af.mil

AF231-0011 TITLE: Hybrid Slip Ring

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

OBJECTIVE: Develop, validate, and produce a through-bore slip ring capsule, fully contained within a defined physical space envelope, containing conventional slip rings for power, a bi-directional fiber optic rotary joint, and a high pressure gas rotary joint, all of which simultaneously operate at sustained high rotational speed and high gas pressure. The slip ring capsule must demonstrate a long mean-time-between-failure (MTBF).

DESCRIPTION: Conventional brush-ring slip ring capsules play a critical role in hardware-in-the-loop missile and gyro systems testing. While unit under test is rotating at high rates, power and high pressure gas must be supplied, and bi-directional high speed digital data must be provided. DoD is facing serious challenges of providing a path for future test and evaluation and to the continuity of current operations. U.S. based manufacturing is being acquired by overseas competitors and quickly losing the capability to produce reliable conventional sip ring capsules containing a through bore while operating at high rotational speeds. Further, advancements in missile and gyro systems technology require high speed digital data rates not currently obtainable with conventional slip ring capsule. The technological advancement of providing a through-bore slip ring capsule operated at high rotational rates containing conventional and fiber optic circuits with integrated high pressure gas conduit in a single capsule within physical space constraints would be a large breakthrough in slip capsule technology. The desired slip ring capsule will contain at a minimum the following attributes, 12 conventional shielded power circuits rated for 5 amps at 60 VDC; 4 conventional shielded power circuits rated for 2 amps at 200 VDC; one bi-directional single-mode fiber optic circuit with less than 2dB loss @ 25 rotations per second; 1 high pressure rotary gas joint, rated at greater than 3500 PSI; the ability to sustain 25 rotations per second; a rotational lifespan of greater than 30 million revolutions; a form factor compatible with existing equipment (less than 2.9” diameter, greater than 0.2” through-bore, less than 10.2” length).

PHASE I: Determine a feasible approach of developing a slip ring capsule with the specifications mentioned above. No government facility or materials or data is required for this program nor will it be provided. Demonstrate the proposed capsule’s ability to meet technical specifications without failure. In particular, address capsule through-bore, bi-directional fiber optic rotary joint performance, high pressure gas rotary joint performance, conventional circuit performance, all simultaneously at sustained high rotational speeds.

PHASE II: Build a prototype from designs proven in phase 1. Evaluate the prototype’s ability to achieve given requirements and provide an estimate of product operational life before repair is required. Required deliverables will include results of stress tests to show prototype meets the required conventional and fiber optic, high speed digital data, rotational speed, and gas pressure requirements simultaneously.

PHASE III DUAL USE APPLICATIONS: Military applications include robust environment data acquisition equipment and advanced aircraft and guided systems T&E. Commercial benefits include advanced drilling machinery, wind turbines, medical equipment, rotating tanks (fluid dynamic experimental equipment), satellite systems, and manufacturing & machine tooling.

REFERENCES:

1. Moflon, Three Important Facts About How A Slip Ring Functions, https: //www.moflon.com/showen407.html;
2. R. Taylor, What is a Rotary Union and How Can It Be Sealed Effectively?, https: //blog.chesterton.com/sealing/what-is-a-rotary-union-and-how-can-it-be-seal-effectively/;
3. Princetel, TUTORIAL Fiber optic rotary joints, http: //www.princetel.com/tutorial_forj.asp

KEYWORDS: high speed slip ring; high speed rotary joint; high speed rotary union; rotary gas joint; rotary fluid joint; fiber-optic rotary joint

TPOC-1: Peter Kreuser
Phone: (850) 882-9979
Email: peter.kreuser@us.af.mil

AF231-0012 TITLE: ADV MMW RAM (Advanced Millimeter-Wave Radar Absorbing Materials)

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 technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Design & develop Radar Absorbing Materials (RAM) optimized for use at Millimeter-Wave (MMW) frequency bands (primarily Ka & W-Bands) in indoor anechoic chambers and outdoor range Radar Cross Section (RCS) measurement applications.

DESCRIPTION: Radar Absorbing Materials are used to control or suppress (attenuate) EM wave reflections in various test & measurement environments. Existing RAM's are available in various shapes/sizes (block, pyramidal, convoluted, wedges) and materials (foam, rubber, paint) which are loaded with different electrical and magnetic properties. The proposed topic is not to develop advanced stealth or LO technology for military platforms, but to provide practical absorber capabilities in the MMW bands to suppress unwanted EM interference in indoor anechoic chambers and on outdoor RCS measurement ranges. High performance RAM can achieve levels of 40-50 dB attenuation depending on the frequency bands of interest. Lower performance, broad-band outdoor materials can range from 10-15 dB. Outdoor RAM's are desired to be rugged, UV and water resistant. There are numerous commercial applications for RAM in industry anechoic chambers (antenna and RCS measurements, EMI/EMC chambers).

PHASE I: Perform an in-depth evaluation and analysis of current RAM design/development techniques for use in indoor and outdoor RCS measurement facilities. Focused on practical, rugged field use and indoor anechoic chambers with materials optimized for performance at Ka & W frequency bands. Determine feasibility of methods required for development of various types of loaded foams (size, shape, waterproofing, fire suppression) and carpet type matting.

PHASE II: Based on the results of the Phase-1 feasibility the Phase-2 will prioritize several different material designs for both indoor and outdoor applications, model projected performance, fabricate sample batches of materials, measure performance and demonstrate use/utility.

PHASE III DUAL USE APPLICATIONS: Building from results of a Phase-2 effort, if successful, implement the unique technology in AF and civilian labs and ranges. There are numerous commercial applications for RAM in industry anechoic chambers (antenna and RCS measurements, EMI/EMC chambers).

REFERENCES:

1. "Radar Absorbing Materials: From Theory to Design & Characterization" KJ Vinoy, RM Jha, 1996 ed.;
2. "Radar Cross Section", (Chapter 8-RAM), Michael T Tuley;
3. "RAM Design", Kemal Yuzcelik, Thesis, Naval Postgraduate School, Monteray CA.

KEYWORDS: Radar Absorbing Material; RAM; Millimeter-Wave

TPOC-1: William Parnell
Phone: (850) 882-9960
Email: william.parnell@us.af.mil

AF231-0013 TITLE: MIN MMW RFSoC Tech

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

OBJECTIVE: Provide a miniaturized Radio Frequency System on Chip (RFSoC) solution that: 1) Supports C, X, Ku, Ka, and W military radar bands at min. 4 GHz signal bandwidth. 2) Performs arbitrary waveform generation and processing of received signals over a min. of 8 transmit and 8 receive channels. 3) Supports multi-channel synchronization of transmit and receive channels. 4) Supports multi-radar (i.e. multi-chip) synchronization. 5) Use-case targets instrumentation radar at outdoor range.

DESCRIPTION: Recent advancements in Radio Frequency System on Chip (RFSoC) technology has allowed the commercial industry to develop and mass produce low-cost automotive radar sensor RFSoC packages that come complete with integrated antennas (e.g. multiple transmit and receive antennas per chip), digital signal processing, and microcontrollers. However, these integrated sensor packages are limited to commercial radio frequency bands (RF) and are tailored to meet the needs of the automotive industry, not the Department of Defense (DoD). An integrated sensor package that incorporates RFSoC technology and is tailored to support common military radar RF bands meanwhile featuring arbitrary waveform generation and digital signal processing capabilities could be used in a variety of military radar applications. The primary application of this RFSoC-based solution(s) will target integration with outdoor range instrumentation radars for the purpose of making RCS measurements. However, other potential applications include software defined radio, arbitrary waveform generator, digital RF memory, radar simulator, HITL simulator, threat simulator, frequency modulated continuous wave (FMCW) radar, linear frequency modulated (LFM) pulsed radar, and bi-static radar. Also, the application of the technologies involved in this effort could be easily adapted to benefit commercial applications in nearby frequency bands. Work on this effort will include the advancement and integration of RFSoC technologies into prototype hardware designed to operate in RF bands allocated for the DoD. Activities will involve research, design, development, modeling, fabrication, and evaluation culminating in a demonstration of modeled and measured performance. The solution(s) must support C, X, Ku, Ka, and W military radar bands. The minimum RF signal bandwidth of the solution(s) should be 4 GHz or more. The solution(s) must support arbitrary waveform generation on transmit channels and digital signal processing (e.g. Fast Fourier Transform) of received signals. The solution(s) should support signal samples that are a minimum of 14 bits of resolution for waveform generation and digital signal processing. The effective radiated power should be +10 dBm or greater. The solution(s) should support a minimum of eight transmit and eight receive channels. The solution(s) should support multi-channel synchronization of transmit and receive channels. Multi-radar (i.e. multi-chip) synchronization should also be supported. The solution(s) must be capable of Ethernet based communications for uploading waveform samples to be generated and for real-time streaming of received signal samples. The goal is for the solution(s) to: 1) limit the overall size of the prototype hardware to 4 inch width x 8 inch depth x 10 inch height, and 2) weigh 10 pounds or less.

PHASE I: Provide an analysis of current technology. Conduct a feasibility study to achieve the stated objectives. Present Preliminary Design and Models. Provide source code of developed software and/or hardware description language used to produce preliminary design.

PHASE II: Present Final Design and Models. Develop prototype hardware. Provide source code of developed software and/or FPGA hardware description language. Demonstrate modeled and measured performance.

PHASE III DUAL USE APPLICATIONS: Building from the Phase 2 effort, field prototype hardware/software and collect data in demonstration of modeled and measured performance. The application of the technologies involved in this effort could be easily adapted to benefit commercial applications in nearby frequency bands.

REFERENCES:

1. Texas Instruments. "mmWave radar sensors". https://www.ti.com/sensors/mmwave-radar/overview.html. Accessed 8/10/22.;
2. AMD Xilinx. "Zynq UltraScale+ RFSoC". https://www.xilinx.com/products/silicon-devices/soc/rfsoc.html. Accessed 8/11/22.;
3. AMD Xilinx. "Defense-Grade Zynq UltraScale+ RFSoCs". https://www.xilinx.com/products/silicon-devices/soc/xq-zynq-ultrascale-rfsoc.html. Accessed 8/11/22.

KEYWORDS: RF System on Chip (RFSoC); Milli-meter Wave (MMW); Arbitrary Waveform Generator; RADAR; FPGA;

TPOC-1: Jason Gallina
Phone: (850) 882-8409
Email: jason.gallina@us.af.mil

AF231-0014 TITLE: Static Detection System

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

OBJECTIVE: Develop and demonstrate a taxiway crossing area foreign object debris (FOD) detection/removal solution capable of scanning, detecting, locating, and relaying information to retrieve loose objects larger than a quarter inch in diameter as measured by any perspective

DESCRIPTION: The precise location of the FOD and other data generated must be usable/able to be integrated by third-party applications and technologies. Upon FOD detection, the FOD-producer or 3rd party needs notification and the system should be functional on the Air Force Information Network and be capable of operating without the need for human assistance. System should be scalable to other areas such as the airfield parking ramp where aircraft maintenance occurs. The ideal state is machine-assisted detection that substantially decreases or eliminates the need to use humans for FOD detection and mitigation. The FOD retrieval unit must integrate with an autonomous independent industrial vacuum and have a FOD warning detection system that can be installed on a nearby terminal (25ft). Must be environmentally sealed/to operate outdoors and able to withstand ambient temperatures from -20F to 120F. It should operate on battery power for 3-5 hours before recharging and have an autodocking capability when it is within (25ft) of the charging station. The unit should be able to travel at a minimum of _10_ MPH and have _10k Pa (Pascal Pressure Units) of suction. The FOD warning detection system should encompass 50 square feet at the FOD checkpoint, this area should include indications (Stop lights) for both POV/GOV traffic as well as Taxiing Aircraft and should be scalable in future iterations. Upon FO Detection, stop lights will illuminate until FO is removed from the FO checkpoint. The intent of this project is to offload the FO detection process. At present, Air Force members that approach taxiway crossings conduct Foreign Object Debris (FOD) checks manually, either individually or in groups. At Spangdahlem, there are over 800 taxiway daily crossings by personal vehicles and service equipment. Barring a few exceptions, vehicle operators must perform FOD checks prior to airfield entry. The quality of checks performed by Flightline workers is subject to any number of external factors affecting the outcome.

PHASE I: A feasibility study that encompasses the following at a minimum; Problem, Solution, Market, Competition, Team/Stakeholders, Financials, Milestones, Additional Information Address at least the following: 1) Annual costs for foreign object damage in military aviation overall broken down by military branch and shown as percent of total military/branch/mission support budget 2) Identify current technology capable of meeting the topic objective 3) Identify if the current technology can retire/replace a current process or technology 4) Identify ways where human lead FOD checks can go wrong, and where technological capabilities are greater than current method used by military 5) Identify security concerns and mitigations 6) Cost overview for both initial purchase, sustainment, and scaling up-to and including use across the Department of the Air Force. 7) Warrantee and service information 8) Solution impacts to cost, quality or speed versus the current method 9) Overview of the technological components to make the solution work 10) Procedural changes needed to make solution work 11) Include a visual of potential solutions complete with descriptors 12) Policy changes needed to make solution work, if any 13) Feasibility for an app component 14) Any discretionary information that may be valuable when choosing a solution proposal=

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on; 1) Real world phase one solution application to a client Air Force base taxiway 2) Testing the scalability of solution 3) Data generation analysis - provide insight to FOD trends 4) Solution/system upgrades based on client Air Force base feedback 5) Provide/cooperate with 3rd party integration for Foreign Object removal applications. 6) Beyond government facility priority, integration into civilian airports would be the next step in applicability/usage. 7) Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

PHASE III DUAL USE APPLICATIONS: Seek to develop non-military applications for technologies developed during or used by this project. Provide ongoing support to military stakeholders. This capability will have applications on military taxi-ways/flight lines in which commercial and private airports could utilize in the same fashion. In addition, it could be modified for use in supply warehousing (if adapted to follow forklifts with LFOD systems or other manned/autonomous vehicles). Fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on-premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with the support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution use current DISA APL common criteria certified components when/where possible. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

REFERENCES:
1. DAFI 21-101;
2. SABI 21-107

KEYWORDS: Foreign Object Debris; Damage; Aircraft Engines; Taxiway Crossing; FOD, Pebble; Flightline

TPOC-1: Christian Ochs
Phone: (339)208-0761
Email: christian.ochs@us.af.mil

AF231-0015 TITLE: ATC Kit

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

OBJECTIVE: Develop a technology to convert mobile/rolling toolboxes (of various sizes and drawer quantities) into automated inventory assisted toolboxes. In other words, develop a sensor suite capable of being applied to any mobile toolbox converting it into an automated inventory toolbox.

DESCRIPTION: Technicians currently rely on manual accountability for tools and equipment - all accountability is hand-recorded. Additionally, inspections and tool replacement uses human judgement to identify, predict, and order tools. Human error is a perceived factor in tool supply issues. Additionally, individual tool locations within the same organization are operated under separate systems that do not allow integration with other programs. Furthermore, none of the current Automatic Tool Control (ATC) toolboxes are capable of operating on the AFIFNET and they cannot track, identify, and determine tool location internally or externally of the toolbox. Technicians spend several hours a day checking tool boxes in and out, inspecting, and replacing tools, wasting valuable time that could have been spent inspecting and repairing aircraft. Personnel need a solution that harnesses current technology to reduce time spent in lines, removes human error, and monitors requirements to keep toolboxes completely functional and ready for usage. Solution to retrofit a mobile toolbox must be capable of tracking/sensing up to 600 tools/tool components, capable of remote data storage, is intuitive, multi-touch, and user friendly. Needs the ability to use a remote located AFIFNET computer or VM capable with a user interface screen and multi-factor authentication on the toolbox. Has tool tracking, tool current location, last known tool location, tool wear-and-tear status, missing tool recognition, foreign object (FO) detection, and incorporates predictive tool replacement with automatic ordering features. Power considerations need to be multi-national, and multiple environment. Must be weatherproof and operational between -20C and +50C degrees. Must meet requirements to obtain a HERO certification with max ""Safe Separation Distance"" of 10 ft for UNSAFE from the AF safety center. User interface, must be usable if user has gloves equipped. Should be able to operate at least 24 hours away from AC (110-220) power source. ATC must be easy for end user to reconfigure/update to remove/add tools/components. ATC needs to be able to operate in a communications compromised environment - i.e.. wireless communications go out. ATC needs to be able to sync relevant data with 3rd parties. The addition of the ATC needs to remain small and lightweight enough to maintain transport requirements of the toolbox (lifting, towing, etc.). The ATC needs to offer connectivity to AFIFNET and commercial systems. May not create signals that would interfere with other electronic devices. The ATC should integrate with and allow integration from other Air Force and Air Force Contractor systems.

PHASE I: A feasibility study that encompasses the following at a minimum; Problem, Solution, Market, Competition, Team/Stakeholders, Financials, Milestones, Additional Information Address at least the following: 1) Annual costs for tools in military maintenance overall broken down by military branch and shown as percent of total military/branch 2) Identify current technology capable of meeting the topic objective 3) Identify if the current technology can retire/replace a current process or technology 4) Identify ways where human conducted tool checks can go wrong 5) Identify security concerns and mitigations 6) Cost overview for both initial purchase, sustainment 7) Warrantee and service information 8) Solution impacts to cost, quality or speed versus the current method | Return on investment 9) Overview of the technological components to make the solution work 10) Procedural changes needed to make solution work 11) Include a visual of potential solutions complete with descriptors 12) Policy changes needed to make solution work, if any 13) Feasibility for an app component 14) Any discretionary information that may be valuable when choosing a solution proposal 15) Feasibility of incorporating the sensor package into a dumb toolbox

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. Company must work with Air Force stake holders to build ATC according to end-user specifications - this requires interaction with and feedback from Air Force end-users. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. An example of a commercial application is the ATC used in a vehicle maintenance application or at a civilian airport. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution utilize current DISA APL common criteria certified components when/where possible.

REFERENCES:

1. AFI 21-101;
2. AFMAN 91-203;
3. Technical Manual 32-1-101

KEYWORDS: Automatic Tool Control; Artificial Intelligence, Identify; Predict; Tool Tracking; Tool Wear; Tool Home Recognition; Foreign Object (FO) Scans; Wired and Wireless Connectivity

TPOC-1: Darrel King
Phone: (339)208-0761
Email: darrel.king.1@us.af.mil

AF231-0016 TITLE: ATC for Small CTKs

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

OBJECTIVE: Develop a technology assisted, portable, ruggedized, toolbox for use in all-weather maintenance environments that can be 3D printed

DESCRIPTION: Technicians currently rely on manual accountability for tools and equipment - all accountability is hand-recorded. Additionally, inspections and tool replacement uses human judgement to identify, predict, and order tools. Human error is a perceived factor in tool supply issues. Additionally, individual tool locations within the same organization are operated under separate systems that do not allow integration with other programs. Furthermore, none of the current Automatic Tool Control (ATC) toolboxes are capable of operating on the AFIFNET and they cannot track, identify, and determine tool location internally or externally to the tool box. Technicians spend several hours a day checking tool boxes in and out, inspecting, and replacing tools, wasting valuable time that could have been spent inspecting and repairing aircraft. Personnel need a solution that harnesses current technology to recue time spent in lines, removes human error, and monitors requirements to keep toolboxes completely functional and ready for usage. Toolbox must be capable of holding up to 50 tools/tool components that is capable of remote data storage, is intuitive, multi-touch, and user friendly. Uses multi-factor authentication but not incessantly. Has tool tracking, tool current location, last known tool location, tool wear-and-tear status, missing tool recognition, foreign object (FO) detection, and incorporates predictive tool replacement with automatic ordering features. Operate on battery power for a minimum of 24 hours prior to needing a recharge or battery swap. The batteries must be easy to swap and capable of recharging within the ATC or on dedicated charging stations. Recharging system must be dual voltage (AC 110-220). Must be weatherproof and operational between -20C and +50C degrees. Must meet requirements to obtain a HERO certification with max ""Safe Separation Distance"" of 10 ft for UNSAFE from the AF safety center. Must be usable if user has gloves equipped. ATC must be easy for end user to reconfigure/update to remove/add tools/components. ATC needs to be able to operate in a communications compromised environment - i.e.. wireless communications go out. ATC needs to be able to sync relevant data with 3rd parties. The ATC box needs to be man portable and usable in wet/dry weather conditions ranging from -20C to 50C. Needs the ability to use a remote located AFIFNET computer or VM capable with a user interface screen and multi-factor authentication on the toolbox. The ATC should integrate with and allow integration from other Air Force and Air Force Contractor systems. ATC sensor kit should be able to be converted into a conventional hand carried toolbox in the event circumstances warrant or in a 3D printed toolbox. The toolbox itself should be 3D printable and print files released to USAF as part of the License agreement to allow allow repair and reprints due to damage as needed. The Air Force may elect to order the full ATC (toolbox and associated technology) or the only proprietary technology that enables the smart features in a locally printed toolbox. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage.

PHASE I: A feasibility study that encompasses the following at a minimum: Problem, Solution, Market, Competition, Team/Stakeholders, Financials, Milestones, Additional Information Address at least the following: 1) Annual costs for tools in military maintenance overall broken down by military branch and shown as percent of total military/branch 2) Identify current technology capable of meeting the topic objective 3) Identify if the current technology can retire/replace a current process or technology 4) Identify ways where human conducted tool checks can go wrong 5) Identify security concerns and mitigations 6) Cost overview for both initial purchase, sustainment 7) Warrantee and service information 8) Solution impacts to cost, quality or speed versus the current method | Return on investment 9) Overview of the technological components to make the solution work 10) Procedural changes needed to make solution work 11) Include a visual of potential solutions complete with descriptors 12) Policy changes needed to make solution work, if any 13) Feasibility for an app component 14) Any discretionary information that may be valuable when choosing a solution proposal 15) Feasibility of 3D printing the toolbox and adding a sensor package

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. Company must work with Air Force stake holders to build ATC according to end-user specifications - this requires interaction with and feedback from Air Force end-users. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. An example of a commercial application is the ATC used in a vehicle maintenance application or at a civilian airport. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

REFERENCES:

1. AFI 21-101;
2. AFMAN 91-203;
3. Technical Manual 32-1-101

KEYWORDS: Automatic Tool Control; Artificial Intelligence, Identify; Predict; Tool Tracking; Tool Wear; Tool Home Recognition; Foreign Object (FO) Scans; Wired and Wireless Connectivity

TPOC-1: Christopher Freeman
Phone: (339)208-0761
Email: christopher.freeman.13@us.af.mil

AF231-0017 TITLE: New Integrated ATC

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

OBJECTIVE: Develop a Military spec/hardened automatic tool control (ATC) toolbox that runs off a remote located network approved computer or virtual machine (VM) and incorporates a user interface screen, multi-factor authentication, tool tracking, tool wear, tool home recognition, Foreign Object (FO) scans, and AI to do predictive tool replacement that runs off a centrally located service approved computer.

DESCRIPTION: Technicians currently rely on manual checkouts and check-ins for tools and equipment requiring human interaction to input data by hand. Additionally, inspections and tool replacement uses human interaction to identify, predict, and order tools. Human error is high, resulting in an overabundance of tools with low replacement rates and not enough spares for tools with high breakage rates. Additionally, individual tool locations within the same organization are operated under separate systems that do not allow integration with other programs. Furthermore, none of the current ATC toolboxes are capable of operating on the current AFIFNET and they cannot track, identify, and determine tool location internally or externally to the tool box. Technicians spend several hours a day checking tool boxes in and out, inspecting, and replacing tools, wasting valuable time that could have been spent inspecting and repairing aircraft. Personnel need a solution that harnesses current technology to reduce time spent in lines, removes human error, and monitors requirements to keep toolboxes completely functional and ready for use. To meet the intent of the objective, the system needs to meet the following requirements: 1. The ATC needs to be MIL-STD-810G/hardened enough to withstand high and low temperatures, dirt, dust, sand, rain, snow, and ice. 2. The ATC needs to be MIL-STD-810G/hardened enough to withstand drops, falls, and impacts. 3. The toolbox must meet requirements to obtain a HERO certification with max ""Safe Separation Distance"" of 10 ft for UNSAFE from the AF safety center. 4. The ATC needs the ability to use a remote located AFIFNET computer or VM capable with a user interface screen and multi-factor authentication on the toolbox. 5. The ATC needs the ability to track and notify technicians on tool locations, wear/condition status of the tool, identify correct placement of tools and notify when a tool is missing, and locate/identify FO within the toolbox. 6. The AI system needs to conduct predictive tool replacement that operates on a centrally located service approved computer, capable of communicating with all ATCs. 7. The ATC must remain mobile. 8. The ATC needs to be capable of receiving power from an outlet ranging from 110-240V with the ability to operate from batteries for 8 hours prior to needing a recharge or battery swap. 9. The batteries must be easy to swap and capable of recharging within the ATC or on dedicated charging stations. 10. The ATC needs to offer wired and wireless connectivity to AFIFNET and Commercial systems and capable of connecting to closed intranet systems operating on NIPR or lower levels. 11. The ATC needs expansion capability to receive new types of tools and compatible with toolbox expansion from other companies and systems to include a REST API for pushing data to future authoritative data repositories and reporting systems. 12. Develop an example of how the ATC could be used in a commercial and military environment for vehicle maintenance and airports.

PHASE I: Complete a feasibility study that should, at a minimum, complete the following using the topic objective and description; 1. Clearly identify who the prime (and additional) potential AF end user(s) is and articulate how they would use your solution(s) (i.e., the one who is most likely to be an early adopter, first user, and initial transition partner). 2. Identify current technology capable of meeting the topic objective that follows all NDAA, DISA, DoD, and Air Force policies, rules, regulations, and laws. 3. If the technology does not exist, determine what needs to be developed to meet the topic objective. 4. Determine if the technology is compatible with required current/emerging Air Force/Commercial assets/systems used within the topic objective. 5. Determine the necessary requirements for any technologies deemed incompatible with each other and current/emerging Air Force assets. 6. Identify if an ATO is required and the necessary stakeholders to ensure implementation across the Air Force. 7. Deeply explore the problem or benefit area(s), which are to be addressed by the solution(s) - specifically focusing on how this solution will impact the end user of the solution. 8. Define clear objectives and measurable key results for a potential trial of the proposed solution with the identified Air Force end user(s). 8. Describe how the solution will need to be implemented across the Air Force. 10. Determine cost of installation, upkeep, and upgrade for the identified technology. 11. Provide a rated scale of feasibility on the identified technology based upon the first five items in this list. 12. Describe technology related development that is required to successfully field the solution. The funds obligated on the resulting Phase I awards are to be used for the sole purpose of conducting a thorough feasibility study using mathematical models, scientific experiments, laboratory studies, commercial research and interviews.

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on; 1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study. 2. Implement countermeasures for issues and identify the necessary evolution of the prototype to foster its eventual transition into a working commercial/warfighter solution. 3. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale). The solution should detail a rapid deployment and sustainment plan based upon lessons learned from the prototype capable of installing the technology at other Air force installations broken down by continent (i.e. separate plans for bases in Europe, CONUS, the Pacific, etc.). 4. Develop a clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security. 5. Specific details about how the solution can integrate with other current and potential future solutions. 6. How the solution can be sustainable (i.e. supportability). 7. Clearly identify other specific DoD or governmental customers who want to use the solution. 8. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed 9. Verify validity of the developed example for using the ATC in commercial and military vehicle maintenance and airport environments.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and commercial users in traditional 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. Additionally, implement commercial applications, marketing, and sales based upon the developed example in Phase II while maintaining government purchasing availability. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution utilize current DISA APL common criteria certified components when/where possible. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

REFERENCES:

1. AFI 21-101;

2. AFMAN 91-203;
3. Technical Manual 32-1-101

KEYWORDS: Automatic Tool Control; Artificial Intelligence; Identify; Predict; Tool Tracking; Tool Wear; Tool Home Recognition; Foreign Object (FO) Scans; Wired and Wireless Connectivity

TPOC-1: Christopher Stoller
Phone: (339)208-0761
Email: christopher.stoller@us.af.mil

AF231-0018 TITLE: Automated Sourcing Supply

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

OBJECTIVE: Develop an automated sourcing supply solution that is compatible with DoD information systems and other developmental technology to bridge current Air Force maintenance operations and logistic systems. The system needs to automatically predict and automatically order a broad range of supply and inventory for end users.

DESCRIPTION: Parts/supply requisition in the USAF is painful for end-users. Currently, Enhanced Technical Management System (ETIMS) - a system that houses Technical Orders (T.O.) and the Integrated Logistics Supply-System (ILS-S) - the main United States Air Force (USAF) logistics management system - do not share data. Not all maintenance functions have access to ILS-S and rely on third parties to inquire about part availability. Currently, all maintenance orders are requested via indirect means - verbally or sent via email - to supply personnel. An order may take up to 120 hours to process the various middle entities and this is only for order placement. The automated sourcing supply system must bridge the end user with the supply system. The solution needs to allow end users to order parts from where the work takes place and anticipate supplies needed for future work in a user-friendly way. The solution must be able to maintain up-to-date part/supply ordering information and unload entries no longer available in the supply system. It must be able to indicate parts available on station or Air Force-wide from T.O. data. The solution must be capable of notifying the appropriate Source of Supply (SoS) and T.O. manager. Information sent to the appropriate parties in advance will give either the SoS time to acquire the parts in the T.O. or to see if the T.O. needs to be updated to better reflect the current supply. Solution must grant the end user easy intuitive visibility over supply availability. Visualized trend analysis must be part of the solution and an option to integrate with 3rd party information display software such as Tableau or Microsoft Power BI. The solution would need two-way read/write with 3rd party Air Force-approved software.

PHASE I: A feasibility study that encompasses the following at a minimum: Problem, Solution, Market, Competition, Team/Stakeholders, Financials, Milestones, Additional Information Address at least the following: 1) Annual costs for supplies in the military overall broken down by military branch and shown as percent of total military/branch 2) Identify current technology solutions capable of meeting the topic objective 3) Identify if the current technology can retire/replace a current process or technology 4) Identify ways where human conducted supply ordering may go wrong 5) Identify security concerns and mitigations 6) Cost overview for both initial purchase, sustainment 7) Warrantee and service information 8) Solution impacts to cost, quality or speed versus the current method | Return on investment 9) Overview of the technological components to make the solution work 10) Procedural changes needed to make solution work 11) Include a visual of potential solutions complete with descriptors 12) Policy changes needed to make solution work, if any 13) Any discretionary information that may be valuable when choosing a solution proposal

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. Provide material and knowledge assistance with stakeholder buy-in Develop application program integration (API) with existing systems of record used to track inventory and logistics Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the software 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. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both, security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request use of DISA APL common criteria certified components when/where available. Request solution use current DISA APL common criteria certified components when/where possible.

REFERENCES:

1. AFH23-123V2PT1 - AFH23-123V2PT4(INTEGRATED LOGISTICS SYSTEM-SUPPLY (ILS-S) MATERIEL MANAGEMENT OPERATIONS)

KEYWORDS: Logistics, Visibility; Supply Chain; Software

TPOC-1: Kailen Kistler
Phone: (339)208-0761
Email: Kailen.kistler@us.af.mil

AF231-0019 TITLE: FL-MSA High-Speed Connectivity

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

OBJECTIVE: Develop and demonstrate a system capable of providing secure Modular Persistent High-speed connectivity for airfield and Munitions storage areas (MSA) utilizing expandable secure network of communication nodes that is EU compliant.

DESCRIPTION: The Flight line of the Future (FLoF) has been an initiative the Air Force has been trying to tackle for about a decade. The initiative has inspired the development and usage of digital Technical Orders (TOs) and the conceptualization of digital task boards, drone scanning, dent scanning, virtual asset management, mixed reality, 3D scanning, and 3D printing technology being used on the flight line. The intended use of these items requires an interconnected network providing intranet and internet connectivity to prevent stove piping and encourage collaboration while reducing time wasted on walking inside to complete paperwork, notify Subject Matter Experts (SMEs), connect with engineers, and carrying CD's from computers to non-networked assets like 3D printers, mills, and lathes. Currently, the typical Air Force flight line does not have any digital connectivity causing the capabilities of current technology to be constrained to hand carrying data. Additionally, the lack of connectivity inhibits the usage of emerging technologies like mixed reality and virtual asset management that requires a connection into the internet. Furthermore, technicians are forced to rely on processes requiring extensive manpower time requirements reducing effectiveness and efficiency. A solution is needed to provide the connectivity required to connect current and future IT and smart assets required to complete maintenance tasks on the flight line. Developing and implementing a robust modular persistent high-speed connectivity for the airfield and MSA will enable the connection of current and future technology. Furthermore, it will enable to opportunity for manpower and time savings never before seen on the flight line and within the MSA. To meet the intent of the objective, the system needs to meet the following requirements: 1. The system needs to beMIL-STD-810G/hardened enough to withstand high and low temperatures, dirt, dust, sand, rain, snow, and ice. 2. The system needs to beMIL-STD-810G/hardened enough to withstand drops, falls, and impacts. 3. The system needs to be capable of receiving power from a source ranging from 110-240V. 4. The toolbox must meet requirements to obtain a HERO certification with max ""Safe Separation Distance"" of 10 ft for UNSAFE from the AF safety center. 5. The system should be able to host large amounts of IT assets connecting to it across a large flight line and storage area with the capability to connect to AFNET or commercial services for internet access. 6. The connectivity capabilities (system) must be usable across current government infrastructure (fiber & copper), and seamlessly integrate into base AFNET enclaves for AF core services. In addition the system must be capable of securely communicate over commercial infrastructure when utilized in a forward deployed location. The system must meet a minimum of Common Criteria Evaluation Assurance Level (CC/EAL) 4 with CC/EAL 5 being desired. 7. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. 8. The system should be powered by AC dual voltage and have a battery back-up system. There need to be an additional capability for the node to operate where AC power is not available and is charged by a variety of means. The battery capacity should allow the system to operate for 48-72 hours without recharging and have the capability to add additional capacity.

PHASE I: Complete a feasibility study that should, at a minimum, complete the following using the topic objective and description: 1. Clearly identify who the prime (and additional) potential AF end user(s) is and articulate how they would use your solution(s) (i.e., the one who is most likely to be an early adopter, first user, and initial transition partner). 2. Identify current technology capable of meeting the topic objective that follows all NDAA, DISA, DoD, and Air Force policies, rules, regulations, and laws. 3. If the technology does not exist, determine what needs to be developed to meet the topic objective. 4. Determine if the technology is compatible with required current/emerging Air Force/Commercial assets/systems used within the topic objective. 5. Determine the necessary requirements for any technologies deemed incompatible with each other and current/emerging Air Force assets. 6. Identify if an ATO is required and the necessary stakeholders to ensure implementation across the Air Force. 7. Deeply explore the problem or benefit area(s), which are to be addressed by the solution(s) - specifically focusing on how this solution will impact the end user of the solution. 8. Define clear objectives and measurable key results for a potential trial of the proposed solution with the identified Air Force end user(s). 8. Describe how the solution will need to be implemented across the Air Force. 10. Determine cost of installation, upkeep, and upgrade for the identified technology. 11. Provide a rated scale of feasibility on the identified technology based upon the first five items in this list. 12. Describe technology related development that is required to successfully field the solution. The funds obligated on the resulting Phase I awards are to be used for the sole purpose of conducting a thorough feasibility study using mathematical models, scientific experiments, laboratory studies, commercial research and interviews.

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on 1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study. 2. Implement countermeasures for issues and identify the necessary evolution of the prototype to foster its eventual transition into a working commercial/warfighter solution. 3. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale). The solution should detail a rapid deployment and sustainment plan based upon lessons learned from the prototype capable of installing the technology at other Air force installations broken down by continent (i.e. separate plans for bases in Europe, CONUS, the Pacific, etc.). 4. Develop a clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security. 5. Specific details about how the solution can integrate with other current and potential future solutions. 6. How the solution can be sustainable (i.e. supportability). 7. Clearly identify other specific DoD or governmental customers who want to use the solution. 8. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

REFERENCES:

1. DAFMAN 17-1301;
2. AFI 21-101

KEYWORDS: High-Speed Connectivity; flight line; Munitions Storage Areas (MSA); Connectivity; Current Technology; Emerging Technology; Future Technology

TPOC-1: Christopher Stoller
Phone: (339)208-0761
Email: christopher.stoller@us.af.mil

AF231-0020 TITLE: Toolbox MX Enabler Suite

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

OBJECTIVE: Develop secure add-on kit that use hardened/rugged user interface devices that are attached to toolbox or outside structure and has a secure link to a Government procured computer or virtual machine providing user access to AFNET services, AF enterprise applications, and MX data systems without exposing a computer to the elements/hazardous environments to eliminate the delay of updating applicable databases/system at the end of shift due to limited/no access to computers at the point of maintenance.

DESCRIPTION: An add-on user interface (UI) kit comprised of (at a minimum) a keyboard, trackpad/mouse/cursor, monitor, and CAC reader (or other AFIFNET PKI authentication capability) which connects to a remote located Government purchased QEB computer/virtual machine (VM) to provide an internet connected mobile/static work station capability. Must be environmentally sealed/intrinsically safe (Class1 Div 2) to operate both indoors and outdoors and able to withstand ambient temperatures from -20F to 120F. It should operate via AC power using 110-240v while maintaining the ability to be powered via a battery system. The battery system must be capable of sustained operation for 8-10 hours before requiring a recharge. The battery recharging system must be dual voltage (AC 110-240v) Additionally, must include an induction pad capable of supplying constant power and internet connectivity to the tool box wirelessly. The induction pad shall also withstand ambient temperatures from -20F to 120F. The kit must meet requirements to obtain a HERO certification with max "Safe Separation Distance" of 10 ft for UNSAFE from the AF safety center. Provide flexible mounting capabilities for attaching to roll-around toolboxes or building walls. The delivered kit must have all of the required capabilities and technologies listed above while maintaining the ability to be operated on AFNET. Such equipment and technology may be of use to various FAA certified maintenance organizations to meet similar tool accountability maintenance documentation requirements.

PHASE I: Complete a feasibility study that should, at a minimum, complete the following using the topic objective and description; 1. Clearly identify who the prime (and additional) potential AF end user(s) is and articulate how they would use your solution(s) (i.e., the one who is most likely to be an early adopter, first user, and initial transition partner). 2. Identify current technology capable of meeting the topic objective that follows all NDAA, DISA, DoD, and Air Force policies, rules, regulations, and laws. 3. Determine compatibility of various technology needed to satisfy the requirements in the topic objective. Develop solutions for non-compatible technologies to meet the topic description. 4. Determine if the technology is compatible with required current/emerging Air Force/Commercial assets/systems used within the topic objective/description. 5. Determine the necessary requirements for any technologies deemed incompatible with each other and current/emerging Air Force assets. 6. Identify if an ATO is required and the necessary stakeholders to ensure implementation across the Air Force. 7. Deeply explore the problem or benefit area(s), which are to be addressed by the solution(s) - specifically focusing on how this solution will impact the end user of the solution. 8. Define clear objectives and measurable key results for a potential trial of the proposed solution with the identified Air Force end user(s). 8. Describe how the solution will need to be implemented across the Air Force. 10. Determine cost of installation, upkeep, and upgrade for the identified technology. 11. Provide a rated scale of feasibility on the identified technology based upon the first five items in this list. 12. Describe technology related development that is required to successfully field the solution. The funds obligated on the resulting Phase I awards are to be used for the sole purpose of conducting a thorough feasibility study using mathematical models, scientific experiments, laboratory studies, commercial research and interviews.

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on; 1.

Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study. 2. Implement countermeasures for issues and identify the necessary evolution of the prototype to foster its eventual transition into a working commercial/warfighter solution. 3. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale). The solution should detail a rapid deployment and sustainment plan based upon lessons learned from the prototype capable of installing the technology at other Air force installations broken down by continent (i.e. separate plans for bases in Europe, CONUS, the Pacific, etc.). 4. Develop a clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security. 5. Specific details about how the solution can integrate with other current and potential future solutions. 6. How the solution can be sustainable (i.e. supportability). 7. Clearly identify other specific DoD or governmental customers who want to use the solution. 8. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

PHASE III DUAL USE APPLICATIONS: The Primary goal of STTR is Phase III. The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution use current common criteria certified components when/where possible. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed

REFERENCES:

1. DAFMAN 17-1301;
2. AFI 21-101

KEYWORDS: Smart Toolbox; Mobil Maintenance Work Station; Tool Box Add-on; Aircraft Maintenance

TPOC-1: James Mejias
Phone: (339)208-0761
Email: James.mejias@us.af.mil

AF231-0021 TITLE: MR Glasses - Aircraft MX

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

OBJECTIVE: Develop voice controlled Mixed Reality glasses that can access aircraft repair manuals from local area network (LAN) repository (disconnected operations) or over the internet and project the applicable guidance into the user’s field of view. With a camera that would be able to capture images/video and AI to allow the glasses measure user defined width/length. The glasses will have the capability to connect via a video conference application to allow on-site consultation.

DESCRIPTION: Develop wireless mixed reality glasses capable of accessing and projecting current S1000D aircraft maintenance technical orders (T.Os.) and blueprint libraries/documents on the glasses and on a designated surface. The glasses must be capable of displaying the images/projections using 2D/3D formats and have the abilities to be manipulated and operated using voice commands and hand gestures while also including noise canceling audio (speaking and hearing) with optional ear pieces. Furthermore, the glasses need the ability to detect/display temperature images and provide measurements along flat and curved surfaces. Additionally, the glasses need AFIFNET internet connectivity (including network authentication via authorized PKI devices/techniques) and the ability to send and receive digital (images, documents, audio, etc.) files along with utilizing audio, and video feeds for local/global communications using current and future video conferencing software/apps (Microsoft Teams, Zoom for Business, etc.). The system would allow the remote view to see the image from the camera and present the technical data/blueprint that the user has displayed. The connection must be capable of operating within large aircraft cargo areas without signal loss. Total weight should be no more than 16-20oz. May be tethered to a belt to support components such as battery packs. The weight on the belt should be evenly distributed for comfort and long wear. Must have the capability to receive updates to include future add-ons for to exchange and interpret data with future software technologies. Finally, the glasses need to offer dual voltage (110-240v) charging capabilities. Overall, the glasses must meet MIL-STD-810G and need to be usable in industrial areas with the ability to withstand impacts, falls and scratches without suffering from a total loss and must meet requirements to obtain a HERO certification with max ""Safe Separation Distance"" of 10 ft for UNSAFE from the AF safety center. Glasses must not cause user to experience pain or fatigue from usage - including eye fatigue - from extended use. Size should be similar to typical industry eye protection. Components used in the ears of the user should be comfortable for user and not cause pain or fatigue.

PHASE I: Complete a feasibility study that should, at a minimum, complete the following using the topic objective and description: 1. Clearly identify who the prime (and additional) potential AF end user(s) is and articulate how they would use your solution(s) (i.e., the one who is most likely to be an early adopter, first user, and initial transition partner). 2. Identify current technology capable of meeting the topic objective that follows all NDAA, DISA, DoD, and Air Force policies, rules, regulations, and laws. 3. If the technology does not exist, determine what needs to be developed to meet the topic objective. 4. Determine if the technology is compatible with required current/emerging Air Force/Commercial assets/systems used within the topic objective. 5. Determine the necessary requirements for any technologies deemed incompatible with each other and current/emerging Air Force assets. 6. Identify if an ATO is required and the necessary stakeholders to ensure implementation across the Air Force. 7. Deeply explore the problem or benefit area(s), which are to be addressed by the solution(s) - specifically focusing on how this solution will impact the end user of the solution. 8. Define clear objectives and measurable key results for a potential trial of the proposed solution with the identified Air Force end user(s). 8. Describe how the solution will need to be implemented across the Air Force. 10. Determine cost of installation, upkeep, and upgrade for the identified technology. 11. Provide a rated scale of feasibility on the identified technology based upon the first five items in this list. 12. Describe technology related development that is required to successfully field the solution. The funds obligated on the resulting Phase I awards are to be used for the sole purpose of conducting a thorough feasibility study using mathematical models, scientific experiments, laboratory studies, commercial research and interviews. 13. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on: 1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study. 2. Implement countermeasures for issues and identify the necessary evolution of the prototype to foster its eventual transition into a working commercial/warfighter solution. 3. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale). The solution should detail a rapid deployment and sustainment plan based upon lessons learned from the prototype capable of installing the technology at other Air force installations broken down by continent (i.e. separate plans for bases in Europe, CONUS, the Pacific, etc.). 4. Develop a clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security. 5. Specific details about how the solution can integrate with other current and potential future solutions. 6. How the solution can be sustainable (i.e. supportability). 7. Clearly identify other specific DoD or governmental customers who want to use the solution. 8. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. Fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution use current common criteria certified components when/where possible.

REFERENCES:

1. DAFMAN 17-1301;
2. AFI 21-101

KEYWORDS: Smart Glasses; Headsets; Aircraft Maintenance; 2D Projection; 3D Projection; Aircraft Maintenance; Digital Aircraft Repair Manual

TPOC-1: James Mejias
Phone: (339)208-0761
Email: james.mejias@us.af.mil

AF231-0022 TITLE: Mobile Asset Management system

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

OBJECTIVE: Develop a mobile standalone asset management system capable of using a variation of sensors and devices to track any AF asset and report location and status on one system capable of feeding a Common Operating Picture (COP) (AGE, weapons, computer, medical equipment, etc.).

DESCRIPTION: Air Force organizations/personnel require a flexible automated asset management capability in order to increase efficiency/effectiveness of asset tracking and reporting while reducing manpower requirements currently required to complete hands-on/visual inventories completed on end of shift, daily, weekly, and monthly time intervals. The asset management/tracking system should utilize various sensors/devices (RFID, Bluetooth, GPS, etc.) to enable the following: 1. Creation of geo-fenced locations (minimum 50 meter radius) for tracking larger equipment 2. Track items entering and exiting buildings/facilities through identified entrances and exits 3. Provide expandable capability to detect devices within a room of a building/facility utilizing hand-held device 4. Provide expandable capability to provide pinpoint location of an asset (not inside a geo-fenced location) if necessary The system needs to track and report on usage rates, repair cycles, status, historical records, and pinpoint locations of the asset to reduce manpower waste while providing the ability to deploy and track assets down to the last tactical mile. The tracking needs to be capable of operating as often as near-real time with options to report at longer intervals. The system needs to be capable of connecting with current Air Force asset tracking/reporting systems by pushing/pulling data to them on a set cycle using AFNET/AFIN and commercial connections. To meet the intent of the objective, the system needs to meet the following requirements using the topic objective and description: 1. The tracking system needs to be modular and deployable in a kit like system capable of quickly being attached to assets using a variety of sensors. 2. The kit needs to be MIL-STD-810G/hardened enough to withstand high and low temperatures, dirt, dust, sand, rain, snow, and ice. 3. The kit needs to be MIL-STD-810G/hardened enough to withstand drops, falls, and impacts. 4. The kit needs to be capable of receiving power from an outlet ranging from 110-240V and operating up to 8 hours on battery power. 5. The system must offer the ability to be powered via a battery source capable of meeting the MIL-STD-810G standard. 4. The toolbox must meet requirements to obtain a HERO certification with max ""Safe Separation Distance"" of 10 ft for UNSAFE from the AF safety center. 5. The sensor must be capable of adhering to multiple types of surfaces with adhesive capable of withstanding exposure to the elements and chemicals like jet fuel, hydraulic fluid, etc. 6. The system needs to operate separate from a network connection while track and report on usage rates, repair cycles, status, historical records, and pinpoint locations of the asset to reduce manpower waste while providing the ability to deploy and track assets down to the last tactical mile. 7. The tracking needs to be capable of operating as often as near-real time with options to report at longer intervals using a variation of sensors and devices (Bluetooth, RFID, GPS, etc.). 8. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage

PHASE I: Complete a feasibility study that should, at a minimum, complete the following: 1. Clearly identify who the prime (and additional) potential AF end user(s) is and articulate how they would use your solution(s) (i.e., the one who is most likely to be an early adopter, first user, and initial transition partner). 2. Identify current technologies capable of meeting the topic objective that follows all NDAA, DISA, DoD, and Air Force policies, rules, regulations, and laws. 3. If the technology does not exist, determine what needs to be developed to meet the topic objective. 4. Determine if the technology is compatible with current/emerging Air Force assets/systems. 5. Determine the necessary requirements for any technologies deemed incompatible with each other and make them compatible with current/emerging Air Force assets. 6. Identify if an ATO is required and the necessary stakeholders to ensure implementation across the Air Force. 7. Deeply explore the problem or benefit area(s), which are to be addressed by the solution(s) - specifically focusing on how this solution will impact the end user of the solution. 8. Define clear objectives and measurable key results for a potential trial of the proposed solution with the identified Air Force end user(s). 8. Describe how the solution will need to be implemented across the Air Force. 10. Determine cost of installation, upkeep, and upgrade for the identified technology. 11. Provide a rated scale of feasibility on the identified technology based upon the first five items in this list. 12. Describe technology related development that is required to successfully field the solution. The funds obligated on the resulting Phase I awards are to be used for the sole purpose of conducting a thorough feasibility study using mathematical models, scientific experiments, laboratory studies, commercial research and interviews.

PHASE II: Develop, integrate, install, test, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on: 1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study. 2. Implement countermeasures for issues and identify the necessary evolution of the prototype to foster its eventual transition into a working commercial/warfighter solution. 3. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale). The solution should detail a rapid deployment and sustainment plan based upon lessons learned from the prototype capable of installing the technology at other Air force installations broken down by continent (i.e. separate plans for bases in Europe, CONUS, the Pacific, etc.). 4. Develop a clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security. 5. Specific details about how the solution can integrate with other current and potential future solutions. 6. How the solution can be sustainable (i.e. supportability). 7. Clearly identify other specific DoD or governmental customers who want to use the solution. 8. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.   Additionally, the system should be expandable enough to operate on a cloud based system capable of consuming, processing, and analyzing data from multiple systems as well as operating independently from the main system during transport but capable of reconnecting to the main system upon return.   The system needs to be capable of connecting with current/emerging Air Force systems using a rest API to enable communications with other Air Force Systems and the capability to data dump into Air Force Systems using different formats as applicable. The system needs to be compatible with current Air Force systems, programs, and apps with the ability to evolve and connect to emerging Air Force systems, programs, and apps. Additionally, fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution use current common criteria certified components when/where possible. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

REFERENCES:

1. DAFMAN 17-1301

KEYWORDS: AF Assets Tracking; Common Operating Picture (COP); Near-Real Time; Pinpoint Locations; Reporting

TPOC-1: Christopher Stoller
Phone: (339)208-0761
Email: christopher.stoller@us.af.mil

AF231-0023 TITLE: Multi-Mission Blue UAS

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

OBJECTIVE: Develop a customizable autonomous Blue Unmanned Aerial Systems (UAS) suite that can conduct emergency response, civil engineering, aircraft maintenance (MX), Operational Support (OS) and Chemical, Biological, Radiological, and Nuclear (CBRN) defense and. Demonstrate extensibility for future payloads and missions.

DESCRIPTION: USAFE is seeking autonomous UAS software and Blue UAS platforms for five unique missions with the ability for future expansion. The UAS software must demonstrate autonomous data and power transfer, provide collision avoidance, autonomous start up, autonomous take off, autonomous recovery, autonomous flight to intended destination and autonomous 2D and 3D scan capability. The UAS platforms must be water proof, demonstrate drone remote identification and interoperability with WinTAK and with the unmanned aircraft traffic management system being utilized as the Command and Control (C2) station. Specified requirements vary depending on tasked mission. Security Forces (SF) require 24/7 response time for emergencies. The UAS platform(s) in question does not need to be airborne at all times but must be available and fully charged at a moment’s notice with a minimum loiter time of 45 minutes. The solution for emergency response must also contain a method for ensuring continuous operations if the battery life of the platform becomes drained, leaving no gap in coverage. The platform must be able to respond within five minutes or less from the initial notice to the location specified (up to 3 miles away). UAS must have universal mounting system for fluid and swift payload changes (i.e. camera, spot light, load speaker, etc.) Civil Engineering (CE) requires easily mobile platforms with high quality cameras in order to conduct outdoor building inspections and developing 3D models. CE also requires High resolution Ortho-imagery in color and Light Detecting and Ranging (LiDAR) payloads (both with accuracy greater than 50 centimeters) for collecting spatial data. Aircraft Maintenance (MX) requires high quality hyperspectral, electric optical (EO) and Infrared (IR) cameras used to autonomously inspect aircraft and develop 3D models used to track maintenance. Operations Support requires an easily mobile platform with high quality electric optical (EO) and Infrared (IR) cameras in order to conduct and track outdoor SERE training, survey/3-D model landing and drop zones and inspect airport lighting, taxiway and runway infrastructure. CBRN requires a universal mounting system similar to SF for easily swappable payloads. Payloads may include but are not limited to Catalytic Bead Sensor (CAT), Electrochemical Detection (EC), Metal Oxide Sensor (MOS), Micro Electro Mechanical Sensor (MEMS), Nano Material Sensors (NANO), Photo Ionization Detection (PID), and Surface Acoustic Wave (SAW).

PHASE I: Evaluate vendor solutions to proposed requirements and ensure key requirements are met; autonomous software, WinTAK integration, and customizable platform(s)/payload mounting system. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

PHASE II: Develop and test autonomous Blue UAS suite for emergency response, civil engineering, and CBRN defense. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

PHASE III DUAL USE APPLICATIONS: Expand capability to additional mission sets and tie into base network. Fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air

Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution use current common criteria certified components when/where possible.

REFERENCES:

1. DoD C-sUAS Strategy 2021;
2. AFMAN 11-502;
3. DAFMAN 17-1301

KEYWORDS: UAS; sensors; extensible; ISR; CBRN; autonomous; MX

~~TPOC-1: Joshua Mote~~
~~Phone: (205) 901-8980~~
~~Email: joshua.mote.1@us.af.mil~~

TPOC-1: James Bailey
Phone: (781) 588-5459
Email: james.bailey@us.af.mil

SF231-0024 TITLE: Cislunar Navigation

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; 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: Conceptualize, design, and develop technical approaches for accurate and resilient navigation solutions to cislunar satellite constellations in support of both Department of Defense (DoD) and/or civil and commercial activities. Realize a proof of concept ensuring reliability, redundancy and robustness and relax mission constraints concerning navigation and communication capabilities as well Size, Weight, and Power and Cost (SWaP-C). Aligned with TN#338 – Cislunar PNT.

DESCRIPTION: Cislunar space is 1,728 times larger than the volume of space within 1 GEO. To operate effectively in a cislunar environment, there is a critical need for a GPS comparable navigation system for spacecraft in cislunar space to identify their exact position. Specifically, any cislunar navigation system should focus on providing navigation improvements on the Moon South Pole to allow first landings and ascending operations and ensure a good coverage for surface operation in that region. Some design tenets of cislunar navigation systems must operate in unstable families of non-planar and non-ellipses. Emerging cislunar navigation technologies need to address operational challenges of large scales of space and time involved in traditional two-way ranging with ground stations on earth, advanced timekeeping and time transfer in a cislunar environment, in addition of the confluence of terrestrial, lunar, and solar gravitational fields. Therefore, the challenge for this topic solicitation is to develop an onboard navigation system that is in support of DoD missions for rapid deployment anywhere and anytime, designed to work with much weaker signals, reduced geometric diversity and limited signal availability from the Earth's Global Navigation Satellite Systems (GNSS) or ranging with ground stations. Investigations conducted will include: i) new concepts and algorithms to take advantage of the availability of multi-constellation, multi-frequency and multi-signal GNSS; ii) use of less expensive onboard clocks by reducing the need for time stability between GNSS signal measurements and X-ray pulsar detectors; and iii) advanced filtering and data fusion, improved space and surface location algorithms. Metrics that will be assessed include position and time accuracy, availability of service (analyzed across cislunar space), bandwidth usage, SWaP-C, and complexity associated with system initialization and overall set up time.

PHASE I: Develop scalable mission architectures, leading to the potential for standardization of a cislunar satellite navigation system and technology. Determine requirements on feasibility of delivering positioning, navigation, and timing services efficiently and effectively in the presence of inherent challenges of observability diversity, measurement noise effects, importance of force models of ever-changing gravitational environments, and relative importance and influence of different inter-satellite links available in each scenario. Conduct necessary trade studies, modeling, and simulation that will contribute to the development of new operations concepts with reduced ground interactions.

PHASE II: Design a proof-of-concept that is capable of supporting a multi-node architecture for nanosecond-level or better time transfers with realistic clock errors and time synchronization challenges towards providing transformational performance to special users. Evaluate operational robustness for spacecraft navigation due to the redundant use of multiple independent GNSS signals and an increase in the number of observables directly available in cislunar environment.

PHASE III DUAL USE APPLICATIONS: Integrate with prospective follow-on transition partners. The contractor will transition the solution to provide improved operational capability to a broad range of potential Government and civilian users and alternate mission applications required precise relative positioning and autonomous cislunar, agile proximity operations.

REFERENCES:

1. 1. Siamak G Hesar, Jeffrey S Parker, Jason M Leonard, Ryan M McGranaghan, and George H Born, "Lunar far side surface navigation using linked autonomous interplanetary satellite orbit navigation (LiAISON)". In Acta Astronautica 117, pp. 116–129, 2015;
2. 2. NASA. Past, present and future Moon Missions. Dec. 2020. URL: https://nssdc.gsfc.nasa.gov/planetary/planets/moonpage.html.

KEYWORDS: Cislunar satellite navigation; positioning, navigation, and timing services; observability diversity; measurement noise effects; force models; gravitational fields

TPOC-1: Khanh Pham
Phone: (505) 846-4823
Email: khanh.pham.1@spaceforce.mil

AF231-0026 TITLE: Meshed Radar Network to Achieve Extended Coverage and Improved Performance from a Small, Lightweight, Low Power AESA for ATC in an Expeditionary Environment

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

OBJECTIVE: Rapid networking of low power radars to extend and enhance coverage volume

DESCRIPTION: PROBLEM SUMMARY: Air Traffic Control (ATC) within the constraints of Agile Combat Employment (ACE) requires minimization of logistical support, and reduction of the deployment footprint to just a few pallet positions on transport aircraft. Reduced Size, Weight and Power (SWaP), however, results in reduced radar range, decreasing the coverage volume from any given radar. Networking individual radars together increases the effective coverage and is commonly achieved in the garrison environment where extensive logistic support is available, and time is less of a concern. Networking radars in an expeditionary environment drives the need for systems that can be rapidly set up and meshed with by multicapable airmen for whom radar systems may not be their primary skillset. CURRENT STATE: The Air Force has pursued development of a small, low power, multi-function X-band AESA radar under a Rapid Innovation Fund (RIF) initiative, the Multifunction Tactical Radar System (MTRS). The lead agency, Air Force Flight Standards Agency (AFFSA), strongly supports this effort, and the PMO has funded additional work under the ATC Future Technologies (AFT) program. In 2023, the PMO will receive a prototype surveillance radar comprised of multiple AESA panels. This configuration is conducive to a rudimentary meshing of the individual coverage volumes, out to the maximum range of each panel.

PHASE I: Develop algorithm to ingest individual radar data and produce an integrated air picture suitable for core ATC Radar Approach Control (RAPCON) functions of aircraft sequencing and separation. Demonstrate this algorithm using the Government Furnished Equipment (GFE) prototype multi-panel configuration. Describe how this algorithm could be extended to more than one multi-panel systems to extend coverage. Describe also how individual panels might be separately deployed at distance, in linear or area patterns, then readily meshed to provide flexible coverage.

PHASE II: Develop the meshing algorithm for extensible, scalable coverage as described in Phase I. Demonstrate rapid, ad hoc networking of multiple AESA systems distributed across the Area of Responsibility (AOR), both single panel and multi-panel systems, including widely separated systems communicating over tactical networks. Describe methods to share this air surveillance data for other applications, including counter UAS. Describe potential other modalities such as weather sensing.

PHASE III DUAL USE APPLICATIONS: Implement the algorithm in a system of AESA radars to be deployed as an expeditionary ATC capability to be procured under the future MTRS program (FY25 POM start). Make the algorithm available to other users of similar AESA systems to extend and enhance coverage volume. Such systems would be applicable to civil air traffic control, first responders and disaster recovery, both for traditional ATC as well as Unmanned Traffic Management (UTM).

REFERENCES:

1. Service Branch: Air Force ; MAJCOM: AFMC ; Lead Agency for Requirements: Air Force Flight Standards Agency (AFFSA) ;

KEYWORDS: Air Traffic Control; ATC; Radar; PSR; ASR; AESA; Phased Array; Sensor; Coverage; Surveillance; Detect; Track; ID; Identify; Identification; IFF; Network; Meshed; UAS; UAV; Weather

TPOC-1: Jean Edouard

Phone: (781) 225-5435
Email: jean.edouard.2@us.af.mil

AF231-0027 TITLE: Decentralized Command and Control of Autonomous Systems

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

OBJECTIVE: The objective of this topic is to develop secure, safe, reliable and economical approaches for the command and control of autonomous systems. This capability is important to the concept of Trusted Autonomy as described in the USD(R&E) Technology Vision for an Era of Competition . To ensure the security and reliability of the autonomous systems over a wide range of conditions a decentralized approach to command and control is needed since the alternative, a centralized approach to command and control, cannot be expected to perform reliably when communications are disrupted. The autonomous systems of interest in this topic are primarily low-cost surveillance, communications and delivery platforms operating in large numbers distributed over wide areas. A capability that enables command and control of large numbers of autonomous systems has military, public safety and commercial applications. The desired approach is an architecture that supports the use of large numbers of unmanned platforms that host sensors and communications links and can perform logistics support by delivering material. These unmanned platforms can be stationary or mobile ground vehicles, marine vessels, or aircraft. The platforms may be designed for long term unattended operations, especially for marine vessels. The ground and marine platforms may also be capable of automated launch and recovery of unmanned aircraft. The command and control system is expected to support a wide range of platform types and operating environments. It is also expected to operate with the existing command and control systems that manage the planning and execution of missions. The collection of autonomous systems must operate in accordance with legal and policy requirements. These requirements have been defined for US DoD systems and commercial systems have similar requirements. Command and control of these platforms requires an information infrastructure that supports strong identity management, secure messaging and workflows that include artificial intelligence and machine learning (AI/ML). The AI/ML workflows should use an information architecture that supports safety and reliability verification and testing through semantic descriptions of data flows and processing.

DESCRIPTION: Industry trends point to increased use of autonomous systems in the future primarily due to economic benefits. These economic benefits favor large numbers of smaller, less expensive systems for many applications such as logistics, communications, and surveillance. There is a potential for a military organization to use large numbers of smaller, less expensive systems in support roles. Countering an adversary that adopts this approach could be difficult using current capabilities and may require developing a complementary approach. A method for effective command and control of large numbers of autonomous systems that is secure, reliable, resilient and economical will be needed. Command and control of autonomous systems is also relevant for commercial, public safety and scientific applications. A command and control system for large numbers of autonomous systems based on traditional technologies such as relational databases and centralized identify management could be more expensive and less reliable than a decentralized approach. A key component of economics will be the openness of the approach to allow for innovation and simplified integration. For the unmanned platforms to operate autonomously requires an information architecture that supports the integration of intelligence in the form of feature detection, course of action development and allocation of available resources. Decentralized databases, such as blockchain, could be used to create reliable and secure messaging and information storage. Recent developments in this area for decentralized finance (DeFi) have potential applicability, such as Layer 2 blockchains for improved performance and reduced cost, tokenization of data and identity to create Self-Sovereign Identification (SSI) and secure messaging. Integrating artificial intelligence and machine learning (AI/ML) into the command and control workflow is an important part of managing large numbers of autonomous systems. Commercial models for integrating AI/ML into command and control workflows include Uber's Michelangelo system . Michelangelo and other AI/ML workflows typically have a data ingest process, a feature detection process, recommendation process and a scheduler. Integrating AI/ML into a system that performs command and control of autonomous systems requires a higher level of verification and testing than a system like Uber's Michelangelo that can rely on the human operators to perform a validity check before taking action.

PHASE I: Phase I proposals could include feasibility studies that examine architectures and technologies that support decentralized command and control of large numbers of autonomous platforms distributed over wide areas in various environments, including urban, rural and marine environments as well as proposals that focus on a specific aspect of this capability, such as cybersecurity, AI/ML workflows or verification and testing. Phase I proposals should describe what aspects of the problem the effort will be focused on and any previous work in this technology area.

PHASE II: Phase II proposals could include evaluation of emerging technologies including performance and security assessments, through prototype development and demonstrations. Phase II proposals should describe what aspects of the problem the effort will be focused on and any previous work in this technology area.

PHASE III DUAL USE APPLICATIONS: A potential Phase III application could involve the distribution of materials over a wide area with a set of collaborating autonomous systems, whether this is a commercial application delivering good to residences, or a military application delivering materiel to remote bases. No government furnished equipment or information or access to government facilities is expected to be required to complete these tasks. In lieu of demonstrations with large number of autonomous systems the proposers would likely perform simulations and possibly demonstrations with small numbers of simple autonomous systems.

REFERENCES:

1. USD(R&E) Technology Vision for an Era of Competition 1-Feb-2022, pg. 4;
2. https://www.airuniversity.af.edu/JIPA/Display/Article/3091254/taming-the-killer-robot-toward-a-set-of-ethical-principles-for-military-artific/;
3. https://media.defense.gov/2019/Jun/18/2002146749/-1/-1/0/JP_001_COOK_TAMING_KILLER_ROBOTS.PDF;
4. https://media.defense.gov/2021/May/27/2002730593/-1/-1/0/IMPLEMENTING-RESPONSIBLE-ARTIFICIAL-INTELLIGENCE-IN-THE-DEPARTMENT-OF-DEFENSE.PDF;
5. https://www.ibm.com/blogs/blockchain/category/trusted-identity/self-sovereign-identity/;
6. https://www.uber.com/blog/michelangelo-machine-learning-platform/

KEYWORDS: command and control; decentralized; autonomous; blockchain

TPOC-1: Kevin Kelly
Phone: (781)225-1617
Email: kevin.kelly.34@us.af.mil

AF231-0028 TITLE: Universal Neural Information Acquisition Architecture for Cognitive Augmentation

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

OBJECTIVE: Develop a composable and extensible software architecture targeting a low/no code user interface for the configuration, logging, and viewing of real-time neural and peripheral sensors combined with human cognitive performance tasks. Additionally, the architecture should be extensible to support the addition of new novel tasks and emerging sensors.

DESCRIPTION: Brain-machine interface (BMI) technology may provide a decisive decision advantage to Airmen by providing dynamic decision support or performance augmentation in response to changes in neural patterns. Coupling BMI with peripheral sensors that monitor heart rate, skin conductance, pupil dilation, or gaze position could enhance the ability to detect issues such as fatigue, workload, or stress. However, challenges emerge when attempting to combine the diverse sensor data meaningfully while maintaining the temporal characteristics. The problem is made more difficult given the heterogeneous nature of data streams delivered by different device manufacturers. As a result, there are many bespoke solutions for sensor fusion with a specified set of input devices. Often these solutions are brittle and tied to a particular manufacturer for one or more devices. More generalized solutions are available (e.g., lab streaming layer [LSL; 1]). These solutions provide a good start for tackling parts of the integration challenge, but do not provide a holistic commercial off-the-self (COTS) solution. In the case of LSL, barriers include limited device support, disjointed user-interface implementations, and the difficulty of integrating new devices. Adding new devices, sensors, or tasks to a project is particularly problematic given that it can a require months of specialized development, discouraging innovation and adoption. Meanwhile, the burgeoning commercial market for wearable sensors and neurotechnology will require additional integration efforts. To facilitate the development and adoption of real-time BMI, a low/no code software architecture is needed for the fusion of neural, physiological, and behavioral data streams that is agnostic to the sensor systems providing inputs. Solutions should be flexible such that input streams can be manipulated (e.g., preprocessed), grouped, hidden, or automated (e.g., monitored) based on the user's selected preferences. Solutions should also have bidirectional integration with established software packages (e.g., MATLAB, Python) and languages (e.g., C#, C++) for relaying user inputs, and facilitating data processing, analysis, and machine learning. Solutions should also have the capability to send/receive data from external APIs for proprietary data processing. Solutions should have clear, well-documented API requirements for input/outputs from new devices and software and, ideally, model existing and emerging (e.g., [2]) industry norms and open-source solutions where feasible. Initially, solutions should be able to function on a secure isolated network, although compelling cloud-based solutions will be considered, especially with documentation describing on-premises setup and configuration.

PHASE I: Phase 1 should focus on concept development. The resulting proposal should completely document: 1. The proposed approach to implementing a low/no code software architecture for multimodal sensor fusion of neural and peripheral sensors and human cognitive performance software 2. The composability of the proposed system, including a description of the level of technical expertise necessary to add multiple sensors to the system and begin data collection 3. The interoperability of the proposed system, including a description of the amount of software development necessary to add a novel, previously unsupported, sensor device to the system 4. The extensibility of the proposed system, including a description of the capabilities for signal processing and machine learning to be applied to individual input streams 5. The bidirectional communication capabilities, including a description of the needs for a another system to receive data from the proposed system

PHASE II: Performers will develop and demonstrate a prototype system. The demonstration should focus specifically on: 1. Evaluating the expertise and technical skills necessary to setup a new system from scratch. Documentation of an independent external evaluation of the implementation and use of the system is highly encouraged, although not required. 2. A description of the interoperability of the system to accommodate an array of existing neural and peripheral sensors and a justification of the selected sensors. 3. A description of the specific details and requirements about how the solution can integrate with current and potential future sensors. Performers will should specifically address what about their solution makes it sustainable. 4. An evaluation of the time necessary for integrating a to-be-determined set of novel neural and/or peripheral sensors into the system 5. An evaluation of the extensibility of the system for integrating real-time or near real-time data processing and analysis signal with local or remote resources.

PHASE III DUAL USE APPLICATIONS: The performer will pursue further generalization of the technology developed, with the aim of transition to a working commercial or warfighter solution as a self-contained BMI middleware application that can be operated by non-experts.

REFERENCES:

1. Swartz Center for Computational Neuroscience (2018). Lab Streaming Layer. https://github.com/sccn/labstreaminglayer;
2. Easttom, C., Bianchi, L., Valeriani, D., Nam, C. S., Hossaini, A., Zapała, D., ... & Balachandran, P. (2021). A functional model for unifying brain computer interface terminology. IEEE Open Journal of Engineering in Medicine and Biology, 2, 91-96.

KEYWORDS: Brain Machine Interface; Brain Computer Interface; Training; Learning; Cognitive Enhancement; Closed loop systems; Extended Reality; Neuromodulation; Cognitive Interventions; Cognitive State

TPOC-1: William Aue
Phone: (937) 938-2573
Email: william.aue@us.af.mil