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

INTRODUCTION

Responsibility for the implementation, administration, and management of the Department of the Navy (DoN) SBIR Program is with the Office of Naval Research (ONR). The Acting Director of the DoN SBIR Program is Mr. Robert Smith, robert.l.smith6@navy.mil. For program and administrative questions, please contact the Program Managers listed in Table 1; **do not** contact them for technical questions. For technical questions about the topic, contact the Topic Authors listed for each topic during the period **24 April 2015 through 25 May 2015.** Beginning **26 May 2015**, the SBIR/STTR Interactive Technical Information System (SITIS) (https://sbir.defensebusiness.org/) listed in Section 4.15.d of the DoD SBIR Program Solicitation must be used for any technical inquiry. For inquiries or problems with electronic submission, contact the DoD SBIR/STTR Help Desk at 1-800-348-0787 (9:00 a.m. to 6:00 p.m. ET).

TABLE 1: NAVY SYSTEMS COMMANDS (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	Activity	Email
N152-081 to N152-096	Ms. Donna Moore	NAVAIR	navair.sbir@navy.mil
N152-097 to N152-098	Mr. Kail Macias	NAVFAC	kail.macias@navy.mil
N152-099 to N152-103	Mr. Dean Putnam	NAVSEA	dean.r.putnam@navy.mil
N152-104 to N152-107	Mr. John Keiran	NSMA	john.keiran@navy.mil
N152-108 to N152-122	Ms. Lore-Anne Ponirakis	ONR	loreanne.ponirakis@navy.mil
N152-123	Mr. John Thom	SPAWAR	john.thom@navy.mil

The Navy's SBIR Program is a mission oriented program that integrates the needs and requirements of the Navy's Fleet through R&D topics that have dual-use potential, but primarily address the needs of the Navy. Companies are encouraged to address the manufacturing needs of the Defense Sector in their proposals. Information on the Navy SBIR Program can be found on the Navy SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DoN's mission can be obtained from the DoN website at www.navy.mil.

PHASE I GUIDELINES

Follow the instructions in the DoD SBIR Program Solicitation at https://sbir.defensebusiness.org/ for program requirements and proposal submission guidelines. Please keep in mind that Phase I should address the feasibility of a solution to the topic. It is highly recommended that proposers follow the Navy proposal template located at www.navysbir.com/submission.htm as a guide for structuring proposals. Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.

Technical Volumes that exceed the **20** page limit will be reviewed only to the last word on the **20th** page. Information beyond the **20th** page will not be reviewed or considered in evaluating the proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, evaluators may deem the proposal as non-responsive and score it accordingly.

The Navy requires proposers to include, within the **20-page limit**, an option that furthers the effort and will bridge the funding gap between Phase I and the Phase II start. Phase I options are typically exercised upon the decision to fund the Phase II. **The Phase I base amount and Period of Performance shall not exceed $80,000 and six months; the Phase I option amount and Period of Performance shall not exceed $70,000 and six months.**

PHASE I PROPOSAL SUBMISSION CHECKLIST:

The following criteria <u>must be met</u> or the proposal will be REJECTED.

____1. Include a header with company name, DoD proposal number, and DoD topic number on each page of your Technical Volume.

____2. Include tasks (separately) to be completed during the option period in the 20-page Technical Volume and include the costs as a separate section in the Cost Volume. Costs for the base and option should be clearly separate, and identified on the Proposal Cover Sheet, in the Cost Volume, and in the work plan section of the proposal.

____3. BREAK OUT SUBCONTRACTOR, MATERIAL AND TRAVEL COSTS IN DETAIL. In the Cost Volume, it is important to provide sufficient detail for the subcontract, material and travel costs. Subcontractor costs should be detailed at the same level as the prime to include at a minimum personnel names, rate per hour, number of hours, material costs (if any), and travel costs (if any). Material costs should include at a minimum listing of items and cost per item. Travel costs should include at a minimum the purpose of the trip, number of trips, location, length of trip, and number of personnel. Use the "Explanatory Material Field" in the DoD Cost Volume worksheet for this information.

____4. If Discretionary Technical Assistance (DTA) is proposed, add information required to support DTA in the "Explanatory Material Field" in the DoD Cost Volume worksheet.

____**5. The Phase I base amount and Period of Performance shall not exceed $80,000 and six months and the option amount and Period of Performance shall not exceed $70,000 and six months. The costs for the base and option periods are clearly separate, and identified on the Proposal Cover Sheet, in the Cost Volume, and in the Technical Volume. If proposing direct DTA, a total of up to $5,000 combined may be added to the Base or Option periods.**

____6. Upload the Technical Volume and the DoD Proposal Cover Sheet, the DoD Company Commercialization Report, and Cost Volume electronically through the DoD submission site (https://sbir.defensebusiness.org/) by 6:00 am ET, 24 June 2015.

____7. After uploading the file on the DoD SBIR/STTR submission site, review it to ensure that it appears correctly. Contact the DoD SBIR/STTR Help Desk immediately with any problems.

PHASE II GUIDELINES

All Phase I awardees will be allowed to submit an **Initial** Phase II proposal for evaluation and selection. The Phase I Final Report, Initial Phase II Proposal, and Transition Outbrief (as applicable), will be used to evaluate the offeror's potential to progress to a workable prototype in Phase II and transition technology in Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I award or by subsequent notification.

NOTE: All SBIR/STTR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations (for all DoN topics, this means by invitation only).

Section 4(b)(1)(ii) of the SBIR Policy Directive permits the Department of Defense and by extension the DoN, during fiscal years 2012 through 2017, to issue a Phase II award to a small business concern that did not receive a Phase I award for that R/R&D. **NOTE:** The DoN will NOT be exercising this authority for SBIR Phase II awards. **Therefore, in order for any small business firm to receive a Phase II award, the firm must be a recipient of a Phase I award under that topic and submit an Initial Phase II proposal.**

The Navy typically awards a cost plus fixed fee contract for Phase II. The Phase II contracts can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 252 of the National Defense Authorization Act of Fiscal Year 2006. The statute set-aside is 1% of the available SBIR funding to be used for administrative support to accelerate transition of SBIR-developed technologies and provide non-financial resources for the firms (e.g. the Navy's Transition Assistance Program).

DISCRETIONARY TECHNICAL ASSISTANCE

The SBIR Policy Directive section 9(b), allows the DoN to provide discretionary technical assistance (DTA) to its awardees to assist in minimizing the technical risks associated with SBIR projects and commercializing products and processes. Firms may request, in their Phase I and Phase II proposals, to contract these services themselves in an amount not to exceed $5,000 per year. This amount is in addition to the award amount for the Phase I or Phase II project.

Phase I awardees that propose more than $150,000 in total funding (Base, Option and DTA) cannot receive a purchase order. Purchase orders are a type of Simplified Acquisition Procedure (SAP) intended to reduce administrative costs, promote efficiency and economy in contracting, and avoid unnecessary burdens for agencies and contractors. The need to issue a Firm Fixed Price (FFP) contract may result in contract delays if the SYSCOM normally issues purchase orders for Phase I awards. FOR ONR TOPICS ONLY: The total Phase I award amount, including DTA, cannot exceed $150K.

Approval of direct funding for DTA will be evaluated for approval by the DoN SBIR office if the firm's proposal (1) clearly identifies the need for assistance (purpose and objective of required assistance), (2) provides details on the provider of the assistance (name and point of contact for performer); and unique skills/specific experience to carry out the assistance proposed, and (3) the cost of the required assistance (costs and hours proposed or other details on arrangement). This information must be included in the firm's cost proposal specifically identified as "Discretionary Technical Assistance" and cannot be subject to any profit or fee by the requesting SBIR firm. In addition, the provider of the DTA may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner). Failure to include the required information in the proposal will result in the request for DTA being disapproved. Exceeding proposal limits identified for Phase I ($150,000 for Base, Option, and DTA) without including the required identification of DTA will result in the proposal's REJECTION without evaluation.

If a firm requests and is awarded DTA in a Phase II proposal, it will be eliminated from participating in the Navy Transition Assistance Program (TAP), the Navy Opportunity Forum, and any other assistance the Navy provides directly to awardees.

All Phase II awardees not receiving funds for DTA in their award must attend a one-day Navy TAP meeting during the second year of the Phase II. This meeting is typically held in the summer in the Washington, D.C. area. Information can be obtained at: http://www.dawnbreaker.com/navy.php. Awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

PHASE III GUIDELINES

A Phase III SBIR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR funding agreements, but is funded by sources other than the SBIR Program. Thus, any contract or grant where the technology is the same as, derived from, or evolved from a Phase I or a Phase II SBIR/STTR contract and awarded to the company that was awarded the Phase I/II SBIR is a Phase III SBIR contract. This covers any contract/grant issued as a follow-on Phase III SBIR award or any contract/grant award issued as a result of a competitive process where the awardee was an SBIR firm that developed the technology as a result of a Phase I or Phase II SBIR. The Navy will give SBIR Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR Phase I/II effort(s). Government prime contractors and/or their subcontractors follow the same guidelines as above and ensure that companies operating on behalf of the Navy protect the rights of the SBIR company.

EVALUATION AND SELECTION

The Navy will evaluate and select Phase I and Phase II proposals using the evaluation criteria in Sections 6.0 and 8.0 of the DoD SBIR Program Solicitation respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. **NOTE: The Navy does NOT participate in the FAST Track program.**

Protests of Phase I and II selections and awards shall be directed to the cognizant Contracting Officer for the Navy Topic Number. Contact information for Contracting Officers may be obtained from the Navy SYSCOM SBIR Program Managers listed in Table 1.

One week after Phase I solicitation closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, e-mail addresses on the proposal coversheets must be correct.

The Navy typically awards a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I.

In accordance with section 4.10 of the DoD Instructions, requests for a debrief must be made within 30 days of non-award notification.

CONTRACT DELIVERABLES

Contract deliverables are typically progress reports and final reports. Deliverables required by the contract, shall be uploaded to https://www.navysbirprogram.com/navydeliverables/.

AWARD AND FUNDING LIMITATIONS

In accordance with SBIR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. Additionally in accordance with SBIR Policy Directive section 7(i)(1), each award may not exceed the award guidelines (currently $150,000 for Phase I and $1 million for Phase II, excluding DTA) by more than 50% (SBIR/STTR program funds only) without a specific waiver granted by the SBA.

TOPIC AWARD BY OTHER THAN THE SPONSORING AGENCY

Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular firm per topic using SBIR/STTR program funds (see above), Head of Agency Determinations are now required (for all awards related to topics issued in or after the SBIR 13.1/STTR 13A solicitation) before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact the original sponsoring agency before submitting a Phase II proposal to an agency other than the one that sponsored the original topic. (For DoN awardees, this includes other Navy SYSCOMs.)

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a solicitation for SBIR may transition in Phase II to STTR and vice versa. A firm wishing to transfer from one program to another must contact its designated technical monitor to discuss the reasons for the request and the agency's ability to support the request. The transition may be proposed prior to award or during the performance of the Phase II effort. Agency disapproval of a request to change programs will not be grounds for granting relief from any contractual performance requirement(s). All approved transitions between programs must be noted in the Phase II award or an award modification signed by the contracting officer that indicates the removal or addition of the research institution and the revised percentage of work requirements.

ADDITIONAL NOTES

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

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

NAVY SBIR 15.2 Topic Index

N152-115	Active Thermal Control System Optimization
N152-116	Affordable Compact HPRF/HPM Attack Warning System
N152-117	Low Size, Weight, Power, and Cost (SWAP-C) Magnetic Anomaly Detection (MAD) System
N152-118	Ultra High Density Carbon Nanotube (CNT) Based Flywheel Energy Storage for Shipboard Pulse Load Operation
N152-119	Guidance System on a Chip
N152-120	Attack Sensitive Brittle Software
N152-121	Compact Air-cooled Laser Modulate-able Source (CALMS)
N152-122	In-Transit Visibility Module for Lifts of Opportunity Program (LOOP) & Transportation Exploitation Tool (TET)
N152-123	Advanced UHF SATCOM Satellite Protection Features

N152-081 TITLE: Synthesis and Realization of Broadband Magnetic Flux Channel Antennas

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: PMA 234 Next Generation Jammer

OBJECTIVE: Design and develop frequency-independent geometries for magnetic flux-channel antennas that are conformal to aircraft surfaces. Solutions are required for line-of-sight and SATCOM applications that are low-profile and achieve higher gain than currently available solutions.

DESCRIPTION: Significant advances have been made recently in the development of magnetic antennas. These antennas are magnetic duals of electric antennas, which allow them to be mounted directly on an aircraft surface. No frequency-dependent backing-cavities are required, which allows true frequency-independent operations. Flux channels in the form of magnetic rings have been shown to replace vertical elements and crossed-linear dipoles. In both cases, no hull penetrations are required save for the feed points, and the external presentation is minimized. However, application to the curved surfaces of aircraft has yet to be addressed. Issues involved are related to the tape-winding process that has been used to manufacture the channels. This process resists conforming to curved surfaces. Designs are required that can be applied to singly and doubly curved surfaces such as those found on aircraft. There is also opportunity here to arrange the geometries to adjust antenna pattern characteristics. The solutions will need to operate over a decade of frequency in the 3 – 600 MHz (MegaHertz) band with frequency-independent characteristics in both impedance and radiation pattern. The antenna should attain a gain greater than 0 dBi and a Voltage Standing Wave Ratio (VSWR) equal to or better than 2.5:1 over at least the upper two octaves of the band. The design should be extendable to other and wider frequency bands for both line-of-sight and satellite communications applications. The primary objective of this solicitation is to extend the capabilities of magnetic-current radiators by constructing frequency-independent geometries. A secondary objective is to consider electrically small antennas and high-power antennas. Using the science and current development state are described by Sebastian in the references [1, 2].

PHASE I: Determine technical feasibility and develop an approach for frequency-independent geometries for magnetic flux-channel antennas that are conformal to aircraft surfaces and designed to meet the performance requirements in the description section. Prove feasibility through analysis and simulation.

PHASE II: Further develop design from Phase I through additional analysis and simulation. Design, manufacture, integrate, and demonstrate the operation of a prototype on a simulated aircraft body to establish practical performance parameters. Based on these results, propose any refinements to the antenna design and fabrication approach and determine the trade-off between cost, weight, and gain-bandwidth performance. Address fabrication cost and volume challenges that are relevant to the general application to aircraft.

PHASE III: Finalize the design from Phase II, perform relevant testing and transition the technology to appropriate Navy and commercial platforms. The small business will support the Navy with certifying and qualifying the antenna for Naval use. As appropriate, the small business will focus on scaling up manufacturing capabilities and commercialization plans.

REFERENCES:
1. T. Sebastian, R. Diaz, D. Auckland and C. Daniel, “A New Realization of an Efficient Broadband Conformal Magnetic Current Dipole Antenna”, presented at the IEEE AP-S/USNC Symposium on Antennas and Propagation, July 2013, http://ieeexplore.ieee.org/.

2. T. Sebastian, “Magneto-dielectric Wire Antennas Theory and Design”, Arizona State University, PhD Dissertation, May 2013.

KEYWORDS: Antennas; wide-bandwidth antennas; low profile antennas; conformal antennas; magnetic materials; flux-channel antennas

TPOC: (301)342-9167

2nd TPOC: (301)757-8923

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-082 TITLE: Design and Produce Millimeter Wave Dipole Chaff with High Radar Cross Section

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: PMA 272 Advanced Tactical Aircraft Protection Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. 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 low cost chaff dipole materials with high Radar Cross Section (RCS) in the millimeter wave (mmW) frequency band to induce error in radar aiming systems or cause a radar guided missile to break its lock on a tracked aircraft.

DESCRIPTION: Current aircraft radio frequency (RF) chaff is made from aluminum coated glass filaments produced in a continuous strand and then cut to lengths that achieve the desired resonance at frequencies in the 2-18 GHz band. The filaments require a slip coating to prevent end welding of fibers when cut, and to minimize clumping when ejected. The typical chaff cartridge can contain millions of these coated glass filaments and has multiple sections of different lengths to create a reflective response across many frequencies at the same time [Ref. 2,3,4]. The millimeter wave band of 30 to 40 GHz is not addressed in the fielded chaff cartridge. The current chaff material is not well suited to be cut and packaged to lengths required for efficacy in the millimeter wave region. Also, calculations show the amounts needed to produce the required response in that region cannot be achieved in the volume of the current chaff cartridge. Recent advances in nano-fibers, nanotubes, meta-materials, conductive polymers, graphite fibers, graphene fibers, metal nanowire technologies, and coating techniques using copper, silver, aluminum, zinc, etc., provide some promise that new higher performing chaff can be produced on a large scale. [Ref. 1,]. The new chaff may be able to double, triple, or even quadruple the number of dipoles in the available volume. A novel dipole chaff material is needed that can be utilized for millimeter wave frequencies, is low cost, and can be produced easily in sufficient quantities, by industry, to satisfy the needs of the military community. This new chaff must have high scattering RCS in the 33 to 38 GHz frequency band. Target cartridge volume is 1.4 inch diameter X 5.8 inch long cylinder. It is desired that the material RCS exceed 500 square meters at 35 GHz per cartridge.

PHASE I: Design, develop and prove feasibility of new innovative chaff in accordance with the parameters in the Description. Provide a detailed analysis conducted by modeling and simulation, calculation or measurement of individual dipole RCS performance and then scale up the RCS performance for a volumetric chaff cloud result. If objective is met for the proposed frequency band of 33 to 38 GHz, then investigate the scalability of the material for the 2 to 18 GHz frequency band to show increase/decrease of effectiveness. Agglomeration or bird-nesting of dipole payload must not exceed 20 percent of sample to facilitate dispersion of the chaff payload upon dispense. The target materials have been in existence for some time now and the basic process of combining and coating have been the subject of experimentation on a small scale. Production of a small quantity consisting of a few ounces of the material to prove the ease of manufacture and demonstrate the simplified process is desired.

PHASE II: Develop a pilot scale manufacturing process for the chaff material. Test material in a controlled environment and demonstrate that modeling and simulation results confirm actual performance findings. Develop plans to integrate the chaff with a dissemination device such as Navy RR-129 cartridge form factor. Using Government Furnished Equipment (GFE) cartridges, produce and provide 30 flight test ready samples for Government-furnished testing on an air platform in order to fully characterize the effects of this chaff on a Navy test range. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE III: Develop a full-scale manufacturing process for proposed material. Participate in qualification testing efforts of the proposed material. Assist in the transition of the technology to appropriate air platforms.

REFERENCES:
1. Waterman, P.C. & Pedersen, J.C. Electromagnetic Scattering and Absorption by Finite Wires, Journal of Applied Physics, 78(2). Retrieved from http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5012870&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D5012870.

2. Schleher, D. C., Introduction to Electronic Warfare, Artech House, 1986, pages 183-195.

3. GlobalSecurity.org. (2011). Chaff - Radar Countermeasures. Retrieved from http://www.globalsecurity.org/military/systems/aircraft/systems/chaff.htm. Last accessed on 1 December 2014.

4. Skolnik, M. I. (1990). Radar Handbook Second Edition, McGraw Hill, (9.5).

KEYWORDS: Chaff; Denial; Electronic Warfare (EW); Electromagnetic (EM); millimeter wave (mmW); Radar Cross Section (RCS)

TPOC: (904)317-1996

2nd TPOC: (301)342-0083

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-083 TITLE: Synthetic Aperture Radar Approaches for Small Maritime Target Detection and Discrimination

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA 299 H-60 Program Office

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Enhance military capabilities through improved detection, tracking and discrimination of small maritime targets at higher altitudes and at comparatively longer standoff ranges than is currently achievable by utilizing non-traditional synthetic aperture radar (SAR) based approaches.

DESCRIPTION: Traditionally SAR has been used to provide imagery of fixed structures on land. Objects moving in the scene were unfocused and generally not of value. For large vessels at sea in relatively calm conditions, some advanced focusing algorithms are able to provide high quality imagery but are not useful for small vessels with very dynamic movements. For maritime environments, the community has relied on low altitude (<1000’) non-coherent techniques that leverage lower clutter returns present in at these low grazing angles. Coherent techniques based on SAR processing are far less sensitive to grazing angle, allowing the platform to operate at higher altitudes and steeper grazing angles (perhaps 10’s of degrees). In addition, they offer improved performance due to a richer set of potential discriminants. Increased standoff ranges are attained using the coherent techniques as well as allowing the use of lower cost, lower peak powered radars. The suggested approach differs from traditional SAR in that the objective is not to “focus” the target but rather to leverage the nature of the target signature and the coherence of the background to improve detection, tracking and discrimination.

PHASE I: Design and demonstrate the feasibility of a SAR based small maritime target approach for detection and tracking using available field data or synthetic data.

PHASE II: Mature the detection and tracking approach to be suitable for integration into an existing Navy airborne maritime surveillance radar system. Develop a set of discriminates using field data for a limited set of target types identified by the Navy.

PHASE III: Refine and improve the implementation for integration on Navy maritime surveillance radar systems suitable for platforms such as the MQ-8C, MQ-4C, MH-60R and P-8A.

REFERENCES:

1. Tang Li-bo, Li Dao-jing, Hong Wen, and Cao Fang, “High Resolution SAR Imaging of Moving Ships,” Geoscience and Remote Sensing Symposium, 2005. IGARSS '05. 2005 IEEE International Proceedings, 25-29 July 2005, pp. 3329-3332.

2. A.D Lazarov and Ch.N.Minchev. (2009). SAR Ship Target by Induced Complementary Movement. Recent Advances in Space Technologies, 4th International Conference. Retrieved from http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=5158242&queryText%3DSAR+Ship+Target+Imaging+by+Induced+Complementary+Movement

KEYWORDS: Maritime Surveillance; Target Detection; Target Tracking; Radar Surveillance; Coherent Signal Processing; Synthetic Aperture Radar (Sar)

TPOC: (301)342-2637

2nd TPOC: (301)342-9173

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-084 TITLE: Test and Certification Techniques for Autonomous Guidance and Navigation Algorithms for Navy Air Vehicle Missions

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: PMA 262 Persistent Maritime Unmanned Aircraft Systems

OBJECTIVE: Develop test and certification techniques for autonomous guidance and navigation algorithms that increase air vehicle autonomous operational capabilities for Navy missions.

DESCRIPTION: Many advanced autonomous guidance and navigation algorithms capable of dynamic route re-planning have been developed. The application of such algorithms to Unmanned Air System (UAS) missions has remained limited. This limited application results from multiple factors; however, the greatest obstacle is airworthiness certification. The development of certification methods for these algorithms remains challenging because of the difficulty in defining test cases and expected results that suitably enumerate the broad range of conditions and non-deterministic responses that may be generated in response to complex environments. The current certification approach relies on brute-force methods to exhaustively test the algorithms making certification efforts prohibitive due to cost and schedule impacts. Therefore, the Navy’s current UAS inventory is limited to fixed, pre-planned mission plans that prohibit fully integrated operations with the fleet. Test and certification techniques for navigation and guidance algorithms specific to Naval missions are needed to integrate higher levels of autonomy into Naval Aviation operations. A wide range of classes of algorithms have seen application in recent UAS autonomous path planning research, such as: potential field methods [1], optimization methods [2], and heuristic search methods [3]. The present inventory of these algorithms is quite large, and the application of each class of algorithm can be quite nuanced. Although some test/demonstration cases have been proposed [4], new, robust analysis, test, and demonstration techniques must be developed to enable the Navy acquisition community to certify systems with autonomous path planning algorithms [5].

PHASE I: Develop and prove feasibility of initial test and certification techniques for autonomous guidance and navigation algorithms for representative Navy mission scenarios. Mission scenarios could include dynamic path re-planning during shipboard launch/departure and recovery/landing flight phases within the ship’s airspace, including integrated operations with other manned aircraft. The test and certification techniques will be evaluated against accuracy, algorithmic scope coverage, and reduction in test scope from full brute-force style evaluation techniques.

PHASE II: Develop a prototype software application/suite for the test and certification techniques and integrate that software with real-time (or faster-than-real-time) software-in-the-loop capabilities that provides a virtual test bed for: (i) assessing the efficacy of various algorithms in different mission scenarios, (ii) developing suitable test/demonstration cases, (iii) robustness of test/demonstration cases across algorithm classes. Develop integration, test, and certification guidelines for the software application/suite to enable testing of future algorithms.

PHASE III: Transition a final software application/suite to the Navy (i.e. Triton, Fire Scout, and UCLASS) and other DoD agencies. Additionally, transition the developed technology to commercial UAS industries.

REFERENCES:
1. Scherer, S., Singh, S., Chamberlain, L., & Elgersma, M. (2010). Flying Fast and Low Among Obstacles: Methodology and Experiments. International Journal of Robotics Research, 27(5). Retrieved from http://ijr.sagepub.com/content/27/5/549.abstract.

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KEYWORDS: Autonomy; Flight Control; Path Planning; Trajectory; Guidance; Airworthiness

TPOC: (301)995-2038

2nd TPOC: (301)995-1637

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-085 TITLE: Gallium Arsenide Based 1-Micrometer Integrated Analog Transmitter

TECHNOLOGY AREAS: Air Platform, Sensors, Electronics

ACQUISITION PROGRAM: JSF-MS

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and package an uncooled optical transmitter operating at a wavelength near 1 micrometer for radio-frequency (RF) photonic link applications on air platforms.

DESCRIPTION: Current airborne military communications and electronic warfare systems require ever increasing bandwidths while simultaneously requiring reductions in space, weight and power (SWaP). The replacement of the coaxial cable used in various onboard RF/analog applications with RF/analog fiber optic links will provide increased immunity to electromagnetic interference, reduction in size and weight, and an increase in bandwidth. However it requires the development of high performance, high linearity optoelectronic components that can meet extended temperature range requirements (-40 to 100 degrees Celsius (C)). Additionally, avionic platforms pose stringent requirements on the SWaP consumption of components such as optical transmitters for avionic fiber communications applications. To meet these requirements, new optical component technology will need to be developed. Current analog optical transmitter technology typically consists of discrete lasers and modulators operating at 1550 nanometers (nm), with a requirement for active cooling for operation in avionic environments. To meet avionic requirements, the transmitter should integrate laser and modulator into a compact uncooled package that can maintain performance over full avionic temperature range. It is envisioned that a Gallium Arsenide (GaAs) based transmitter at approximately 1 micrometer wavelength can meet this requirement. One (1) micrometer GaAs optical sources can operate over an extended temperature range (>100 degrees C) at high efficiency (up to ~60%). This is currently not possible at 1550nm. The desired optical component is a GaAs-based integrated analog transmitter (laser and high-efficiency modulator), with an integrated optical source with low relative intensity noise (RIN) (<-160dBc/Hz), 100 milliwatt (mW) output power, uncooled operation over a minimum temperature range of -40 to +100 degrees C, and an integrated optical intensity modulator with low V-pi (<2V), packaged in a ruggedized package that has a height less than or equal to 5 mm, and a volume of <2.5 cubic centimeters. The packaged transmitter must perform over the specified temperature range and maintain hermeticity and optical alignment upon exposure to typical Navy air platform vibration, humidity, thermal shock, mechanical shock, and temperature cycling environments [4].

PHASE I: Develop and analyze a new design and packaging approach for an uncooled 1 micrometer optical transmitter that meets the requirements outlined in the Description section. Develop fabrication process, packaging approach, and test plan. Demonstrate feasibility of the optical transmitter with a supporting proof of principle bench top experiment.

PHASE II: Optimize Phase I transmitter and package design and develop a prototype. Test prototype transmitter to meet design specifications in a Navy air platform representative of a relevant application environment, which can include unpressurized wingtip or landing gear wheel well (with no environmental control) to an avionics bay (with environmental control). The prototype transmitter should be tested in an RF photonic link over temperature with the objective performance levels reached. Demonstrate a prototype fully packaged transmitter for direct insertion into analog fiber optic links.

PHASE III: Perform extensive operational reliability and durability testing, as well as optimize manufacturing capabilities. Transition the demonstrated technology to Naval Aviation platforms and interested commercial applications.

REFERENCES:
1. Pappert, S., (2008), Photonics for RF Systems, IEEE Avionics Fiber Optics and Photonics Conference.

2. Ackerman, E.I., Cox, C.H., (Dec. 2001), RF fiber-optic link performance, IEEE Microwave Magazine, 2, issue 4, pp. 50-58.

3. Novak, D, Clark, T. R., (2007), Broadband adaptive feedforward photonic linearization for high dynamic range signal remoting. Military Communications Conference.

4. MIL-STD-810G (31 Oct 2008). Environmental Engineering Considerations and Laboratory Tests.

KEYWORDS: Laser; Radio Frequency; transmitter; Gallium Arsenide; Wideband; Fiber Optic

TPOC: (301)342-9115

2nd TPOC: (301)757-7124

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-086 TITLE: Flight Deck Lighting Addressable Smart Control Modules

TECHNOLOGY AREAS: Electronics

ACQUISITION PROGRAM: PMA 251 Aircraft Launch and Recovery Program Office

OBJECTIVE: Develop Flight Deck Lighting Addressable Smart Control Modules to digitally control Light Emitting Diode (LED) aviation light fixtures on United States (US) Navy surface combatants.

DESCRIPTION: Surface aviation and amphibious assault ships launch and recover aircraft whose pilots typically use Night Vision Devices (NVDs) for night operations. As a result, the NVD flight deck lighting solution requires control and dimming of various individual lighting fixtures and circuits aboard these ships. Digitally addressable control of these lighting fixtures is required in order to dim and/or turn these lights on and off depending on what the flight operations and atmospheric conditions require. The US Navy desires a new solution for aviation lighting aboard air capable ships utilizing LED technology through a standardized smart module that will be able to recognize the lighting package configuration and what type of fixture it is controlling through embedded firmware/software; this would allow lights of different functions and power requirements to be daisy chained, significantly reducing cable runs and installation costs. As lights are added to the system, they should self-configure and appear on the operator control panel in the correct lighting group. The smart module would eliminate the need for multiple configurations, set-up issues and complex troubleshooting while providing a simplified configuration that allows it to be easily replaced when a light is not able to be turned on/off, dimmed, or flashed from the operator control panel. Failures of any light should not affect the operation of any other light. The existing lighting control system includes an expensive (estimated $60,000) electronics box, FLEXDRIVER, which drives up to forty-eight light fixtures on a ship in each enclosure; this reduces system reliability and creates single point failures. A large ship may need in excess of twelve FLEXDRIVER's, each of which must be individually configured for the compliment of lights the flight deck has. Each configuration is a unique mix of multiple driver cards for the specific light fixtures it drives and each light has a direct connection to a FLEXDRIVER, increasing system cabling. An innovative approach is needed to identify the most cost effective methods to achieve successful installation of the smart module. Objectives to consider include the ability to reduce the system cable plant, minimize system interconnections, provide redundancy for fault tolerance, provide for on/off, flashing and dimming control of various lighting groups, configurations that can be incorporated into existing lighting fixtures or interconnection junction boxes while minimizing total system cost of ownership. The consolidated control of the total system would be over the shipboard Local Area Network (LAN). The proposed system should meet strict Electro Magnetic Interference (EMI) requirements of Mil-STD-461 and navy shipboard environmental requirements. Of note, there are twelve different LED lighting fixtures of varying quantities that make up the Advanced Flight Deck Lighting (AFDL) system. More will be developed in the future. Current lighting fixtures range from a single LED fixture to fixtures containing multiple LED strings (1-6) with different voltage (3-28VDC) and current (68-3150ma) requirements.

PHASE I: Design and demonstrate the feasibility of a universal smart LED Light Fixture Control module, as discussed in the Description section, with respective embedded firmware/software capable of having universal applications on all US Navy flight decks while identifying methods to keep overall system costs to a minimum.

PHASE II: Based on the Phase I effort develop a production-representative prototype of an LED Light Fixture Control smart module and demonstrate its functionality in a lighting control system on a shipboard representative lighting layout with either real or simulated loads, provided by NAVAIR (e.g., either a test bench or real fixtures at NAVAIR Lakehurst or a location to be determined (TBD)). Design concepts should be updated to detailed design documentation. Analysis of shipboard environmental sustainability should be provided at a minimum, with environmental testing of the PRM conducted ideally. The ability to provide a failure analysis is desired, as is an estimate of service life.

PHASE III: Finalize development of an optimized LED Light Fixture Control smart module design for robustness and full environmental qualification, including shock testing. Test prototype in conjunction with a shipboard representative flight deck lighting system (TBD by NAVAIR). Produce units for delivery to fleet and shore sites. Transition and integrate the smart module into its intended platform(s).

REFERENCES:

1. NAVAIR drawing 3975AS160 for a Deck Surface Floodlight. (Please visit SITIS to download).

2. DDG-1000 interconnecting cabling drawing 3975AS0105. (Please visit SITIS to download).

3. Department of Defense. (1967). MIL-STD-461, MILITARY STANDARD: ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS REQUIREMENTS FOR EQUIPMENT. Retrieved from http://everyspec.com/MIL-STD/MIL-STD-0300-0499/MIL-STD-461_8678/.

KEYWORDS: Surface Aviation Ships; Lighting Control System; Digitally Addressable; Light Emitting Diode (LED); Aviation Lighting; embedded firmware control

TPOC: (732)323-1696

2nd TPOC: (732)323-2459

3rd TPOC: (732)323-1431

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-087 TITLE: Ability for Electronic Kneeboard (EKB) to Communicate and Operate in a Multi-level Security Environment

TECHNOLOGY AREAS: Air Platform, Information Systems, Electronics

ACQUISITION PROGRAM: PMA 281 Strike Planning and Execution Systems Electronic Kneeboard Program

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a software solution for operating mobile tablets in multi-level secured, disjointed mission environments to aid in the establishment of a common Electronic Kneeboard (EKB) capability across all United States Naval (USN) and United States Marine Corps (USMC) aviation platforms.

DESCRIPTION: The Electronic Kneeboard (EKB) is currently being developed to enable access to digital publications, tactical imagery, and other dynamic data in all USN and USMC aircraft. This capability will greatly enhance aircrew situational awareness, reduce cockpit clutter, improve precision fire, and enable in-flight mission re-planning. The warfighter would greatly benefit from a mobile platform capable of communicating on multi-level security domains, leveraging any and all available transport media. The utility of EKB is dependent on a tablet device ability to operate at both unclassified and classified levels, within a loosely-defined and inconsistent connectivity model. Unclassified operation will be required for various administrative functions (Naval Air Training and Operating Procedures Standardization (NATOPS)/Naval Aviation Technical Information Product (NATIP)/Standard Operating Procedures (SOP), study, access to email, and routine mission planning); while the classified environment will be essential for tactical mission execution that includes but is not limited to ingestion of live data feeds, chat, tactical imagery, etc. The objective of this project is to design and develop a software-based solution to achieve unclassified and classified (definition for classified is Secret) personas on a single tablet. The development effort will have to address a major challenge, which will require a highly innovative approach to devise a software tool that is sufficiently "secure" to meet National Security Agency (NSA) requirements for highly classified communications. Proposers should consider the requirements of NSA’s Commercial Solutions for Classified (CSfC) program (see reference below). Further, the software-based solution should utilize a variety of transport media to send/receive data from/to the device when a network connection is present. The solution should address the need for predictable, timely execution of system commands. The software tool should utilize a smart algorithm/load balancer to analyze available connections and make the most efficient use of the bandwidth provided over each security level, based on network performance metrics, application priority, and others. For example, a shipboard environment may have a Satellite Communications (SATCOM) presence/Consolidated Afloat Networks and Enterprise Services (CANES) Wi-Fi, a Forward Operating Base may have SATCOM/cellular, and a training squadron may have cell/Wi-Fi/Navy Marine Corps Intranet (NMCI) hardwire. This approach would enable devices to receive, process, and display a variety of data types from existing networks, aircraft systems, and sensors. Data types to include standard Office documents, imagery files, e-mail, text, and voice traffic. A smart processing construct is critical to the success of this effort. Current solutions in this problem space fail to effectively leverage both internal system resources and external system interfaces. Internal resources (i.e. system memory, Central Processing Unit (CPU) cycles) are simply divided based on a predetermined split across various virtual machines. This structured methodology does not account for the dynamic reallocation of critical resources based on mission need. Further, current tablet technologies do not gracefully assess system interfaces and the bandwidth available across each of them. Standard bandwidth monitoring techniques are obtrusive, utilizing methods which further exacerbate the limited bandwidth problem.

PHASE I: Design and develop a software-based concept to achieve high assurance data isolation/compartmentalization via dynamic data identification.

PHASE II: Develop a prototype software tool with a path towards multi-level secure processing capability and certification. Preliminary testing of the prototype will be conducted with the inputs/artifacts provided by the government sponsor to support flight certification process. Demonstration of load/resource balancing across security levels is key. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE III: Integrate the software tool into EKB tablet to assure interoperability with existing EKB applications (list to be provided as needed) and conduct operational tests with mission representative datasets in simulated network environments. Collect performance metrics from developmental tests and refine smart processing algorithm(s) to optimize performance. All certification and accreditation artifacts will be provided for both information assurance and flight certification.

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1. Neff, T.L. (2013). It's Time to Tame the Tablet for the Enterprise Mobility, Innovation Insights. Retrieved from http://insights.wired.com/profiles/blogs/it-s-time-to-tame-the-tablet-for-enterprise-mobility#axzz3AHLX65Ug

2. Moriarity, J. (2013). Protecting Mobile Data Across Multiple Enterprise Platforms, Devices, Innovation Insights. Retrieved from http://insights.wired.com/profiles/blogs/protecting-mobile-data-across-multiple-platforms-devices-in-the#axzz3AHLX65Ug

3. Durbin, S. (August 2014). On the Horizon: 10 Threats to Information Security, Innovation Insights. Retrieved from http://insights.wired.com/profiles/blogs/on-the-horizon-10-threats-to-information-security#axzz3AHLX65Ug

4. National Security Agency. (2009). Secure Mobile Environment Portable Electronic Device (SME PED). Retrieved from http://www.nsa.gov/ia/news/2009/sme-ped.shtml

5. National Security Agency. (2014). Commercial Solutions for Classified Program. Retrieved from https://www.nsa.gov/ia/programs/csfc_program/index.shtml

KEYWORDS: Bandwidth; Communication; Tablet; Electronic Kneeboard (EKB); classified and unclassified processing; load balancer; smart processing

TPOC: (703)200-7851

2nd TPOC: (301)342-3782

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-088 TITLE: Infrared Search and Threat Identification

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: PMA 265 F-18 Aircraft Program Office Advanced Targeting Forward Looking Infrared (ATFLIR) Program

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Design a software application that can be used with an infrared (IR) sensor to identify a potential target threat by analyzing its infrared signature.

DESCRIPTION: A number of thermal imaging devices and sensor systems that are capable of tracking an IR signature exist in the fleet today; however, they do not have the capability to identify the threat level of the designated target. For example, the AN/AAQ-37 Distributed Aperture System (DAS) on the F-35 provides situational awareness, detection, and tracking but not threat identification. The Advanced Targeting Forward Looking Infrared (ATFLIR) on the F/A-18 provides long range target detection without threat identification. The capability to infer, from existing sensor IR imagery data, the identification and classification of high end airborne threats, is needed. This passive capability would be integrated into existing airborne sensors to allow for threat identification in emission controlled and emission denied tactical operational environments. The goal is to provide threat identification as a software application within the current sensor system such as the F-35 DAS or the F/A-18 ATFLIR. The capability needs to provide temporal discrimination of IR signatures and positive threat identification with a low false alarm rate. The solution must be supportable with the form, fit, and function of the target sensor with efforts to minimize space, weight, and power (SWAP) impacts for future compatibility. The government will provide SWAP requirements once the target sensor is selected.

PHASE I: Define and develop a concept for an IR threat identification capability. Compare innovative techniques in IR threat identification against existing techniques and quantify the performance differences. Formulate and prove feasibility of a concept for implementation using existing IR sensors technology and identify whether the proposed solution will require a hardware component. A limited, unclassified threat data set will be provided for application in concept development.

PHASE II: Produce prototype technology based on the concept developed in Phase I. Develop models and simulation techniques to show achievable performance. Demonstrate the functional technology and its performance in a controlled environment. Validate the selected technique and demonstrate advantages within the scope of specific IR threat data to be provided by the Government. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DSS and NAVAIR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material in accordance with DoD 5220.22-M during the advanced phases of this contract.

PHASE III: Transition the technology into a suitable candidate IR sensor system, identified by the Navy, and provide empirical evidence on the effectiveness of system threat identification. Transition the developed technology to the Fleet.

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1. Renuka, D. V. & Reddy, K. M. (2013). Infrared Background and Missiles Signature Survey, Defense Science Journal, 63(6). DOI : 10.14429/dsj.63.5762

2. Bhanu, B. & Jones, T. (1993). Image Understanding Research For Automatic Target Recognition, IEEE Aerospace and Electronic Systems, 8(10). Retrieved from http://www.vislab.ucr.edu/PUBLICATIONS/pubs/Journal%20and%20Conference%20Papers/before10-1-1997/Journals/1993/Imageunderstandingresearch93.pdf

3. Department of Defense. (2006). DoD 5220.22-M, National Industrial Security Program Operating Manual. Retrieved from http://www.fas.org/sgp/library/nispom/nispom2006.pdf

KEYWORDS: Imagery Processing; Threat Identification; Threat Detection; Infrared (IR); Thermal Imaging; infrared (IR) Temporal Analysis

TPOC: (301)757-0725

2nd TPOC: (301)757-0729

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-089 TITLE: High Peak Power 1.9 um Thulium-Doped Solid-State Lasers for Next-Generation Compact and Robust High Peak-Power Blue Lasers

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: PMA 264 Air AntiSubmarine Warfare Systems Sonobuoys and Sensors Systems Program

OBJECTIVE: Develop a compact, ruggedized and scalable high peak-power 1.9 um laser for use as a critical source and/or active optical element for airborne atmospheric and maritime-based laser imaging and ranging (LIDAR).

DESCRIPTION: A need exists for high pulse energy high repetition-rate lasers for LIDAR transmitters. LIDAR systems have been shown to be a powerful tool to remotely probe various oceanographic and atmospheric processes. Each system generally requires specialized transmitters at often hard to achieve wavelengths. Often the lasers available to hit these wavelengths are not suited for high peak-power operation. A Thulium and Holmium 2 um system, together, is ideally suited to cover this requirement. It has a large tuning range, and in combination with one or two frequency conversion steps, it can cover a large part of the electro-magnetic spectrum. Furthermore, the long-lived upper states required for energy storage can facilitate high pulse energy operation. There is even more compelling motivation for the Navy that is driving the development of this high peak-power 1.9 -um solid state laser. There has been a requirement for a high peak-power blue laser system solution to be operated in pulsed mode with high repetition rate for standoff oceanographic sensing applications. A combination of the intrinsic wide tuning range of Thulium and a two stage second-harmonic generation (SHG) can be utilized to generate light optimized for different ocean scenarios. The current state-of-the-art blue laser solutions with high peak-power capability usually incorporate complex, inefficient, and relatively bulky and heavy multiple-stage non-linear processes that require second or third harmonic generations and/or optical parametric oscillation approaches. These approaches often do not meet the stringent space, weight, power (SWaP) and performance and reliability requirements set forth by the Navy. Therefore, it is anticipated that frequency quadrupling of a compact high peak-power 1.9 um laser would potentially result in a blue laser with high peak-power with 50% reduction in size and weight, thereby circumventing many of the drawbacks of the more conventional approaches. NASA Langley Research Center has been actively pursuing coherent Doppler wind LIDAR development for 3-D winds measurement for the last fifteen years. The intensive research efforts have led to significant advancement of a 2 -um laser transmitter, and the NASA team has recently demonstrated a Holmium- (Ho) and Thulium- (Tm) doped solid state laser and amplifier at ~2um emission wavelength with 250 millijoules (mJ) per pulse at a pulse repetition rate of 10 Hz [1] and a Ho:YLF slab amplifier with 125 mJ at 350 Hz [2]. These are Holmium-based systems at wavelengths slightly longer than 2 um. For some Navy applications such as the aforementioned application in the blue spectral range, it is desirable to use wavelengths shorter than 1.9 um. To cover this desired wavelength range, further development of Tm-based solid-state lasers with high peak-power and repetition rate is needed. It is therefore the goal of this program to seek the development of a compact, ruggedized, high energy, high repetition rate, 1.9 um, Thulium laser that will meet the size, weight, power performance and reliability requirements stated in the following.

The performance objectives of the laser solution are:
1. High repetition rate -- Threshold: 200 Hz; Objective: 250 Hz.
2. High peak-power -- Threshold: 80 mJ per pulse with pulse width no more than 100 ns.
3. Wavelength -- Threshold: between 1.850 um and 1.960 um; Objective: 1.890 um.
4. Line width of less than or equal to 2 Angstroms.
5. Polarization -- single polarization >100:1.
6. Wall plug efficiency -- Threshold 10%; Objective 20%.
7. Laser beam quality M-squared less than 3.
8. Light weight. (Total weight including the laser head, cooling system, power supply, and control system) -- Threshold: less than 50 lbs; Objective: less than 35 lbs.
9. Small volume. (Total volume for the cooling system, power supply, control system and laser head) -- Threshold: less than 2 cubic feet; Objective: less than 1 cubic foot.
10. Electrical power requirement -- Threshold: less than 1.5 kW; Objective: less than 1 kW.
11. Ability to be ruggedized and packaged to withstand the shock, vibration, pressure, temperature, humidity, electrical power conditions, etc. encountered in a system built for airborne use.
12. Reliability: Mean time between equipment failure -- 300 operating hours.
13. No cryogenic cooling allowed.

PHASE I: Design and determine the feasibility of a viable robust 1.9 um solid-state laser system which meets or exceeds the requirements specified in the Description section. Identify technological and reliability challenges of the design approach, and propose viable risk mitigation strategies.

PHASE II: Design, fabricate, and deliver a laser system prototype based on the design from Phase I. Test and fully characterize the system prototype.

PHASE III: Finalize the design and fabricate a ruggedized laser system solution and assist to obtain certification for flight on a NAVAIR R&D aircraft. Identify transition partners and create a business plan that will provide a robust, compact and flexible LIDAR transmitter to the oceanographic and atmospheric sciences community.

REFERENCES:
1.   Singh, U. N., et al. (2010). "Advances in high-energy solid-state 2-micron laser transmitter development for ground and airborne wind and CO2 measurements." Remote Sensing. International Society for Optics and Photonics.

2. Strauss, H. J., et al. (2013). "330 mJ single-frequency Ho: YLF slab amplifier." Optics letters 38.7: 1022-1024.

KEYWORDS: Airborne; Asw; Lidar; Remote Sensing; High Power Laser; Thulium

TPOC: (760)939-0239

2nd TPOC: (301)995-2865

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-090 TITLE: Multi-Wavelength and Built-in Test Capable Local Area Network Node Packaging

TECHNOLOGY AREAS: Air Platform, Electronics

ACQUISITION PROGRAM: JSF-MS

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 5.4.c.(8) of the solicitation. 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 wavelength division multiplexed (WDM) optical network node capable of 10 Gbps operation and integrated built-in test (BIT).

DESCRIPTION: The Navy is interested in advancing built-in test (BIT) capable digital avionics single-mode wavelength division multiplexing (WDM) local area network (LAN) node technology. Combining integrated active and passive WDM components with planar light-wave circuits (PLCs), and integrated optical time domain reflectometry (OTDR) technology will create low cost, space, weight and power (SWAP) WDM packaging technology for Department of Defense (DoD) aviation platforms. Application of BIT capable WDM technology on DoD aviation platforms will enable a drastic increase in the aggregate transmission bandwidth and network node connectivity, reliability and maintainability relative to today's copper and single-wavelength fiber optic point-to-point link designs. Current fiber optic systems utilizing single wavelength point-to-point links limit the ability of the avionics designer to maximize network redundancy, reliability, and maintainability, while minimizing the number of onboard interconnects. This fundamental limitation of point-to-point fiber optic links for high speed digital data transmission points directly towards WDM technology as a viable solution. The inherent speed and latency advantages of optical communication in future designs trend toward ultra-high speed fiber optic WDM local area networking. The recent development of precision fiber optic component connection and OTDR application specific integrated circuit technologies and advancements in integration of ruggedized digital WDM active components and avionics WDM LAN topologies point toward an innovative research program to integrate the various components into functional packages for board level integration. It is expected that WDM LAN technology will be incorporated in future generation avionics architectures. In order to meet the needs of military avionics, the Navy is seeking innovative approaches for creating WDM LAN nodes based on hybrid-integrated BIT capable optoelectronic packages containing OTDR application-specific integrated circuit (ASIC), tunable laser, wavelength converter, fixed and tunable multiplexer/de-multiplexer, planar lightwave circuit (PLC), and advanced connection technology. Placing WDM LAN node components on a printed circuit board enables easy insertion within avionics weapons replaceable assemblies. This will advance technology readiness and thus eliminate apprehension on the part of avionics integrators to adopt

WDM LAN technology in next generation designs. Successful development could also result in significantly reduced WDM LAN component packaging cost. Final packaged solutions including all electronic interface circuitry shall meet the following SWAP requirements. Size: Package height shall be less than 8 mm Threshold / 5 mm Objective. Package footprint shall be less than 100 cm2 Threshold / 50 cm2 Objective. Mass: Package mass shall be less than 1000 grams Threshold / 500 grams Objective. Power: Package shall require less than 12 W of electrical power (including cooling if needed) to meet Phase II routing objectives.

PHASE I: Develop and demonstrate the feasibility of a hybrid-integrated WDM LAN node package. Simulate the in-package optical routing for ring, bus, star and mesh topologies, including the performance over expected optoelectronic package assembly tolerances. Include plan to meet SWAP requirements.

PHASE II: Develop a manufacturable prototype of the WDM LAN node package designed in Phase I. Demonstrate four optical input/outputs each supporting a minimum of 4 C-band 100 GHz spaced wavelengths per input and output port at a minimum of 10 gigabits per second per wavelength with a bit error rate no greater than 10E-12. Test both device components and the package over a -40 to +100 Celsius temperature range. Phase II has the potential to be classified, the contractor will need to be prepared for personnel and facility certification.

PHASE III: Increase manufacturing readiness and transition to manufacturing for avionics application for both Navy and commercial usage.

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4. C. Kuznia, et al. (2014) “Novel high-resolution OTDR technology for multi-Gbps transceivers,” Proc. Of OFC, pp. 1-3.

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KEYWORDS: Avionics; Wavelength Division Multiplexing; network node; advanced packaging; built-in test; Planar Lightwave Circuit

TPOC: (301)342-9115

2nd TPOC: (301)757-7124

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-091 TITLE: Advanced Non-Destructive System to Characterize Subsurface Residual Stresses in Turbo-machinery Components

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: JSF-Propulsion

OBJECTIVE: Develop a non-destructive inspection (NDI) system that provides quantitative measurements and tracking of subsurface residual stress at critical locations of turbo-machinery components of the propulsion system.

DESCRIPTION: Compressive surface treatments are frequently used in turbo-machine components to add a factor of safety to their component life. The residual stress (RS) profile that is imparted to metallic components can vary by application, service use, time, and environment. The US Navy is interested in non-destructively measuring the subsurface residual stress field in metallic engine components, specifically in titanium and Inconel® alloys. The current industry standard for measuring RS is x-ray diffraction (XRD) which is limited to measuring surface stresses. In order to measure subsurface stresses with XRD, the component must be destructively evaluated. Because of this, a subsurface stress for a production component is unable to be confirmed except for the few candidates used for quality assurance. Even when these candidates are analyzed, XRD-measured RS does not correlate well with the design model showing the difficulty in modeling subsurface stress. Extensive measurements of surface RS have been performed during recent years confirming that surface RS relaxes at critical locations of engine components with operational usage. These components are designed to initially have compressive RS at key locations; however, as the RS relaxes with usage, it may approach a tensile condition and the component no longer benefits from the intended factor of safety. An NDI system that provides quantitative, subsurface measurements of RS at critical locations of turbo-machinery components of the propulsion system is sought. Such technology will provide the ability to implement subsurface stresses to a design model, confirm that the design intent was met, as well as offer the ability to actively monitor the life remaining for a component due to operational stress relaxation. Critical components of concern include fans, disks, and blisks/integrally bladed rotors (IBR). Critical locations tend to be inside surfaces of bolt-holes, bores, slots and fillet radii.

In order to be a valuable design tool, the new NDI device must be capable of the following:

- Resolving stress within 10% of actual stress value (emphasis will be placed on method of validation);
- Resolving stress location within 10% of modeled local mesh size;
- Discerning stress values in each element of the model used to life the component;
- Results for stress magnitude and location should be repeatable to less than 10%, using ASTM F1469 as a guideline;
- Through component measurement for typical gas turbine engine components is desired. The ability to measure residual stress at depths customary to advanced surface treatments (~0.150 inches) is necessary. Components can be moved or manipulated to achieve this requirement;
- Measuring Titanium- or Inconel®-based alloys common to cold section components with ability to expand to other materials;
- Producing a favorable return on investment;
- And be safe for the user.

Attributes such as time per measurement, measurement environment and system size should be addressed. Time per measurement and system size should be minimized as much as possible while the measurement environment should be practical (e.g., humidity, component cleanliness, etc.) The ability to quantify the percentage of each grain orientation (e.g., 100, 111 planes) for cubic and hexagonal structures in a specific volume and discern the stress of a specific orientation is not required but would be encouraged. The desire for this solicitation is to develop a technology with the ability to measure subsurface stresses for use in component design, and the ability to be developed into a manufacturing quality control tool as well as a portable, field inspection device. Establishing a working relationship with relevant original engine manufacturer(s) (OEM), while not required, will greatly enhance probability of success.

PHASE I: Demonstrate feasibility and proof-of-concept of proposed NDI system capable of quantitatively, nondestructively and reliably measuring and tracking surface and subsurface RS at critical locations of turbo-machinery components. Provide preliminary design for a system.

PHASE II: Develop, produce, validate and implement a robust and rugged NDI RS measurement prototype system based on the results of Phase I. The prototype should be capable of obtaining the necessary subsurface RS data nondestructively and tracking it for comparative analyses during the life cycle of each individual component. Integrate the system to develop life management methodology and validate life management algorithms for application to be used on engine components. Provide detailed design for a system. Perform a demonstration of the developed NDI system.

PHASE III: Mature the system for field use by making the system robust, rugged and ensuring ease of use for the operator in both Navy and commercial applications. Perform any final testing and commercialize and transition the technology for field and Original Equipment Manufacturer usage.

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KEYWORDS: Residual Stress; non-destructive inspection (NDI); Gas Turbine Component Life Management; Residual Stress Mapping and Tracking; Advanced Surface Treatment Characterization; Stress Relaxation

TPOC: (301)757-0486

2nd TPOC: (301)757-0472

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-092 TITLE: Inducing Known, Controlled Flaws in Electron Beam Wire Fed Additive Manufactured Material for the Purpose of Creating Non-Destructive Inspection Standards

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: JSF-Air Vehicle

OBJECTIVE: Develop and demonstrate effective and reliable methods for inducing known and controlled flaws representative of porosity, lack of fusion, and solidification/shrinkage crack defects into electron beam-wire fed additive manufactured (EBAM) standards.

DESCRIPTION: Several military platforms are targeting EBAM for production of new, replacement, and repair components. Standard NDI methods are currently being applied to EBAM components, but significant capability gaps exist in inspections of component preforms thicker than approximately 3". Uncertainty remains around the probability of detection, minimum detectable flaw size, and resolution of non-destructive inspections (NDI) on typical flaws found in additive manufacturing (AM) materials. Improved standards are needed to down select and optimize specific NDI techniques (X-ray, computed tomography (CT), and ultrasound (UT)) for these components. Typical NDI standards for X-ray, CT, and UT inspection consist of a block of material fashioned to a representative shape and thickness to represent the component to be inspected. Representative flaws are introduced by drilling side-drilled and/or flat bottomed holes and/or burning electric discharge machining (EDM) notches into the standard. These flaws do not always adequately represent volumetric flaws within a component, particularly with methods such as CT. A novel method to induce known, controlled flaws in EBAM materials for production of improved NDI standards offers the promise of increased confidence and reliability in these inspections.

PHASE I: Determine and demonstrate feasibility to develop reliable and repeatable methods for inducing known, controlled flaws representative of porosity, lack of fusion, and cracking due to residual stresses in Ti-6Al-4V samples deposited by EBAM. Demonstrate the feasibility of applying at least one such approach by fabricating and inspecting coupon specimens.

PHASE II: Provide practical implementation of a production-scalable process to implement the recommended approach developed under Phase I. Evaluate the approach through the fabrication and evaluation of a sufficient quantity of NDI test coupons. Develop and fabricate an NDI standard using the recommended method utilizing relevant specifications as cited in the references and Government defined flaw geometries (minimum flaw size will nominally be 0.0500 in. +/- 0.0005 in.).

PHASE III: Transition the NDI standard manufacturing approach to military aircraft component fabricators and commercial industry which utilize EBAM for new, replacement, or repair components.

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2. ASTM International. ASTM E 2007: Standard Guide for Computed Radiography. Retrieved from http://www.astm.org/Standards/E2007.htm.

3. ASTM International. ASTM E 1441: Standard Guide for Computed Tomography (CT) Imaging. Retrieved from http://www.astm.org/Standards/E1441.htm.

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KEYWORDS: Additive Manufacturing; X-ray; Computed Tomography; Ultrasound; Standards; non-destructive inspection (NDI)

TPOC: (904)790-6420

2nd TPOC: (904)790-6410

3rd TPOC: (904)790-6424

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-093 TITLE: Innovative, High-Energy, High Power, Light-Weight Battery Storage Systems Based on Li-air, Li-sulfur (Li-S) Chemistries

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles, Weapons

ACQUISITION PROGRAM: PMA 234 Airborne Electronic Attack and Next Generation Jammer

OBJECTIVE: Develop and demonstrate reliable Lithium-air (Li-air) and Lithium-sulfur (Li-S) battery technologies that have the potential for high energy, power density, and cycle life for Naval aircraft applications.

DESCRIPTION: As the Navy modernizes its Fleet, the energy needs of naval aircraft are increasing significantly. Meeting the energy demands of these aircraft is a formidable challenge which requires looking beyond current Lithium-ion (Li-ion) batteries. The state-of-the-art Li-ion cells have a theoretical specific energy of 387 Wh/kg (watt hour/kilogram) and energy density of about 1015 Wh/L (volumetric energy density), respectively. The specific energy of the Li-ion cells are attractive because, in comparison to nickel-cadmium and lead-acid batteries, Li-ion batteries offer significant advantages – decreased weight (~1/3) and increased capacity (~3X). The decrease in weight would result in cost savings due to lower fuel consumption during flight or the ability to increase payload, which increases mission capability. Li-air and Li-S are two emerging chemistries that can meet such energy demands. There are two types of rechargeable Li-air batteries undergoing research, namely, non-aqueous and aqueous systems. The theoretical specific energy for the non-aqueous system (organic electrolyte based) is 3505 Wh/kg and the theoretical energy density is about 3436 Wh/L, which are about ten times greater than the Li-ion cells. The corresponding parameters for the aqueous systems are 3582 Wh/kg and 2234 Wh/L, respectively, which are also approximately ten times greater than the Li-ion cells [1]. The Li-sulfur cells have a theoretical specific energy of 2567 Wh/kg with a theoretical energy density of 2200 Wh/L. Each component of the non-aqueous Li-air battery faces unique technical challenges. For example, dendrite formation on the Li metal anode raises safety concerns that impact the capacity retention of the cell and contribute to voltage gap during cycling process. One of the challenges for the aqueous type Li-air is the requirement of a Li-ion conducting membrane to protect the Li metal. The polysulphide solubility is a concern for the Li-S batteries [1-3]. These challenges lead to low specific energy and poor cycling efficiency for the current Li-air and Li-sulfur systems. Combinations of material innovations and advancement in obtaining stable interfaces are key to solving such challenges. Disruptive new Li-air and Li-S concepts have the potential to increase cycle life, round trip efficiency, and power density from their current levels which are critical to the development of reliable next-generation battery chemistry technologies. The purpose of the topic is to develop 28V (Volt) DC (Direct Current) / 270 VDC electrical energy storage devices based on emerging chemistries such as Li-air and Li-S. The offerors must demonstrate the minimum specific energy for Li-air cells in the range of 600-1000 Wh/kg or higher (at least 3X higher than Li-ion cells) or in the range 400 – 800 Wh/kg for Li-S cells. The offerors must propose innovative approaches to overcome the challenges mentioned above to achieve the defined threshold values with the goal of approaching theoretical energy density as objective values. The battery system to be developed (28V / 270V DC) must be stable under aircraft operational, environmental, electrical, and safety requirements governed by applicable government documents [4-5]. The requirements include, but are not limited to, sustained operation over a wide temperature range from -40 deg (degrees) C (Celsius) to +71 deg C, including exposure to +85 deg C and the ability to withstand carrier based shock and vibration loads, altitude range up to 65,000 ft (feet), per MIL-STD-810G [6], and electromagnetic interference of up to 200 V/m (Volts Per Meter), per MIL-STD-461F [7]. Proposed innovative pathways must meet additional requirements of low self-discharge (< 5%

per month), good cycle life (> 2000 cycles at 100% Depth of discharge (DOD)), and long calendar life (4-7 years' service life) at cell level (threshold) and at battery product level (objective). The diagnostic/prognostic capabilities of the system that will lead to developing a safer, reduced total ownership cost functional product should also be addressed.

PHASE I: Design and develop an innovative concept to address low specific energy and low cycle life and demonstrate the feasibility of Li-air and or Li-S battery at full-cell level. Perform critical safety and electrical performance evaluations of Li-air and/or Li-sulfur batteries.

PHASE II: Develop a prototype and demonstrate the functionality of a Li-air and/or Li-S battery over a wide-temperature range, under select harsh environmental, storage, and cycling conditions. In addition, initiate the scale-up and design processes and develop preliminary cost structure.

PHASE III: The functional aircraft-worthy prototype battery product should be developed with performance specifications satisfying targeted acquisition requirements coordinated with Navy technical point of contacts. Complete testing per military performance specifications and transition to appropriate platforms (Ex. F/A-18E/F, F-35 etc.). Commercialize the Li-air, Li-S battery technology and leverage the advantages of scalable manufacturing process to develop a cost-effective manufacturing process for technology transition to various system integrations for both DOD and civilian applications.

REFERENCES:
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6. MIL-STD-810G - Department of Defense Test Method Standard: Environmental Engineering Considerations Laboratory Tests (31 Oct 2008). Retrieved from http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G_12306/.

7. MIL_PRF-461F – Department of Defense Interface Standard: Requirements For the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment (10 Dec 2007). Retrieved from http://everyspec.com/MIL-STD/MIL-STD-0300-0499/MIL-STD-461F_19035/.

KEYWORDS: Battery; Lithium; Aqueous and non-aqueous; Safety; Lithium-air (Li-air); Lithium-sulfur (Li-S) batteries

TPOC: (301)342-0365

2nd TPOC: (301)995-4559

3rd TPOC: (301)342-0816

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-094 TITLE: Model-Based Tool for the Automatic Validation of Rotorcraft Regime Recognition Algorithms

TECHNOLOGY AREAS: Air Platform, Information Systems

ACQUISITION PROGRAM: PMA 299 H-60 Aircraft Program Office

OBJECTIVE: Develop a model-based tool and test kit that will validate rotorcraft-based regime recognition (RR) codes for effective integration into health and usage monitoring systems (HUMS).

DESCRIPTION: Due to practical, technical, and logistical limitations associated with achieving direct loads monitoring for every fatigue sensitive component on an aircraft, the Navy is relying on flight maneuver recognition to provide usage data across a fleet of aircraft in order to refine fatigue life calculations. However, current RR tools have trouble accurately and precisely recognizing flight regimes. These existing RR tools are based off of empirical or rule-based systems. They are derived from actual flight tests, which makes them vehicle-, load out-, weather-, and pilot- dependent. In addition, their development is costly and time-consuming, since each air vehicle system and maneuver type must be individually flight tested and verified against the RR code. As a result, RR codes do not have the accuracy required for fleet usage in HUMS. It is therefore important to verify that future RR codes for use in rotorcraft applications correctly represent as many flight conditions as possible. In order to ensure the fitness of RR tools, per ADS-79D-HDBK, new RR codes require an independent verification and validation (IV&V) effort. Current verification of RR tools is performed by manually comparing the input of physical flight test data to the RR tool's output. This process is often labor intensive and error prone. Without an automatic and standardized way of comparing codes, selecting the 'best' code can be a subjective process. Automating the validation process would not only expedite the process considerably, it would also allow for the quantitative comparison of RR codes. The use of physics-based simulation to recreate a set of validation test flights can reduce flight test costs and streamline the RR validation process. Despite their present shortcomings, an effective RR code would be invaluable for tracking fatigue damage to parts through the accurate detection and measurement of flight regimes experienced by a rotorcraft. RR schemes have many other possible benefits to rotorcraft operations, including updating service usage spectrums, as well as component damage tracking. These improvements could drastically reduce unscheduled maintenance and downtime. An automated validation tool which leverages physics-based simulation that will provide validation of RR codes, be fast, simple to use, and provide feedback on the accuracy of the RR tool's identification of regimes is sought. This validation tool should be able to identify codes that capture at least 97 percent of maneuvers, or sufficient maneuvers in order to not under-predict the fatigue damage fraction of life-limited parts by more than 0.5 percent. The tool should alert users to inconsistencies between the outputs of the RR code and the performed maneuvers. The validation tool should use scripted HUMS flights on instrumented aircraft.

PHASE I: Design and develop a model/concept for a physics-based tool for the automatic validation of rotorcraft RR software. Demonstrate the feasibility of the approach.

PHASE II: Provide practical implementation of the methodology developed in Phase I and incorporate it into a prototype tool which includes a suitable graphical user interface (GUI). The prototype tool must be able to analyze RR code for a specific rotorcraft platform and mission load out. Improve the accuracy, robustness, and speed of the tool to help spur the development of more robust RR codes. Demonstrate the developed prototype tool with scripted HUMS flights on instrumented aircraft and eventually streaming data from a flight simulator.

PHASE III: Transition and integrate the validation tool into a software package for use with RR code outputs obtained from actual flight data from onboard a Navy/Marine helicopter. Perform field testing to demonstrate the robustness of the system when dealing with real flight data. Expand the tool to be able to analyze code for actual production platforms (e.g. H-53E/K, H-60R/S, and H-1) and different load outs for each required platform, as well as for use in commercial establishments. Evaluate qualification test results and provide procurement specification for transition to an actual production platform.

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KEYWORDS: Regime Recognition; Flight Simulators; Flight Test; Health and Usage Monitoring Systems (HUMS); independent verification and validation (IV&V); Model-Based

TPOC: (301)704-4869

2nd TPOC: (301)342-8396

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-095 TITLE: Ultra-High Temperature (UHT) Sensor Technology for Application in the Austere Environment of Gas Turbine Engines

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: Joint Strike Fighter-Prop

OBJECTIVE: Develop an in-situ engine sensor system capable of operating, uncooled, in a temperature regime upwards of 2500°F in an environment featuring high speed flow and abrasive material with the capability to observe rotating component vibration and clearance.

DESCRIPTION: Current blade health monitoring sensors are capable of operating at 1100°F continuously uncooled, and have been demonstrated to work up to 1800°F with cooling. Use of compressor air for sensor cooling would adversely impact the cycle efficiency and potentially produce case distortion, and hence, a need exists to develop uncooled sensors that can operate in a +2500°F environment in the aft end of the turbo machinery. Design progression also alludes to a high-temperature need in the compression system. Current developmental and future engines for Department of Defense (DoD) propulsion systems will need to operate at high efficiencies to meet the mission-weighted fuel burn (MWFB) requirements. This means that engines operate with tighter running clearances, increased blade loading and at substantially higher temperatures. As these designs have matured, high cycle fatigue (HCF) failures have become a more common problem. Engine structural integrity program (ENSIP) criteria (MIL-HDBK-1783B, A.4.13.3) was modified to state that components shall have a minimum HCF life of 10^9 cycles (up from 10^7) and must be designed to 40% of the endurance limit (down from 60%); however, these contemporary design standards are still lacking in their ability to mitigate HCF failures. As a result, broader design margins are required to mitigate safety risks. Mission requirements for enhanced propulsion system performance and reduced fuel burn present significant design challenges for original engine manufacturers (OEM's). An effective method to increase performance, while decreasing weight and specific fuel consumption (SFC), is to dramatically increase compression ratio and use fewer, more efficient stages. These increased compression ratios directly translate to increased temperatures which exacerbate the HCF issues. There is a need to understand the temperature environment in which these airfoils operate to better assess the impact to dwindling HCF margins due to thermal effects on fatigue and endurance capabilities. Current developmental and future engines are expected to see increased creep incidents due to rising engine stresses and temperatures. With larger stresses present inside engines, creep can occur at lower temperatures (cold creep) and may appear more prevalent in the cold sections of engines, although creep has traditionally been classified as a hot section issue. There exists a need to understand the impact of degradation mechanisms such as HCF, cold creep and others on material capabilities during engine operation. Important aspects of a sensor system for this environment to consider are footprint, overall ruggedness, and practicality of system-engine interface. An onboard diagnostic system must be of compact geometry and maintain a minimum weight. Should a system utilize line of sight probes requiring ports through the engine casing, said ports should also be minimized in size and number. An onboard system will be subjected to engine vibration, debris in gas path and possible perturbations from bypass air (on a turbofan engine). The vibration experienced by the engine case and the rotor is not necessarily in unison so the system must be able to discern blade vibration due to foreign or domestic object damage (FOD or DOD) or HCF from other vibratory noise such as that from relative motion between case and rotor. Ideally, the system must be structurally ruggedized to withstand the vibrations and loads of an operating aircraft, debris that may be in the flow path and the high-speed airflow. Currently we work with probes that are 1/2 to 1/4 inches in diameter, and just over 1 inch in length. There is no current upper bound on weight, however one must consider that weight is a premium in aircraft design and the more light-weight a design is the more attractive it is as a solution. These probes penetrate engine cases and today we would like to see innovation in decreasing these penetrant sizes. Of course, an innovative design proposal that challenges our concepts of probe construction and functionality is welcomed. It is highly recommended, though not required, that the collaboration with original equipment manufacturers be maintained throughout this development.

PHASE I: Design and demonstrate the feasibility of an UHT in-situ engine sensor system at temperatures in the region of 2500°F and as cited in the Description section. Proof of concept demonstrating the system's ability to identify and report airfoil high cycle fatigue and FOD/DOD events in real time, at elevated temperatures, is necessary. Operating in austere engine environments should be given serious consideration in this phase.

PHASE II: Based on Phase I effort, further develop and test in-situ engine sensor system prototype. Rig testing should be conducted to elevate technology readiness level (TRL) to an appropriate level for a representative demonstration (a minimum TRL level of 4 is expected). The system should ultimately demonstrate robustness in design and function for successful operation in a representative environment. Conceptual design for the final system configuration should also be completed.

PHASE III: Ruggedize the design and perform required operational testing. Commercialize and transition the developed technology to appropriate Navy platforms.

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KEYWORDS: Sensors; Ultra-High Temperature; Non-Intrusive Stress Measuring System (NSMS); Domestic Object Debris/Damage (DOD); High Cycle

TPOC: (301)342-3233

2nd TPOC: (301)757-0486

3rd TPOC: (301)757-0472

Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-096 TITLE: Miniaturized, Fault Tolerant Decentralized Mission Processing Architecture for Next Generation Rotorcraft Avionics Environment

TECHNOLOGY AREAS: Air Platform, Information Systems, Electronics

ACQUISITION PROGRAM: PMA 275 V22 Osprey Program and PMA 276 H-1 Helicopter Program

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 5.4.c.(8) of the solicitation. 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 decentralized mission processing architecture/system capable of distributed processing amongst multiple fully capable mission computer nodes with a higher degree of fault tolerance/reliability allowing for at least a designation of Mission Critical with an objective of Flight Critical level of reliability operating in conformance with the Future Airborne Computing Environment (FACE) standard.

DESCRIPTION: Most avionics systems for rotorcraft currently rely on a federated mission computer/processing architecture which centralizes the aggregation of data for processing and subsequent Human Machine Interface (HMI)/subsystem transmission. Current Rotocraft Federated architecture habitually claims redundancy by having a secondary processing computer that is either fully capable, or has a reduced situational awareness (S/A) capability giving the operators a 'fly home' mode upon failure of the primary processing unit. This architecture has resulted in development of high cost mission computers, $200K-$400K/unit, requiring multi-million dollar investments by the government. This centralized processing system worked in the past as power usage was lower; however, newer systems using commercial off the shelf (COTs)/government off the shelf (GOTs) processing boards in a 3U and 6U format are high speed/high power creating the need for heat rejection >200W for a relatively small surface area which is expected to increase as more video intensive processing is introduced with the Digital Terrain Elevation Data (DTED) II/III based tracking and digital map systems. As part of this effort, an evaluation of the integration of COTs/GOTs systems vs custom design needs to be investigated to optimize the processing profile. This system should be fault tolerant, capable of losing up to 50% of the processing nodes while maintaining full situational awareness (S/A) across 4 Extended Graphics Array/High Definition (XGA/HD) (720 and 1080p) displays, processing map, digital video and A/C sensors. Additionally it should have a singular nodal processing system of at least 3 nodes with a documented expandability limit, a unit cost 20% or less of existing mission computers which cost $200,000 - $300,000. Another systems integration based point to consider is that the majority of aircraft avionics systems are designed for a 1553B daisy chain architecture for digital data transfer. New, higher speed systems rely more on a hub/spoke architecture with designated relay points (i.e., Ethernet) which drive physical integration issues based on the eight (8) wires necessary for connection between each node vs two (2) wires for legacy wired communications systems, i.e., 1553 and serial. Modular Open Systems Architecture (MOSA) and the Future Airborne Computing Environment (FACE) will be required for the majority of Avionics components in the future. While a MOSA computing environment should be achievable, there has been some debate about the ability to utilize an abstraction layer and maintain a true Real-Time processing environment. This issue should be addressed in the design of this system, identifying roadblocks to full FACE conformance and potential mitigations. This architecture could be utilized as a host architecture/framework for next generation Jet Engine controls, serving as the enabling functions for a dynamic distributed controls system if a the flight critical level of reliability and signal integrity is achieved during this effort.

PHASE I: Determine the technical feasibility of distributed avionics architecture, identifying any technological breakthroughs necessary to meet the high-uptime system requirements and distributed processing stability.

PHASE II: Produce a prototype mission processing architecture validating the proposed design from Phase I that is capable of being certified for flight. The actual certification process need not be completed for this phase but a high degree of confidence that the hardware qualification required for a Safety of Flight or Mission Critical System will be achieved. Demonstrate full functionality, automatically without operator intervention, when one of the nodes is disabled.

PHASE III: Produce a set of Production Representative Units PRU's (pre Low Rate Initial Production LRIP units) for retrofit integration into an AH-1Z utilizing the existing monolithic software running on an existing rotorcraft platform demonstrating the ability to process the existing software in at least three separate, fully redundant nodes. Commercial applications, such as the automotive and manufacturing industry, will also be continued to be developed.

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1. Bieber, P., Boniol, F. (May 2012). New Challenges for Future Avionic Architectures, Aerospacelab Journal Issue 4, AL04-11.

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3. Jakovljevic, M. (Oct 2013). 2nd generation IMA: Extended virtualization capabilities for optimized architectures, 2013 IEEE/AIAA 32nd DASC.

KEYWORDS: Avionics; Mission Computer; Mission Processing; Architecture; engine controller; RTOS

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-097 TITLE: Low Emissions Waste to Energy Disposal

TECHNOLOGY AREAS: Materials/Processes, Human Systems

ACQUISITION PROGRAM: NAVFAC Directed Energy and Navy Expeditionary Combat Command

OBJECTIVE: Develop new waste to energy incinerator system with the goal of achieving net zero consumption of energy in disposal of waste while meeting air quality standards and reducing fuel consumption.

DESCRIPTION: Island bases and other remote forward operating bases (FOB) have limited land and energy resources to dispose of municipal solid waste (MSW). Open air pits are discouraged and congressionally required to be nearly-eliminated. Due to the high volume of generated MSW and limited amount of real-estate, landfills and bio-digestive approaches are impractical. Incinerators currently being used require expensive, complex scrubbers in order to meet air quality standards. Existing incinerators in use also consume excessive amounts of fuel (diesel or JP8) and require waste characterization and sorting to ensure proper operation. On island bases and other remote FOB's, fuel is costly to import - not only in monetary value, but manpower and lives as well. Current DoD waste disposal practices for contingency bases involves trucking away waste or bringing in additional fuel to burn the waste, which adds to the transportation burden and increases risk to personnel. An Army Environmental Policy Institute (AEPI) study reported than a soldier or civilian was wounded or killed for every 24 fuel resupply convoys in Afghanistan during FY 2007 [2]. Thermal approaches to MSW disposal are sought that would generate energy in the form of a fuel, useful thermal energy, or electrical energy. The goal is to achieve net zero consumption of energy in the disposal of MSW, while meeting air quality standards (see Ref 6). However as a minimum the results of this project must show quantifiable improvement in energy consumption. The new incinerator system must be simple to operate and maintain in all climate conditions. The system must be able to be setup and operational within 24hrs. Fuel or energy generation must be produced within 24 hours of operation. Typical thermal approaches that may be considered in developing the incinerator system include but are not limited to: combustion, gasification, pyrolysis, and thermal depolymerization. Plasma arc gasification concepts should address energy intensity of the process, include simplicity and robustness of the hardware to be used. Bio-approaches are not ideal, but will be considered. Any bio or chemical system must be robust and capable of functioning in all global climate conditions. GENERAL SPECIFICATIONS: The proposed incinerator system, when developed into a working system, should meet the following logistics foot print and capacity: For transportability to remote island bases or FOB, as well as ease of assembly, the system should be contained in TRICON size containers that can be reassembled and dismantled like modular building blocks. Each TRICON must weigh not more than 10,000 lbs, the maximum capacity of the material handling equipment within the Naval Mobile Construction Battalion's Table of Allowance. The system should be contained in no more than eight TRICON containers. The proposed incinerator system should be able to deliver at least a 95% reduction in volume of waste, be flexible in handling solid waste to include food, waste oil, and damp wood or vegetation. The system should be able to handle at least 1200lbs of waste a day and be able to be operated with a minimum of two personnel. Effluents and any char from the process needs to be environmentally safe for easy disposal. The system must be able to be setup and operational within 24hrs. Fuel or energy generation must be produced within 24 hours of operation.

PHASE I: Determine feasibility of developing a portable incinerator system capable of MSW disposal with the goal of achieving net zero energy consumption while meeting air quality standards. Provide simulation and design plans for fabrication of working prototype waste disposal incinerator system. Laboratory scale demonstration would be desirable but not required as a Phase I deliverable.

PHASE II: Fabricate and demonstrate a fully functioning incinerator system prototype with measurable energy consumption improvement. The measurable improvement should be close to or at the goal of net zero energy consumption. Air quality measurement will be tested to quantify emissions. Prototype system should be delivered, sized and fitted into TRICON containers, meeting specifications as discussed in the Description section.

PHASE III: Based on the results of Phase II, the small business will manufacture an incinerator system with measurable energy consumption improvement close to or at the goal of net zero energy consumption and transition the system for Navy use in an operationally relevant environment. The small business will support the Navy with testing and validation of the system to certify and qualify it for Navy use. A system capable of handling a small 150 man camp will be field tested and evaluated. Standard MSW will be consumed with targeted >95% reduction in volume. Portability and ease of setup will be evaluated. The primary application will be fixed facilities at remote Naval locations. Simple system operation and maintenance will also be considered in evaluating possible wider DoD implementation.

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KEYWORDS: Waste to Energy, incinerator, trash, disposal, green energy, emissions, EPA, alternative energy, plasma, gasification, pyrolysis

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N152-098 TITLE: Modular Smart Micro/Nano-Grid Power Management System

TECHNOLOGY AREAS: Information Systems, Electronics

ACQUISITION PROGRAM: NAVFAC Directed Energy

OBJECTIVE: Develop technology that simplifies implementation of microgrids. A modular, turnkey microgrid in a box solution is sought that would reduce cost and is universal and expandable to most facilities equipment, while ensuring cybersecurity of the base power grid.

DESCRIPTION: Microgrids are being considered at DoD installations to better manage energy usage, with the objective of providing better efficiency, reliability, and higher integration of renewable generation such as wind and solar. While the benefits of microgrids are broadly touted, implementation has been slow and complex. A turnkey modular micro/nano-grid controller design is sought, that would expedite test and validation of the benefits provided by a microgrid in actual facilities test platforms. A modular approach would also result in standardization and high volume such that economy of scale and better reliability could be achieved than low volume production. The envisioned power controller would be analogous to a network router, be modular and expandable such that each controller shall be able to communicate with one another in a mesh-type network with cyber security features. Each power controller would be plug-and-play such that standard types of power generators such as PV and DC battery backup, grid connection, and loads can be detected and managed with minimal configuration. A modular approach would mean that the capacity of each controller may be small with a few controlling the power on a building but in sufficient aggregate the mesh of controllers would be able to manage a large base. Power would be transferred between buildings through existing power distribution lines. This would require integrated medium voltage solid state transformers in the power controller. Proposals should focus on hardware design, cyber security, and networking functionality of the concept in order to achieve desired results.

PHASE I: Phase I should address hardware, cyber security, and mesh network algorithms. Determine feasibility and develop a concept for a solid state power converter capable of bidirectional power conversion with connection directly to the distribution line (4kV-7.5kV). The hardware should meet safety requirements for connection to the utility grid at medium voltage and be islandable. Cyber security solutions should address implementation of metering and controls that meet DoD Information Assurance Certification Approval Process. Also identify a design and concept for a modular hardware architecture to house the controls that would be universal and compatible with third party microgrid converters. Approaches for mesh network algorithms should be developed and simulation of aggregate functionality performed to demonstrate feasibility of intelligently managing load and generation across a base using 30kW modular controllers on each building.

PHASE II: Develop and Integrate hardware, software, and cyber security Modular Smart Microgrid Power Management System prototype into an existing base power grid. Prototype hardware delivered will include a microgrid controller with networking capability, integrated cybersecurity features, and 4 ports for grid connection, PV generation, DC battery backup, and 120VAC loads. The hardware shall be tested and validated for capability to connect to medium range distribution voltages.

PHASE III: Conduct full scale operational demonstration of micro-grid capability using modular controllers in a mesh-network between several buildings through existing distribution lines. Assist the Navy sponsor in transitioning a final design functioning Modular Smart Microgrid Power Management System into designated base power grids.

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3. Rick Thompson, “The Networked Grid: Can Solid-State Transformers Shape the Future of the Grid?” 2011. https://www.greentechmedia.com/articles/print/the-networked-grid-can-solid-state-transformers-shape-the-future-of-the-gri

4. Maryam Sadeghi, Majid Gholami, “Neural Predictive Model Control for Intelligent Universal Transformers in Advanced Distribution Automation of Tomorrow”, Recent Researches in Applications of Electrical and Computer Engineering, 2012. http://www.wseas.us/e-library/conferences/2012/Vouliagmeni/ACA/ACA-05.pdf

KEYWORDS: Microgrid, energy efficiency, renewable energy, power management, distributed generation, green energy, energy storage, electric vehicle

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N152-099 TITLE: Cooled BusWork for Shipboard Distribution and Energy Storage

TECHNOLOGY AREAS: Electronics, Weapons

ACQUISITION PROGRAM: PMS 320, Electric Ships Office; POM-15 Multi-function Energy Storage Module

OBJECTIVE: Develop an innovative modular bus bar cooling system for energy storage with high rate heat removal that leverages the thermal mass and conductivity of bussing systems.

DESCRIPTION: Improvements in the manufacturing of power density, power quality, and efficiency in power and energy management and control are needed by the Navy to meet power and energy demands and allow for future mission growth. The Navy is seeking to foster the development of common, affordable electrical components and systems that could have broad application to ships. Electrochemical storage (battery) cells have designs which do not lend themselves to effective thermal management. For planar and cylindrical cells, the axes which offer the maximum surface area are those which offer the greatest thermal resistance. This is due to the nature of the design, which is effectively a layered structure of polymer, metal and some thin chemical coatings, all wetted in an organic electrolyte. Developing a cooling system at the in-plane direction of the conductors may result in better thermal regulation from the use of tab and bussing connections, as well as vents, sensors, and others which are often tied to the cell-ends, particularly by leveraging thermal regulation internal to the cells under high rate transient conditions (ref #1). Cooling of the out-of-plane surfaces would likely still be used in combination with the innovative new system. The objective of this effort is to optimize use of the busbar for cooling, given its intimate contact with the conductors internal to the cell, as well as its mass and necessity to be routed throughout battery modules for electrical conductivity (ref #2). Typically, batteries are electrically connected to one another through busbars or similar buswork. And, typically, the main purpose of the busbars is to conduct current with minimal resistance. However, in this work, an advanced busbar for innovative thermal control and enhanced electrical performance is desired. The system will have to include the capability to circulate a cooling medium for optimized thermal control. Buswork developed should allow for integration on any battery module, thus the technologies proposed should be scalable from small 10Ah type cells through 60+Ah large format cell designs. Proposed approaches can be passively or actively operational and must consider the flow of cooling media and electrons in terms of media selection, system continuity, and failure modes. Technologies developed for this specific application will also be explored for applicability to electric power distribution buswork, such as those used in switchboards. Technologies proposed under this effort should not contain precious or hazardous materials, nor require significant deviation from a typical battery system design (such as cells placed in a geometric array and connected in series). It is optimal for these devices to operate such that chilled water is not required, though glycol/water mixtures can be assumed to be available at 40 degrees C, with sufficient flow available to meet mission needs. Ambient spaces should be assumed to be up to 60 degrees C and battery maximum operational temperatures should also be assumed to be 60 degrees C. In order to maintain density of the energy storage devices, the proposed approaches should not increase the cell length over 50% beyond the commonly accepted value for bussing for a specific ampacity associated with the cell’s maximum rating. If a special cooling fluid is to be utilized, the interface to shipboard cooling fluid should be considered, along with the impact on efficiency and device/system density and packaging size. The end intent is to utilize this design as part of a tightly-packaged battery system, complete with thermal management, monitoring, fire suppression and requisite safety devices; the innovative approach proposed under this solicitation would serve as the connectivity between cells in battery modules of different sizes and ratings.

Proposed buswork concepts should meet the following thresholds:

- Deliverable Design Characteristics Value
- Chemistry Li-ion
- Cell Capacity: 20-30Ah, scalable
- Cell Form Factor: Cylindrical or Prismatic (pouch or hard cell)
- Cell Case Polarity: Case positive, neutral or negative
- Operational Rate: Continuous >15 C-rate
- Design: Modular; combine in series via rack mount to obtain system interface
- Module Packaging: Metal or Polymeric Exterior

- Module Voltage: =48 VDC
- System Voltage: =1000 VDC
- Voltage Isolation: >2000 VDC
- Ambient Conditions: 0-60°C air
- Coolant Media: 0-35°C Seawater and/or 5-40°Coolant (50/50 Propylene Glycol/Water)
- Volumetric Penalty: =50% larger than appropriate copper busbar
- Management: Battery Monitoring System (BMS) capable of temperature and voltage cut-out
- Isolation: Contractor and Fuse
- Safety Process: NAVSEAINST 9310
- Shock*: MIL-S-901D
- Vibration*: MIL-STD-167-1A
- Transportability*: MIL-STD-810G

* = Design to this attribute

PHASE I: The company will demonstrate the feasibility of the concept in meeting Navy needs for an innovative modular bus bar cooling system and will establish that the concept can be feasibly developed into a useful product for the Navy. The company will prove the concept of external, axial heat transfer in-plane with the current flow and identify performance advantages. Proof of concept will be demonstrated on a small cell or cells, which can be cycled in a manner suitable to create sufficient internal heating, and compared to a control approach. The proof of concept should also be demonstrated on cycling cells or integrated into a battery versus a control of the same design.

PHASE II: Based on the results of Phase I effort, the small business will develop a Phase II prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in Phase II Statement of Work (SoW) and the Navy need for improved thermal management, in this case, via an innovative modular bus bar cooling system for energy storage with high rate heat removal that leverages the thermal mass and conductivity of bussing systems. The company will demonstrate the cooling device to support an arrangement of cells at the 48V module level. The prototype design should provide no less than 10Ah (threshold), 30Ah (objective), and should show applicability to be utilized with various cell geometries and battery architectures. The company will deliver a minimum of five of these prototypes to the Navy for evaluation. The Company will perform detailed analysis to ensure materials are rugged and appropriate for Navy application. Environmental, shock, and vibration analysis will also be performed.

PHASE III: The company will apply the knowledge gained in Phase II to build an advanced module, suitably packaged with 1000VDC strings of cooled batteries, including battery management system, and characterize its performance at high discharge rates as defined by Navy requirements. Working with the Navy and applicable Industry partners, demonstrate application with the bus bar cooling system to be implemented within shipboard and/or land-based test site to support energy storage or other applications. The company will support the Navy for test and validation to certify and qualify the system for Navy use. The company shall explore the potential to transfer the bus bar cooling system to other military and commercial systems (electric grid, electric vehicles). Market research and analysis shall identify the most promising technology areas and the company shall develop manufacturing plans to facilitate a smooth transition to the Navy.

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year 2014, pp. 298 – 304. www.uta.edu/faculty/jaina/MTL/pubs/Drake-JPS2014.pdf, Retrieved 5 November 2014

KEYWORDS: Thermal management of electrochemical storage systems; Battery; busbar; battery cooling; battery heat removal; energy storage

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N152-100 TITLE: Navy Air Cushion Vehicles (ACVs) Lift Fan Impeller Optimization

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: PMS 377- Ship-to-Shore Connector Program

OBJECTIVE: Develop an advanced landing craft lift fan with increased airflow, performance, fuel efficiency, and noise reduction.

DESCRIPTION: The Ship-to-Shore Connector (SSC), a replacement hovercraft for the existing fleet of Landing Craft, Air Cushion (LCAC) vehicles, utilizes a lift fan system to discharge air into the craft's skirt and bow thrusters to lift the hovercraft under normal operation. Each SSC utilizes two identical lift fans which are defined by an impeller and a volute assembly. Each lift fan impeller includes a center disk, blades which are attached to both sides of the center disk, and two outer shrouds. Lift fan impeller blades are removable and replaceable without requiring the disassembly of the lift fan system. There is no commercial hovercraft of this scale and payload capacity. The current SSC lift fans meet craft performance requirements, but the SSC Program Office seeks the development of an advanced lift fan that increases fan efficiency by at least 10% while achieving minimal noise levels (125 db or less). Improvements in fan efficiency will increase fuel economy. SSC lift fan performance will be enhanced when impeller blade characteristics are optimized through their entire length. Current impeller blade characteristics, such as shape, and structure, affect aerodynamic losses and efficiency of the impeller. However, studies suggest (Ref. 1) conventional design methods, such as the streamline curvature of the fan blades, do not adequately address aerodynamic improvement. In addition, an extrusion manufacturing process used to form impeller blades also inhibits the development of an optimum shape. Each impeller blade includes a large attachment foot on each end of the blade which disturbs flow and reduces efficiency and mass airflow. Each inner lift fan impeller blade foot is attached to the fan center disk through a series of bolted fasteners and each outer lift fan impeller blade foot is attached to one of the two outer shrouds through a series of bolted fasteners. Although, undergoing dimensional modifications and other changes, the foot-to-blade transition area continues to negatively impact the aerodynamics within the lift fan system. This foot-to-blade transition promotes flow separation along the blade, and may change the angle in which the airflow is directed into the bow thruster and skirt supply ducts, which affects the efficiency of the fan by approximately 3-4% (Ref. 1). Extending the blades radially outward and away from the fastened area or a design which removes the footing while maintaining structural integrity are a couple of ways the lift fan system could achieve greater efficiency. Sweeping the blade shape may also improve efficiency (Ref. 2), however, areas to consider that may be affected by any changes to blade design are the blade leading and trailing edges, maximal flow, and direction of flow. There are little commercial alternatives to a Navy-grade centrifugal fan applied to an air-cushion system. Due to this limited availability, all performance aspects will be relative to legacy craft data and projected SSC estimates. The overarching goals of this effort are the development of a cost-effective advanced lift fan blade design and manufacturing process that will increase lift fan efficiency by at least 10% to optimize SSC fuel efficiency and reduce noise; extend SSC mission range; and minimize SSC production and life cycle costs. In addition, the Navy requires the removal and replacement of fan blades without the removal of the impeller from the SSC. The advanced lift fan impeller must meet the Navy's fan specification (Ref. 3).

PHASE I: The company will define and develop a concept for a lift fan impeller that meets the requirements as stated in the Description section above. The company will demonstrate the feasibility of the concept through aerodynamic modeling and analysis and show that the concept will provide a cost-effective lift fan for the Navy with improved fan efficiency and fuel economy. The company must also demonstrate the manufacturability of the fan. The concept must provide the capability for impeller blade removal and replacement without removing the impeller from its installed location on the craft.

PHASE II: Based on the results of Phase I effort and the Phase II Statement of Work (SOW), the company will develop a prototype lift fan impeller for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II SOW and the Navy fan specification for efficiency, noise, and vibration. System performance will be demonstrated through installation and testing on SSC and by modeling and analysis. The fan must demonstrate increased fan efficiency (by at least 10%) and reduced noise level (below 125 db). The prototype will also need to be evaluated to ensure individual lift fan impeller blades can be removed without removing the impeller from its installed location on the craft. Evaluation results will be used to refine the prototype into an initial design that will meet the SSC Craft Specifications.

PHASE III: The company will be expected to support the Navy in transitioning the lift fan impeller to Navy use on the SSC. The company will finalize design and fabricate production prototype lift fan impeller, according to the Phase III SOW, for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation in accordance with SSC Craft Specifications to certify and qualify the system for Navy use and for transition into operational SSCs. Following testing and validation, the end design is expected to produce results outperforming the current SSC lift fan in regards to fan efficiency, air flow, and noise reduction.

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3. SSC Fan Specifications (to be provided via SITIS).

KEYWORDS: Lift fan performance; lift fan impeller blade; lift fan impeller efficiency; lift fan airflow; removable and replaceable fan blades; ship to shore connector

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N152-101 TITLE: Amphibious Combat Vehicle Ramp Interface Modular Buoyant Kit (MBK) for Joint High Speed Vessel (JHSV) Stern Ramp

TECHNOLOGY AREAS: Ground/Sea Vehicles, Human Systems

ACQUISITION PROGRAM: PMS 385, Program Office for Strategic and Theater Sealift

OBJECTIVE: Develop a Modular Buoyant Kit (MBK) for the JHSV stern ramp to facilitate Splash-Off Launch and Retrieval (L&R) of the United States Marine Corp's (USMC) Amphibious Combat Vehicles (ACVs) and Assault Amphibious Vehicles (AAVs).

DESCRIPTION: The United States Marine Corps has advised the Navy that it needs to develop a light weight kit that can be readily attached to the JHSV's stern cargo ramp so that when the ramp is lowered directly into the water it would allow AAVs and ACVs to be launched and retrieved from the JHSV near the shore (splash-off). The Marine Corps needs a high speed shallow draft connector that can launch a dozen or more AAVs/ACVs within three miles from shore. These amphibious vehicles do not carry sufficient fuel to enable them to carry out their assigned mission ashore if they are launched from deep draft Amphibious Landing Ships positioned at a long standoff distance. The Navy is seeking concepts that do not require significant modifications to the ramp structure, but should rely instead on light weight discrete systems to protect the ramp from sea state-induced motion and facilitate desired transfer operations. The Navy intends to develop a kit that will permit the L&R of Amphibious Vehicles close to shore from shallow draft high speed JHSVs. The Navy seeks the development of an innovative compact lightweight MBK that can be stored inside the JHSV's vehicle bay. The MBK will serve as flotation to the current JHSV stern ramp to facilitate launch and retrieval of the USMC ACVs and AAVs (Ref 1) through full Sea State 3 (SS3) with significant wave heights up to 1.25 meters without damaging the ramp. The primary purpose of the MBK will be to provide protection to the ramp from induced relative motions from the sea. The MBK also needs to be designed to accommodate the weight of the future Advanced Combat Vehicle (ACV) that is projected to weigh approximately 30 short tons and will be splash-launched directly into the sea via the stern cargo ramp and then driven back up the ramp from the sea and aboard the JHSV. The current stern cargo ramp that is installed in the JHSV has had structural failures when operated above its specified design condition. The current JHSV stern cargo ramp is designed to support vehicle transfer through SS1, flat seas up to 1 ft (Ref 2), during L&R (Ref 3). Torsion is particularly damaging to the JHSV ramp and its connections to the JHSV structure at-sea transfers. JHSV or receiving platform motions may impart dangerous accelerations to vehicles transiting the ramp. MBK development should be focused upon satisfying requirements in a cost effective manner. The MBK system should be portable enough to store in a Twenty-foot Equivalent Unit (TEU) meeting TEU tare weight restrictions of 47.6k lbs and be easily transferred from the vehicle bay to the stern "porch" with standard shipboard cargo movement forklift or similar gear. While JHSV does slow down to almost a complete stop prior to unfolding and deploying the ramp, the MBK must be designed so that it can be prepared for use by shipboard personnel while the JHSV is underway at speeds of up to 20 knots. As the ramp is being unfolded, the MBK should be designed to automatically position itself beneath the ramp prior to the ramp being lowered into the water. The MBK must be able to dynamically compensate for motion in SS3 while in use to ensure safe L&R. The MBK needs to be designed to operate in SS3 for the worst case condition in which the vehicle is being driven along the edge of the ramp instead of right down the middle of the ramp. It needs to be able to dynamically compensate for SS3 conditions using buoyancy, configuration, and other innovative techniques to prevent damage to the JHSV and the ACVs or AAVs during L&R. The addition of the MBK should also have little to no effect on ramp deployment and retrieval time. This will allow deployment of amphibious combat vehicles from the much more affordable JHSV platform rather than the traditional delivery by LPD 17 and Landing Craft Air Cushions (LCAC).

PHASE I: The company will develop concepts for an MBK to enable the JHSV stern ramp to be used to launch and retrieve amphibious vehicles meeting the requirements described above. The company is expected to demonstrate the feasibility of its concepts through dynamic modeling and simulation to show that the concepts avoid damage to the JHSV and amphibious vehicles during splash-launch and recovery of heavy 30 ST loads in Sea State 3. Feasibility demonstrations must show that ramp structural design limits are not exceeded and that the cost of the MBK is affordable to the Navy; not more than $250K, however, the Navy seeks the most affordable solution capable of meeting the technical requirements.

PHASE II: Based on the results of Phase I effort and the Phase II Statement of Work (SOW), the company will develop a prototype MBK for evaluation. The prototype will be evaluated by scale model test, modeling, and simulation to determine its capability in meeting the performance goals defined in Phase II SOW and the Navy requirements listed in the description for an innovative compact lightweight modular MBK. The MBK prototype will be tested in the laboratory on a motion platform to demonstrate that the MBK can accommodate amphibious launch and recovery in Sea State 3 without exceeding the design limits of the JHSV and without damage to the JHSV, the amphibious vehicles, or the MBK.

PHASE III: The company will be expected to support the Navy in transitioning the technology for Navy use. The company will finalize design and fabricate full scale production prototype for the JHSV stern ramp, according to the Phase III SOW, for evaluation to determine its effectiveness in an operationally relevant environment. If the MBK successfully completes the relevant environment evaluation, the Navy expects the company to support full-scale test and validation during a Fleet Experiment to certify and qualify the system for Navy use.

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KEYWORDS: Flotation of stern ramps; launch and recovery of amphibious vehicles; modular stern ramps; dynamic sea state compensation; stern ramp torsion; splash-off

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N152-102   TITLE: Modular Boat Ramp to Launch and Retrieve Watercraft from Joint High Speed

Vessel (JHSV)

TECHNOLOGY AREAS: Ground/Sea Vehicles, Human Systems

ACQUISITION PROGRAM: PMS 385, Program Office for Strategic and Theater Sealift

OBJECTIVE: Develop an innovative auxiliary modular boat Launch and Retrieval (L&R) System suitable for fast-tempo launch and retrieval of small boats and Unmanned Underwater Vehicles (UUVs) from the stern of a Joint High Speed Vessel (JHSV).

DESCRIPTION: The JHSV's boat crane does not have the requisite man loading safety factor needed to allow the boat crew to remain on board during L&R. In order for small boats to debark from the JHSV, they must enter the water using the boat crane without the crew on board, and then the small boat must be positioned alongside the JHSV in a coordinated effort by the crane operator and members of the ship's crew using tag lines. After the small boat is secured alongside the JHSV, a Jacobs Ladder must be rigged between the JHSV and the small boat in order for the boat crew to climb into the small boat and depart. In order to embark a small boat aboard the JHSV after returning from a mission, the crane operator and members of the ship's crew using tag lines must again position and secure the small boat alongside the JHSV and rig the Jacobs Ladder so that the boat crew can climb back aboard the JHSV. This operational limitation of not allowing the crane to lift the boat while its crew is aboard creates a safety concern whenever members of the boat crew are transferring between the JHSV and their small boat using a Jacobs Ladder in Sea State 3 or greater. This crane man loading restriction not only creates an operational safety concern but significantly slows down the rate at which small boats can be launched and retrieved from the JHSV. Therefore, approaches that are safer and support higher rates of small boat launch are being sought. The JHSV has a requirement to rapidly L&R a variety of manned and unmanned watercraft in full Sea State 3 (SS3) conditions with wave height of 3-5 feet (ref #1). The manned and unmanned vehicles include 11 meter Rigid Hull Inflatable Boats (RHIB), 40 foot High Speed Boats (HSBs), SEAL Delivery Vehicles (SDVs), Unmanned Underwater Vehicles (UUVs), and 40 foot long endurance drones. This watercraft have large length to beam ratios making them susceptible to spinning about the axis formed between the crane's boom tip and hook caused by motions imposed upon the JHSV from the sea. L&R at this scale is not done commercially and high volume of craft launch at this weight is not done. The Navy has determined that the existing crane installed aboard the JHSV should only be used for moving cargo aboard the JHSV from one place to another and that a different approach needs to be undertaken for watercraft L&R. To that end, this topic seeks to develop an approach for watercraft L&R that does not rely upon using the crane installed aboard the JHSV. An approach involving the development of an auxiliary ramp is being sought because that approach appears to be both safer and capable of providing faster L&R of watercraft. If successful, the Navy will either fund a ship alteration to modify the current stern cargo ramp or fund a ship alteration to develop and install an additional light weight modular boat ramp between the existing crane and the cargo ramp for L&R of watercraft from the JHSV. The operational safety and the rate at which L&R can be performed become much worse as the Sea State increases from SS0 through SS3. The crane installed on board the JHSV for this purpose has not successfully demonstrated L&R of watercraft above Sea State 2. Navy is seeking an innovative new Modular Boat Ramp (MBR) system that could be situated on the stern of the JHSV (ref #2). This system must be able to L&R manned 11 meter RHIBs SEAL Delivery Vehicle (SDV), or High Speed Boat (HSB) through SS3, (ref #3) allowing the boat crew to remain on board the RHIB during the entire L&R cycle. This system should be readily adaptable for L&R of Unmanned Surface Vehicles (USV) and UUVs in full SS3. The L&R system should be designed so that it can accommodate the launch or retrieval of all small crafts less than or equal to 40 feet in length in less than 15 minutes in SS3. When the system is fully operational, subsequent small crafts should be able to be launched every 10 minutes and retrieved every 20 minutes. The maximum dimensions of the small boats that JHSV shall accommodate and L&R are as follows: a. Length: 12.32 m (40.41 ft.), b. Width: 2.74 m (9.00 ft.), c. Height: 2.72 m (8.92 ft.). The design and fabrication of the system concept must be combatable to an all-aluminum vessel, comply with all applicable safety standards for manned boat operations, be readily stowed aboard the JHSV's Vehicle Mission Bay (VMB), and be easily transferable from the VMB at a location near the back porch area to facilitate temporary installation of the system near the stern of the JHSV. This effort also requires technologies that facilitate command and control of the system by both ship's force and the crew aboard the small boat. This L&R system must also provide a manual backup mode of operation permitting at sea capture and release of the small crafts from the JHSV.

PHASE I: The Company will develop a concept for a Modular Boat Ramp (MBR) system that meets the requirements described above. The company will conduct feasibility studies, including hydrodynamic assessments of the system, and demonstrate the feasibility of the operational Launch and Retrieval (L&R) system concept via physics-based modeling and simulation. Feasibility studies must show that the MRB is affordable for the Navy; not more than $125K, however, the Navy seeks the most affordable solution capable of meeting the technical requirements.

PHASE II: Based on the results of Phase I and the Phase II Statement of Work (SOW), the small business will develop a prototype MBR for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II SOW and the Navy requirements for the Modular Boat Ramp (MBR). The MBR must be able to safely launch and retrieve both manned and unmanned vehicles in SS3. The MBR must be a modular device capable of L&R times and vehicle size requirements described above in SS3 to ensure the operational tempo of JHSV L&R. System performance will be demonstrated through prototype evaluation and testing, modeling, and analysis. The contractor will evaluate results and refine requirements for the L&R system.

PHASE III: The company will support the Navy in transitioning the MRB system for Navy use aboard JHSV and similar vessels. The company will develop a full-sized MBR system in accordance with their Phase III SOW for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy for test and validation to certify and qualify the system for Navy use.

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KEYWORDS: Modular boat ramp; launch and retrieval in high Sea States; remotely operated launch and retrieval system, launch and retrieval system; Joint High Speed Vessel; launch and retrieval of manned craft; launch and retrieval of unmanned craft

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N152-103 TITLE: Innovative Flexible Equipment Support Infrastructure

TECHNOLOGY AREAS: Information Systems, Ground/Sea Vehicles, Electronics

ACQUISITION PROGRAM: PMS 400D Aegis New Construction Destroyers

OBJECTIVE: To develop an affordable, innovative modular flexible equipment support structure for large cabinets and consoles that will provide greater adaptability and configuration flexibility for Command Center System upgrades to reduce modernization and reconfiguration costs.

DESCRIPTION: US Navy Destroyers need an equipment support infrastructure for several shipboard electronics and command spaces for a Common Processing System (CPS). The purpose of the flexible infrastructure (FI) is to provide equipment configuration flexibility and the ability to complete Command Center System modernization and upgrades at reduced cost (by 30 to 60 percent) (Ref 1) compared to fixed-system modifications. Costs are associated with changes in doctrine, organization, training, material, personnel, and facilities. The innovative designs developed will allow the Navy to incorporate a reconfigurable, modular support structure for large cabinets and consoles in the remaining DDG 51 class ships as well as have it considered for back fit in existing DDG 51 Class ships. DDG 51 Destroyers are continuously upgraded for numerous reasons including; new mission capability, response to new threats, or to add advanced technology to increase reliability (Ref 2). These upgrades involve the addition or substitution of new cabinets, displays, and electronics resulting in long periods in shipyards for re-outfitting of support structures in new configurations. During this time, ships are not available for deployment. An infrastructure that will allow equipment cabinets to be moved or replaced without welding would reduce significant work in the upgrade package. Support structure cutting and re-welding is labor intensive, time consuming, and very costly. The current FI systems found on other ships are designed with very specific bolt-hole patterns. Presently, DDG 51 Class cabinets and consoles do not align with the existing FI bolt-hole patterns and the solution so far has been a heavy adapter plate. Although technically feasible, current adapter plates are undesirable because they are very heavy, restrict access for bolting, and protrude beyond the dimensions of the cabinet causing a tripping hazard and increase the height of the cabinet. The total height of the cabinets is limited to 75 inches, consequently, when the FI replaces the existing deck structure, it must not cause cabinet height allowances to be exceeded. Increased height cannot be tolerated without significant ship redesign of the existing deck heights. This topic seeks innovative solutions to produce a light-weight, affordable, and flexible support structure that can accommodate very heavy cabinets and reduce installation costs by more than 30% in comparison to the current legacy structure. Current FI systems used on other ships are designed to handle cabinets of 150 pounds per square foot. A significant number of the cabinets on DDG 51 Class Destroyers are heavier than this. Typical shipboard computer racks and cabinets are 19 inches wide by 24 inches deep by 59.5 inches high (Ref 3) and weigh up to 2,000 pounds. While the FI must accommodate the weight of cabinets, it must not add weight to the ship when it replaces the existing deck structure. It is anticipated, however, that by not utilizing the adapter plates and potential use of lighter material for use in the flexible structure itself, the overall flexible system will help in reducing the total ship weight. The design of any support infrastructures, adapter plates, or modifications to the ship must meet ship specification requirements for underwater shock (MIL-S-901D), EMI (MIL-S-461F), and safety (NAVSEA DDS 078-1). Additionally, modifications to the existing ship design need to be minimal in order to prevent increased modification costs of ships to deploy FI on new and existing ships. In addition, the FI must have minimal weight and component costs and be easy to install.

PHASE I: The company will develop a concept for an affordable, innovative equipment support structure that will meet the requirements described above. The company will demonstrate the feasibility of the design concept through material selection and testing, as well as, analytical modeling and simulation with anticipated cost analysis. The approach/analysis should demonstrate the structural design has the capability to meet load requirements at the same or reduced weight compared to the existing deck structure.

PHASE II: Based on the results of Phase I and the Phase II Statement of Work (SoW), the company will develop prototype FI for evaluation. Prototype FI will be evaluated to determine its capability in meeting the performance goals defined in the Phase II SoW and the Navy requirements for a weight neutral and innovative equipment support structure. The FI will be evaluated in a mock-up of the CPS to ensure that it meets load, re-configurability, height, cabinet mounting, and weight requirements. Evaluation results will be used to refine the prototype FI into an initial design that will meet Navy needs. Transition of the technology for Navy use will include documentation that describes all installation, maintenance, and repair practices and procedures and meet Shock, EMI, and safety requirements.

PHASE III: The Navy expects the company to support transition of the FI to Navy use aboard DDG 51 Class ships. The company will produce production components for evaluation in the Combat Information Center and the Combat Systems Equipment Room on board DDG 51 to determine its effectiveness in an operationally relevant environment. Additionally, the company will support the Navy for test and validation to certify and qualify the system for Navy use.

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KEYWORDS: Flexible infrastructure; electrical cabinet modularity; modular support structures; adaptable reconfiguration; adaptable support structure; rapid reconfiguration

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N152-104 TITLE: Manufacturing Near-Net-Shape Conformal Electro-optic Sensor Window Blanks from Spinel

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: UCLASS, The Carrier Unmanned Aviation Program Office PMA-268

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Demonstrate a manufacturing process for near net shape spinel blanks for large conformal sensor windows. A related topic NSMA-152-918 will address methods to manufacture large conformal sensor windows that could be made from these blanks in the future.

DESCRIPTION: Electro-optic sensor windows that conform to the local shape of an aircraft mold-line are desirable for future air platforms to allow for a large sensor angle of regard. Conformal shapes may have little to no symmetry depending upon their location. Spinel is an excellent material candidate as it is both durable and multi-spectral (ultraviolet through mid-wave infrared). Spinel is more erosion resistant than multispectral zinc sulfide, which is another logical candidate for a large conformal window. The availability of blanks currently limits the size and curvature for potential window applications. The objective of this project is to develop and demonstrate new manufacturing processes to provide near net shape blanks to improve upon current state of the art processes which start with a thick, planar blank and grind them to the desired shape. Currently, the thickness of the planar blank limits the maximum sag (height of window from highest to lowest point) that can be obtained to approximately one inch. Although actual shapes will be chosen by mutual agreement with the government, it is expected that the approximate conformal shape for Phase II will be 16x16 inches with a sag of six inches. A small grain spinel is preferred for enhanced strength, which is a desired property.

PHASE I: Demonstrate feasibility to manufacture near net shape conformal electro-optic sensor window blanks from spinel. To prove feasibility, produce a minimum of two uncracked, fully dense spinel window blanks having final fired dimensions of at least a 6x6inch footprint, sag of three inches, and thickness of ½ inch. A toroid is a possible demonstration shape. Measure the transmission spectrum of the material using polished flat specimens cut from one of the window blanks. Desired transmission is within 4% of the theoretical value for spinel at a wavelength of 0.63 microns and within 2% of the theoretical value for spinel at a wavelength of 4 microns.

PHASE II: Scale up to produce a minimum of two uncracked, fully dense spinel window blanks having final fired dimensions of at least a 16x16inch footprint, sag of six inches, and thickness of one inch. Demonstration shape may be a toroid or other free-form shape mutually agreed upon with the government. Measure the transmission spectrum and flexure strength of the material using polished flat specimens cut from one of the window blanks. Desired transmission is within 4% of the theoretical value for spinel at a wavelength of 0.63 microns and within 2% of the theoretical value for spinel at a wavelength of 4 microns. A material strength of greater than 200MPa is desirable, as measured by ring-on-ring flexure testing.

PHASE III: Implement manufacturing processes for commercial production and commence full rate production in order to support Navy requirements. Assist the Navy in transitioning this technology to identified platforms.

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KEYWORDS: Spinel; transparent ceramics; slip casting; conformal window; transparent armor; sensor window; infrared window

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N152-105 TITLE: Metrology of Visibly Opaque, Infrared-Transparent Aerodynamic Domes, Conformal Windows, and Optical Corrector Elements

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: Air-to-Air Missiles Program Office (PMA-259)

OBJECTIVE: Develop a method and hardware to measure the optical figure and transmitted wavefront error of visibly opaque, infrared-transparent aerodynamic domes, conformal windows, and optical corrector elements with a precision of one tenth of the measurement wavelength, or better.

DESCRIPTION: The function of electro-optical sensors is greatly impacted by the window's properties. Survivability depends on material strength, hardness, and thermal properties. Targeting is limited by optical properties of the window material. Drag is reduced by aerodynamic shapes. The objective of this project is to create metrology methods and hardware to measure the optical figure and transmitted wavefront error of visibly opaque, infrared-transparent aerodynamic domes, conformal windows, and optical corrector elements to provide feedback for optical figure correction by an optics shop. Example materials include standard grade zinc sulfide (ZnS), hot pressed magnesium fluoride (MgF2), and germanium (Ge). Some materials of interest have negligible transparency below 2 microns and aspheric shapes made from these materials cannot be measured by any known method today. Possible candidate shapes include toroidal windows, tangent ogive domes, and arch shaped correctors. Methods capable of measuring objects whose two surfaces deviate more than 5 degrees from parallel could be useful. Potential metrology methods should have a precision of one tenth of the measurement wavelength, or better.

PHASE I: Evaluate the feasibility of measuring the optical figure and transmitted wavefront of visibly opaque, infrared-transparent aerodynamic domes, conformal windows, and optical corrector elements with a precision of one tenth of the measurement wavelength, or better Demonstrate breadboard capability to measure freeform shapes such as a 5 inch diameter x 7 inch tall aerodynamic dome provided by the government. Measurement must produce surface figure and transmitted wavefront maps with a precision of 0.5 micron or better.

PHASE II: Improve the metrology technique and hardware developed in Phase I by increasing ease of use, precision of results, measurement speed, and adaptability to different shapes and sizes. The output of the method must be in a form that provides feedback to an optical polishing shop for figure correction.

PHASE III: Implement commercial metrology capabilities. Manufacture an instrument for sale to optics manufacturers to measure visibly opaque aspheric optics. Alternatively, provide a commercial service to measure visibly opaque aspheric optics.

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KEYWORDS: Metrology; conformal windows; aerodynamic domes; infrared transparent; visible opaque; measurement

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N152-106   TITLE: Metrology of Visibly Transparent Large Aspheric Optics

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: UCLASS, The Carrier Unmanned Aviation Program Office PMA-268

OBJECTIVE: Develop a method and hardware to measure the optical figure and transmitted wavefront error of large aspheric optics including conformal windows, aerodynamic domes, and corrector optics. Measurements should have a precision of 0.1 micron or better. Candidate materials will have suitable transparency at a wavelength of one micron for optical measurements.

DESCRIPTION: Aspheric optics represent the next generation in electro-optic sensor windows allowing for windows that conform to the local shape of an aircraft moldline, domes that reduce drag in missiles, and optical elements that correct for distortions produced by conformal windows and aerodynamic domes. The objective of this project is to develop metrology methods and hardware to measure the optical figure and transmitted wavefront error of large conformal windows, aerodynamic domes, and optical corrector elements to provide feedback for optical figure correction by an optics shop. Methodology development could begin with glass or fused silica specimens but is expected to move to spinel by Phase II. Possible candidate shapes include toroidal windows, tangent ogive domes, and arched optical corrector elements. Specimens to be measured are expected to have a footprint up to 24x24 inches. Metrology methods should have a precision of 0.1 micron or better.

PHASE I: Evaluate the feasibility of measuring the optical figure and transmitted wavefront of aspheric optics including conformal windows, aerodynamic domes, and corrector optics. Demonstrate breadboard capability to precisely measure (0.5 micron) freeform shapes such as a 4x4 inch toroidal window provided by the government. Produce a design capable of measuring large aspheric optics up to 24x24x24 inches. Instruments that operate at visible or one micron wavelengths are acceptable. Measurement must be capable of handling optics with little to no symmetry. A method capable of measuring objects whose two surfaces deviate more than 5 degrees from parallel could be useful but is not required.

PHASE II: Build and demonstrate the instrument designed in Phase I capable of measuring aspheric optics up to 24x24x24 inches. Specimens for measurement possibly made of glass or plastic will be provided by the government. Measurement results must be in a form that provides feedback to an optical polishing shop for figure correction. The measurement goal is a precision of 0.1 micron or better. The intent for this instrument is to be used on the floor of an optics shop making large aspheric and conformal optics.

PHASE III: Implement commercial metrology capabilities. Manufacture an instrument for sale to optics manufacturers to measure large aspheric optics. Alternatively, provide a commercial service to measure aspheric optics.

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KEYWORDS: Metrology; conformal windows; aerodynamic domes; Measurement; Large Optics; Aspheric

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N152-107 TITLE: Manufacturing of Visibly Transparent Large Conformal Windows

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: UCLASS, The Carrier Unmanned Aviation Program Office PMA-268

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop methods to grind and polish freeform conformal sensor windows with dimensions up to 24x24 inches with a sag height of approximately 8 inches and an optical precision of 0.5 micron or better. The purpose of this topic is to demonstrate manufacturing methods for optics from glass. A related topic NSMA-152-257 will address the production of near-net-shape spinel blanks for future manufacturing of optics.

DESCRIPTION: Conformal electro-optic sensor windows are desirable for future air platforms as they maintain the shape of the aircraft moldline and allow for a large sensor angle of regard. Such windows may have little to no symmetry depending upon their location. Spinel is an excellent candidate window material as it is both durable and multi-spectral (ultraviolet through mid-wave infrared). Spinel is more erosion resistant than multispectral zinc sulfide, which is another logical candidate for a large conformal window. The objective for this project is to create methods to grind and polish freeform conformal sensor windows with dimensions up to 24x24 inches with a sag height of approximately 8 inches and an optical precision of 0.5 micron or better. It is expected that methods will be developed with glass or fused silica and that a full sized window will be made from glass or fused silica. It is also possible that a full sized spinel blank may be available from the government during this project.

PHASE I: Demonstrate the feasibility of grinding and polishing a glass or fused silica conformal window with dimensions of 12x12 inches. The contractor shall propose a shape with a window sag height of approximately four inches and lacking rotational symmetry. The precise shape of the conformal window will be selected by mutual agreement with the government. The root-mean-square precision of the optical figure shall be 0.5 micron or less with a clear aperture extending within half an inch from the edge.

PHASE II: Based on Phase I effort, scale up window fabrication with glass or fused silica to lateral dimensions of 24x24 inches with a sag of approximately eight inches. The shape shall be proposed by the contractor with mutual agreement from the government. A root-mean-square precision of the optical figure of 0.5 micron or less with a clear aperture extending within half an inch from the edge is desired. There is a possibility that a spinel blank will be made available by the government for Phase II.

PHASE III: Implement commercial manufacturing capabilities for large conformal windows made of durable ceramics such as spinel. Manufacture an instrument for sale to optics manufacturers to make large, aggressively aspheric optics. Alternatively, provide a commercial service to manufacture such optics.

REFERENCES:

1. S. DeFisher, E. Fess, and F. Wolfs, “Freeform and Conformal Optical Manufacturing,” Proc. SPIE 2013, Volume 8708 paper 870813. (http://www.spie.org/x1848.xml)

2. J. DeGroote Nelson, A. Gould, N. Smith, K. Medicus, and M. Mandina, “Advances in freeform optics fabrication for conformal window and dome applications,” Proc. SPIE 2013, Volume 8708 paper 870815. (http://www.spie.org/x1848.xml)

3. J. Taylor, R. Boland, E. Gowac, P. Stupik, and M. Tricard, “Recent advances in high-performance window fabrication,” Proc. SPIE 2013, Volume 8708 paper 870816. (http://www.spie.org/x1848.xml)

KEYWORDS: Optical fabrication; conformal windows; large optics; aspheric optics; sensor window; infrared window

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N152-108 TITLE: Accelerating Instructor Mastery (AIM)

TECHNOLOGY AREAS: Information Systems, Human Systems

ACQUISITION PROGRAM: FNC: Accelerating the Development of Small Unit Decision Making (ADSUDM) - POR: MCTIMS

OBJECTIVE: Develop an instructor platform (software and hardware components) that supports the development of novice instructors. This platform will be used by military instructors in formal schools houses (e.g., The Basic School) and easily integrate into MCTIMS and other learning management systems.

DESCRIPTION: Educators typically study for four years at a university building a solid foundation of instructional knowledge. In addition, most educators also have observed practical experience before they instruct on their own. In contrast, active duty military instructors often don’t have the benefit of any education on how to instruct. They are often recently graduated students; although their content knowledge is strong, they lack "expert instructor techniques" (i.e., strategizing, executing, and adapting classroom instruction as needed to achieve desired outcomes). Given the limited learning and practice opportunities for military instructors, there is a need to capture, explore, and practice military-specific best instructor techniques in the schoolhouse, in order to enable and accelerate effective and engaging instruction even by inexperienced instructors. There are many different ways to possibly facilitate instructor development outside of a traditional education setting. One method is to develop simulated environments. For example, TeachLivE is a mixed reality environment that uses simulated students to help educators practice their pedagogical skills. In this type of environment, the scenarios can be tailored and scaffolding techniques can be provided to support until the instructional skills are mastered [1]. Another method is to facilitate peer collaboration. Enabling re-use and re-combinations of previously developed training material (e.g., documents, PowerPoint slides, video, audio, practical exercises, etc.) allows instructors to use, update, and further develop items that have proven effective in similar training curricula. Similar approaches have been studied in higher education, where teachers collaborate to generate content based on knowledge about teaching with technology [2, 3]. It is unclear which approach and systems would best facilitate and expedite learning and development for inexperienced instructors. Outside of the civilian traditional educational development model and system (e.g., 4-year degree, professional conferences, etc.) there are limited technologies and materials for inexperienced military educators / instructors to effectively learn and practice pedagogical skills. Innovative solutions are sought to address this gap in enhancing inexperienced instructor capabilities among military populations. These capabilities should be as open source as possible, require a low / no manpower footprint, and be a tool that can be self-sustaining and extensible for wide variety of military courses.

PHASE I: Determine requirements for the development of software that provides capability to improve and accelerate the development of novice instructors. Requirements for data collection should include types of data and methods for easily capturing each type of data. Phase I deliverables will include: (1) requirements for the system components; (2) overview of the system and plans for Phase II; and (3) mock-ups or a prototype of the system. If awarded, the Phase I Option should also include the processing and submission of all required human subjects use protocols, should these be required. Due to the long review times involved, human subject research is strongly discouraged during Phase I. Phase II plans should include key component technological milestones and plans for at least one operational test and evaluation, to include user testing.

PHASE II: Develop a prototype system based on Phase I effort, and conduct a training effectiveness evaluation. Specifically, military instructor performance areas will be provided to support the development of the training effectiveness evaluation. A near-term training need will be identified as a use case for initial system development. All appropriate engineering tests and reviews will be performed, including a critical design review to finalize the system design. Once system design has been finalized, then a training effectiveness evaluation will be conducted with a Marine Corps population. Phase II deliverables will include: (1) a working prototype of the system that is able to interact with existing system specifications and (2) training effectiveness evaluation of system capabilities to provide demonstrable improvement to the instructor population.

PHASE III: If Phase II is successful, the company will be expected to support the Marine Corps in transitioning the technology for Marine Corps use. The company will develop the software for evaluation to determine its effectiveness in a Marine Corps formal school setting. In addition, the small business will support the Marine Corps with certifying and qualifying the system for Marine Corps use within the Marine Corps Training Information Management System. As appropriate, the small business will focus on broadening capabilities and commercialization plans.

REFERENCES:
1. Dieker, Lisa A. et al. “The Potential of Simulated Environments in Teacher Education: Current and Future Possibilities.” Teacher Education and Special Education: The Journal of the Teacher Educatino Division of the Council for Exceptional Children (2013).

2. Abbott, M., Greenwood, C. R., Buzhardt, J., & Tapia, Y. (2006). Using technology-based teacher support tools to scale up the classwide peer tutoring program. Reading & Writing Quarterly, 22(1), 47-64.

3. Laurillard, D. (2008). The teacher as action researcher: using technology to capture pedagogic form. Studies in Higher Education, 33(2), 139-154.

KEYWORDS: Instructors; best practices; curriculum development; education; training; military training development

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-109 TITLE: Reliability Centered Additive Manufacturing Design Framework

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: EPE-FY-17-03 FNC entitled "Quality Metal Additive Manufacturing" or QUALITY

OBJECTIVE: To exploit the entire AM design space by developing a Reliability-Centered AM Computational Design Framework (RCAM CDF) that incorporates reliability, inspectability and repairability in to the AM components themselves thereby assuring proper operation and safety throughout their entire operational life and assisting with the qualification and certification processes. The definition of “reliability” used in this topic is the “period of time during which a manufactured component will function in the operational environment with a specified level of performance and in a safe manner”.

DESCRIPTION: Additive Manufacturing (AM) offers the opportunity to fabricate equivalent (i.e. same fit/form/function) structures and components in a more cost effective manner and in ways that are not currently possible with subtractive, casting or other manufacturing approaches. Unfortunately, today there are only a limited number of AM components that can achieve complete equivalency to their original counterparts which significantly limits the use of this technology. Still, if the design space for AM parts is enlarged, enormous benefits could be realized if we are able to incorporate reliability, inspectability and repairability to those parts. By explicitly exploiting some of the inherent AM material anisotropies while minimizing or eliminating known AM weaknesses via effective utilization of topological designs; material, microstructural and functionally graded designs and other design space trade-offs, efficient and reliable structural or functional components can be fabricated. Standing in the way for exploiting these seemingly endless design space trade-offs is the ability to inspect and reliably assure operational safety and performance of such advanced designs throughout the operational life of these components. This SBIR topic is seeking innovative approaches to monitor in-situ the reliability of complex AM parts through their entire design life by including “reliability assurance” as an integral part of the design process and embedded in the AM part itself. This topic is not interested in AM parts with simple geometrical designs which could be inspected with existing Commercial Off The Shelf (COTS) Nondestructive Evaluation (NDE) equipment. Depending on the primary function of the AM part (such as carrying structural load, thermal management, material transport, flow control, signature control, etc.) the approach to ensure reliability will vary. Other factors will also need to be considered when choosing the approach such as part accessibility, part criticality, degree of multi-functionality, AM method used to manufacture the part, AM material options and many others. Cost should also be a factor when down selecting amongst several approaches that yield similar levels of safety and reliability. Addressing this topic in its entirety would require resources beyond those available through a single SBIR program because of the number of disciplines that need to be brought to bear. An AM design framework that incorporates reliability throughout the life of the component should integrate understanding and modeling of: 1 - the different manufacturing technologies (SLA, SLS, SLM, FDM, EBM, EBF3, etc.) used to manufacture AM parts; 2 - the materials, processing, microstructure, property, defect types and distribution in the final AM components; 3 - functional performance and progression (load bearing, thermal management, material transport, EM); 4 - the development, progression and criticality of damage in the AM parts; 5- the interaction between the different damage types and the interrogation method used to monitor part for integrity (such as ultrasonic, electromagnetic, thermal, visual, etc.); 6 - as well as the reliability of the monitoring approach itself. Therefore, to narrow the scope of this SBIR topic, this solicitation will focus in only one AM technology for metallic components. Also, “repairability” will only be considered for implementation during Phase III if deemed necessary. The Navy will only fund proposals that are innovative, address the proposed R&D and involve technical risk.

PHASE I: Develop a Reliability-Centered AM Computational Design Framework (RCAM CDF) that incorporates a specific AM process for metallic components. This design framework should include at minimum part geometry, material mechanical properties, defect types, as well as an inspection, monitoring or other methodology to guarantee reliability of the component throughout its operational design life. Only small laboratory coupons will be fabricated during this phase of the program to verify and validate different aspects of the RCAM CDF.

PHASE II: The Phase I RCAM CDF will be optimized and expanded to incorporate those characteristics that were not previously developed (such as a design optimization algorithm, material microstructure, microstructure evolution, damage nucleation and progression and others as resources allow). The entire RCAM CDF framework will be further optimized for usability, robustness and performance. Small scale laboratory coupons will be fabricated to assist with the expansion and optimization activities of the RCAM CDF. For validation purposes, a small air to air heat exchanger (HX) will be designed using the RCAM CDF. The Principal Investigator will fabricate a minimum of four heat exchanger prototypes. The first HX will be used for dimensional and functional characterization after manufacturing. The second HX will be used to perform detailed cross sectional photo-micrographic analysis to validate the RCAM CDF after manufacturing. The third HX will be used to monitor its reliability throughout an accelerated testing phase. And the fourth HX prototype will be used to perform detailed photo micrographic analysis to validate part reliability after the accelerate testing. The small business must involve an original equipment manufacturer (OEM) during this phase of the contract to facilitate the transition to Phase III.

PHASE III: If Phase II is successful, the company will be expected to support the Navy in transitioning the RCAM CDF for Navy use. Working with the Navy, the company will integrate the RCAM CDF framework for evaluation to determine its effectiveness in an operationally relevant environment. The OEM involved during Phase II will be part of the transition team. Phase III will include defining the additive manufacturing parameters for qualified full scale system production and establishing facilities capable of achieving full scale production capability of Navy-qualified HXs. The small business will also focus on identifying potential commercialization opportunities.

REFERENCES:
1. W.E. Frazier, “Metal Additive Manufacturing: A Review”, DOI: 10.1007/s11665-014-0958-z, ASM International, JMEPEG (2014) 23:1917–1928.

2. M. Schmid, G. Levy, “Quality Management and Estimation of Quality Costs for Additive Manufacturing with SLS”; Retrieved from: http://e-collection.library.ethz.ch/eserv/eth:47104/eth-47104-01.pdf or from www.iwf.mavt.ethz.ch/ConfiguratorJM/publications/Quality_Ma_133345735583221/p107.pdf

KEYWORDS: Additive Manufacturing, Computational Design Framework, Reliability, Structural and Functional Health Monitoring.

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-110 TITLE: Dive Helmet Communication System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Human Systems

ACQUISITION PROGRAM: NAVSEA 00C (Diving Programs)

OBJECTIVE: Create technologies to improve diver communications at working depths compensating for different gas densities and minimizing communication feedback. The objective is to investigate applications of digital signal processing and actuators (speakers and microphones) and apply these findings in developing a Helmeted Diver communication system(s). This development is to address diver helmet communications that will operate in high noise of diver helmet breathing noise and underwater tool noise while operating in varying gas density/mixtures (squeaky voice). The developed system (helmet (bottom-side) and diver station (topside)) must demonstrate improved and clear communications in actual dives and/or dive chambers. The components must be rugged and usable in marine environments while utilizing existing umbilical lines. It would include noise monitoring and consider future fiber optic signal umbilical lines.

DESCRIPTION: The current system being used is analog circuits (circa 1960's) with components to match. The communication components are susceptible to moisture and handling damage. Thus the existing communication system has reduced intelligibility in the varying noise levels of the current helmet. The diver helmet currently used by Navy divers (Kirby Morgan KM 37NS) has documented high noise levels from the breathing system with a circa 1960's communication system (analog on copper wire). This is a challenging communication environment which is complicated when using helium mixed gas (squeaky voice) and/or at depth (compressed air). Breathing air maximum operating depth is 190 feet seawater (fsw) and is 300 fsw for helium-oxygen mixes. Either breathing medium may be used in water temperatures as low as 37°F, or as low as 28°F if the helmet is used with the hot water shroud and a hot water supply. In addition, at water temperatures below 40°F, the diver will be dressed in either a variable volume dry suit or a hot water suit. Additionally, the diver community has high incidence of noise induced hearing loss (high frequency). An ideal communication system would use modern, digital signal processing, with matched microphones and speakers (actuators) to overcome these challenges and the feedback that occurs in the current analog system. All required components must be included in the system for improved diver (helmet) and topside communications. The system shall be able to frequency compensate to keep incoming signals in the optimal voice range for divers and correct for topside signals. The new system must be robust enough to handle the moisture/salt in a marine diving (90% humidity) scenario and the inherent rough handling of diver equipment. The system should also include the capability for noise monitoring and use of fiber optic signal umbilical lines in the future (i.e. accommodate the use of fiber optic cables and the reduction of copper wire in the umbilical lines). The system must work in the current noise levels of 94 to 97 dBA, which are noise hazardous (reference 1) and compromise current communications. ANSI S3.2-2009 (R2014) (Method for Measuring the Intelligibility of Speech over Communication Systems) would be an appropriate means of evaluation using the modified rhyme test. ANSI S3.2-2009 (R2014) includes factors that affect the intelligibility of speech. The new system must reduce the noise feedback loop in the helmet, producing high noise levels at the diver's ear, which increases the noise exposure. The goal is to reduce noise levels below 85 dBA.

PHASE I: Determine the feasibility of developing and constructing communication technologies to provide clear communications between divers and the topside station. Develop a detailed design for a diver communication system that can meet the performance and the constraints listed in the equipment description for the Kirby Morgan KM37NS dive helmet in reference 2. Similar commercial system is shown in reference 3. Currently approved communications systems are listed in reference 4. The technical manual (N00178-04-D-4012/HR06) is reference 5. Perform design trade-offs to provide initial assessment of concept performance for topside, bottom-side, multiple divers and umbilical components and be suitable for the marine environment. The dive helmet communication system must consider forward fit and back fit and be reported in the Phase I Final Report. System concept must address pressure changes which occur in the helmet. System may utilize frequency shifting to deal with gas density and/or mixed gas. System concept must also address diver utility (i.e. ear equalization) if considered. Phase I includes the initial layout and capabilities description to build the unit in Phase II. Current topside design factors are Space: 10" x 9" x 14.5"; Weight: 22lbs; Power: 110/220 VAC 50/60 Hz (autosensing) or internal/external battery 12 VDC.

PHASE II: Produce dive helmet communication system prototype hardware based on Phase I concept design for evaluation. Finalize the prototype design and validate improved communications at topside station. Also, validate improved communications under while breathing air (maximum operating depth is 190 feet seawater (fsw) and is 300 fsw for helium-oxygen mixes. Either breathing medium may be used in water temperatures as low as 37°F, or as low as 28°F if the helmet is used with the hot water shroud and a hot water supply. In addition, at water temperatures below 40°F, the diver will be dressed in either a variable volume dry suit or a hot water suit. Install developed prototype in a Kirby Morgan KM 37NS dive helmet. The developer will use its own helmet during Phase II. Speech intelligibility tests shall be performed to confirm the communication improvements. Deliver two full prototype dive helmet communication system kits for testing and evaluation at a location chosen by the US Navy.

PHASE III: Construct production units suitable for certification for the Approved for Navy Use (ANU) List and develop marketing plans for a broad range of customers. Kits shall include all hardware required for modification of helmets, topside equipment, installation, operations and maintenance procedures.

REFERENCES:
1. Nedwell, Dr. J., et. al., “The Significance of Noise Exposure of Divers During Typical Diving Operations in the Norwegian Sector of the North Sea, UHMS Scientific Meeting, St. Louis, Missouri, June 19-21, 2014.

2. Kirby Morgan® 37 & 57 Helmets Operations and Maintenance Manual KMDSI Part # 100-073.

3. Amcom™ III 3-Diver Portable Rechargeable Communicator with Internal Charger. Retrieved from: http://www.amronintl.com/amron-international-amcom-3-diver-portable-rechargeable-communicator-with-internal-charger.html

4. Authorized for Military Use (AMU) List found at: https://www.supsalv.org/00c3_AMU.asp?destPage=00c3

5. TECHNICAL MANUAL, UNDERWATER BREATHING APPARATUS (UBA) KM 37 NS, N00178-04-D-4012/HR06.

KEYWORDS: Dive helmet, diver communication system, Kirby Morgan helmet, salvage diving, mixed gas, re-compression chambers

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-111 TITLE: Rapid Initialization and Filter Convergence for Electro-optic / Infrared Sensor Based Precision Ship-Relative Navigation for Automated Ship Landing

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: INP CNR Leap Ahead: Sea-based Automatic Landing Recovery System (SALRS)

OBJECTIVE: Develop fast initializing, real-time, precision ship-relative navigation (PS-RN) sensor processing for shipboard automated aircraft landings, using electro-optical and infrared motion imagery across the range of lighting conditions and environmental obscuration.

DESCRIPTION: Carrier based fixed wing aircraft need accurate, high rate, and high integrity precision ship-relative navigation (PS-RN) to conduct safe and efficient automated landings. This SBIR is focused on capability that is not dependent on Radio Frequency (RF) emissions or Global Positioning System (GPS) in order to reduce vulnerability to interference. The PS-RN solution must initialize very quickly because of the relatively high closure rates (approx. 120 knots). Electro-Optical/Infrared (EO/IR) aircraft mounted cameras are attractive sensors due to low cost and size, but do not directly measure range and angle, so these calculations must be reliably extracted from the imagery at a high data rate (approx. 30 Hz). They must initialize quickly (10 seconds or less) when imagery becomes usable as the aircraft approaches the ship, even with obscured visibility and deck motion. Current image detection, tracking, and template matching require too much time (over 1 minute) to be usable for a jet aircraft approach in reduced visibility. Convergence rate of linearized filters is not adequate for the required precision of relative navigation; non-linear filters may provide a workable approach. For this SBIR effort, the sensors to be used are aircraft mounted electro-optic and/or infrared cameras, with optional use of ship mounted light or beacon sources. The navigation scenario begins at 4 nautical miles (NMI), with the aircraft at 1200 feet Mean Sea Level (MSL), and within 10 degrees of the landing area centerline. The aircraft inertial measurement unit (IMU) can be used. Ship location is known within 1/2 NMI, course and speed are known within 10 degrees and 5 knots. The ship must be detected and tracking begin rapidly when it enters the sensor field of view; the initialization goal is 10 seconds. The camera system, including lenses, must be small (approx. 200 cubic inches) and able to withstand the electromagnetic interference, shock, and vibration environment of a carrier landing. Only two fixed focal lengths can be used for the entire approach. Computer processing must be done on 1 or 2 cards added to an existing mission computer. Aircraft pose estimate must be accurate within 0.20 degree in azimuth and elevation, and range within 4%. It must be a high integrity solution with sufficient accuracy and continuity (in concert with the IMU) suitable for aircraft control. Ship motions corresponding to sea state 4 must be identified. The lights or beacons must be suitable for installation on the deck, hull, catwalk, or other structural location on an aircraft carrier.

PHASE I: Determine feasibility for the development of rapidly initializing detection, tracking and relative pose estimation processes that could be used to provide navigation inputs to the flight control system of a carrier based fixed wing aircraft for landing on an aircraft carrier. Develop a system concept for this purpose and report on the results.

PHASE II: Based on Phase I effort, develop and demonstrate sensor processing using available sensor(s) for rapid-initialization PS-RN real-time capability, in simulation, in full range of lighting conditions, from full sun to overcast moonless night, with sea state 4 deck motion. Determine through simulation maximum range capability in fog and rain, and determine the heaviest fog and rain that can exist and still allow accurate navigation to begin at no less than ¾ nautical mile. Collect imagery data during flight approaches and landings in day and dark night conditions using low cost surrogate aircraft and a land based facility. Use these imagery data to demonstrate rapid-initializing real time PS-RN in the laboratory. Conduct an open loop demonstration of real time PS-RN capability in flight. Update the models and software for delivery to the Navy simulation laboratory.

PHASE III: From the results of Phase II, design and fabricate a processing system using available sensors which can be carried by an F/A-18 aircraft. The Navy will gather flight test imagery using this system in a separately funded flight test effort. Using the data from this flight test, demonstrate precision ship-relative navigation capability in the laboratory. Develop a preliminary design for an integrated sensor and processing system to be installed on an aircraft carrier and a selected Navy carrier aircraft for operational use.

REFERENCES:

1. Coutard, Laurent, and François Chaumette. "Visual detection and 3D model-based tracking for landing on an aircraft carrier." Robotics and Automation (ICRA), 2011 IEEE International Conference on. IEEE, 2011.

2. Wang, Dan, and Wei Wang. "Airborne Integrated Vision/Inertial Navigation System for Landing on Aircraft Carrier." Advanced Materials Research 748 (2013): 747-753.

3. Burns, William Robert. "A Vision-Based Algorithm for UAV State Estimation During Vehicle Recovery." (2011).

KEYWORDS: Electro-optic; infrared; navigation; aircraft; landing; ship

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-112 TITLE: Robust MEMs Oscillator Replacement for Quartz Crystal TCXO Oscillator

TECHNOLOGY AREAS: Sensors, Electronics, Weapons

ACQUISITION PROGRAM: Hyper Velocity Projectile, SHD FY15-17, PEO IWS 3C Surface Gunnery Program

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 5.4.c.(8) of the solicitation. 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-G mechanical shock and temperature shock tolerant microelectromechanical system (MEMS) replacement for quartz temperature compensated crystal oscillators (TCXO), currently used as precision frequency reference devices in GPS receivers, radio transceivers, and other radio frequency devices.

DESCRIPTION: High Precision Temperature Compensated Crystal Oscillators (TCXO's) are used in GPS receivers, radio transceivers, and other radio frequency devices used in guided munitions. Quartz TCXO's are useful as a clock reference for these devices because of their high frequency stability, often well below 2 parts per million (ppm). However, quartz crystal devices are sensitive to both mechanical shock and rapid temperature changes. This is particularly an issue for high velocity gun-launched guided projectiles. This topic seeks a MEMS oscillator comparable in performance to temperature-compensated crystal oscillators (TCXO) in frequency accuracy, temperature stability, while providing similar or improved phase noise. The design must be survivable up to 30kgee high-G mechanical shocks during firing and temperature extremes with rapid fluctuations up to 250 degree F/min (surface) caused by aeroheating during flight. The design must also remain within or reduce the size, weight and power envelope of existing crystal oscillators it is meant to replace. The design must also perform within the operational constraints of existing crystal oscillators by exhibiting minimal aging and acceleration sensitivity, and by reaching a functional level of stability (<0.1 ppm / sec) within 0.25 seconds of application of power.

PHASE I: Develop a proof of concept approach for a MEMS oscillator that meets the requirements as stated in the topic description. Support the concept design by material testing and analytical modeling. A critical demonstration experiment with components in a laboratory environment is desired.

PHASE II: Further refine the approach and build prototype devices. Characterize the device’s frequency accuracy, temperature stability, phase accuracy and temperature and shock shifts. Deliver prototype devices for government testing.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the technology for Navy use in the Hyper Velocity Projectile program. Work with GPS receiver manufacturers to integrate the MEMS oscillator in GPS receivers. Develop a plan to determine the effectiveness of the replacement MEMs Oscillators in an operationally relevant environment. Support the Navy with certifying and qualifying the system for Navy use. When appropriate focus on scaling up manufacturing capabilities and commercialization plans.

REFERENCES:
1.   W.-T. Hsu, 2009, “Recent Progress in Silicon MEMS Oscillators,” in Proceedings of the 40th Annual Precise Time and Time Interval (PTTI) Systems and Applications Meeting, 2-4 December 2008, Reston, Virginia, USA (U.S. Naval Observatory, Washington, D.C.), pp. 135-146.

2.   R. Henry and D. Kenny, 2008, “Comparative Analysis of MEMS, Programmable, and Synthesized Frequency Control Devices Versus Traditional Quartz Based Devices,” in Proceedings of the IEEE International Frequency Control Symposium, 19-21 May 2008, Honolulu, Hawaii, USA (IEEE CFP08FRE), pp. 396-401.

KEYWORDS: MEMS, Oscillator, GPS, electronics. shock hardened, temperature compensation

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-113 TITLE: Unmanned Undersea Vehicle (UUV) Detection and Classification in Harbor Environments

TECHNOLOGY AREAS: Sensors, Battlespace

ACQUISITION PROGRAM: Strategic Systems Program Nuclear Weapons Security WQX-2 POR ACAT III

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 5.4.c.(8) of the solicitation. 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 or improve current sensing technologies that will provide reliable detection and classification of UUVs operating in a harbor environment.

DESCRIPTION: New or improved sensing concepts and technologies are needed to better recognize the presence of Unmanned Undersea Vehicles (UUVs) operating in ports and harbors, particularly in the proximity of U.S. Navy ships and submarines. The maturity and proliferation of UUVs throughout the world is presenting an emerging challenge for force protection in harbor environments. It is important to counter sensor laden units that do not present a direct threat, but an armed UUV presents a particularly compelling challenge. The mobility of UUVs limits the effectiveness of traditional mine countermeasures like change detection. The stationary nature of the assets that are being protected in harbors allows for slow and deliberate approaches by enemy platforms. Current strategies for detecting and classifying UUVs employ systems that were originally designed to detect combat swimmers and scuba divers. A number of these systems have demonstrated some capability against UUV targets that were presented in a controlled research environment, but the typical warning ranges do not provide a completely satisfactory response window. It is envisioned that multi-modal layered approach has the potential to significantly increase the average response window available to counter UUV approaches to U.S. Navy assets.

PHASE I: Determine the technical feasibility of a UUV sensing approach that would be effective for Remus 100 size and larger targets and develop a system design and concept of operation for implementing it, either as an independent system or in concert with existing sonar technology. Design considerations include an objective standoff distance of 1000 meters and a false alarm tolerance of one per day. The improved sensing technology will be integrated into the over-arching asset protection infrastructure.

PHASE II: Produce UUV sensor prototype hardware along with a concept of operations based on the Phase I effort. Demonstrate and validate performance of the UUV sensor developmental system against Remus 100 size targets in a relevant environment. A completely functional system is not required at the end of the Phase II effort; however, a demonstration during Phase II should clearly support the expected performance of a final design.

PHASE III: Based upon Phase I and Phase II efforts, the developed sensing technologies and systems that have demonstrated effective detection and classification of UUVs in harbor environments will be candidates for prototype development and test and evaluation that will support incorporation into the Strategic Systems Program Nuclear Weapons Security WQX-2 Program of Record. Additional transition targets include the Naval Facilities Command Electronic Harbor Security System.

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KEYWORDS: UUV; Harbor; Sonar; ATFP; Diver; Intruder

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-114   TITLE: GaN Avalanche Devices for RF Power Generation

TECHNOLOGY AREAS: Materials/Processes, Sensors, Electronics

ACQUISITION PROGRAM: Netted Emulation of Multi-Element Signatures against Integrated Sensors (NEMESIS)

OBJECTIVE: Develop high efficiency, high power avalanche-diode-based millimeter- (mm-) wave and terahertz (THz) sources in Gallium Nitride (GaN) diodes.

DESCRIPTION: Radio Frequency (RF) power generation by diode sources enables compact and affordable sources for a wide range of sensor applications. Avalanche breakdown is an important mechanism for the generation of RF power in a two terminal diode. Examples are IMPact ionization Avalanche Transit Time (IMPATT) diodes demonstrated in Silicon, Gallium Arsenide (GaAs), and Indium Phosphide (InP). By both thermal considerations and large breakdown field, Gallium Nitride-based avalanche devices should offer a substantial advance (~100X) in power output with improved efficiency

(~2X). The problem in wide bandgap nitrides is that until recently, avalanche breakdown has not been experimentally observed, despite two decades of material advances. The absence of experimental observation is often attributed to the higher dislocation density of current GaN technology, which lowers the breakdown electric field threshold due to non-avalanching mechanisms. Recently there are reports of the observation of avalanche-breakdown-like behavior in GaN devices for power electronics, where avalanche breakdown phenomena are exploited to prevent device burnout. No RF devices have been developed to exploit the avalanche behavior. The goal of this topic is to demonstrate RF power generation in Gallium Nitride or related group III-Nitride diodes exploiting avalanche breakdown.

PHASE I: Determine feasibility of exploiting avalanche breakdown in the III-Nitride system in a representative diode structure for RF power generation. Demonstrate avalanche gain behavior with a diode in a representative circuit. Design the required device geometries and material properties for W-band operation along with the expected power output and DC conversion efficiency, based on the current state of the art for high quality GaN materials and prior theoretical work on scaling studies of microwave diodes and material properties of GaN. The planned device should be capable of operation up to a nominal current density of 100,000 A/cm2.

PHASE II: Develop and demonstrate the device design formulated in Phase I. Fabricate the device with the appropriate GaN material technology, processing, and geometry to demonstrate RF power generation at a nominal frequency of 94 GHz in an appropriate circuit. Characterize the device performance as a function of DC operating parameters, circuit matching, and thermal effects. A fixtured device with waveguide output will be delivered to the government for validation along with test data detailing the device performance. Based on the measured device performance and scaling considerations, estimate expected performance for Ka-, and G-band operation.

PHASE III: Develop an RF source module based on the Phase II results for compact payloads for expendable decoys. Phase III should optimize power output and efficiency and develop device packaging that minimizes device heating through thermal management approaches. Leverage power electronics manufacturing approaches to enable affordable mm-wave sources.

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KEYWORDS: Gallium Nitride GaN; avalanche gain; avalanche diode; IMPATT oscillator; millimeter waves; THz.

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N152-115 TITLE: Active Thermal Control System Optimization

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PEO IWS 2 – Air and Missile Defense Radar

OBJECTIVE: Develop software tools to design and optimize the control architecture of multiple cold plate, high heat-flux thermal systems.

DESCRIPTION: Thermal Management is a critical requirement for future warships with electronic propulsion, weapon, and sensor systems. Innovative thermal architectures are needed to cool next-generation, high-energy density electronics which are expected to exhibit highly transient loads during pulsed operation. Two-phase cooling systems, such as vapor compression cycles, pumped cooling loops, and hybrid systems, are of particular interest for electronics cooling applications due to the large heat transfer coefficients from boiling flow, as well as their capability to maintain isothermal conditions as ambient temperature varies. In the presence of large thermal transients, active control may be required to avoid temperature variations, thermal lag, flow instabilities and critical heat-flux, which do not occur in state-of-the-art systems based on single-phase convective cooling. While control strategies for air-conditioning and refrigeration systems are well developed, the use of phase change cycles for electronics cooling is relatively new. In order for the thermal control system to accommodate transients, the component response times need to be understood and the control system optimized to ensure stable operation of coupled components while avoiding dry-out. The objective of this topic is to develop a software toolset with a graphical user interface to model various component configurations and control approaches for an electronics thermal control system. This toolset will allow for modeling of component interactions under dynamic thermal loads and evaluation of control methodologies for optimizing thermal performance, while minimizing system size and weight. Such components include, but are not limited to, variable speed compressors, pumps, electronic expansion devices, accumulators, charge compensators, liquid receivers, cold plates, condensers, and other components used in a two-phase thermal control system. The toolset will need to be able to monitor temperature, pressure, and flow, and simulate active control of components for modification of operation based on control algorithms and user inputs.

PHASE I: Develop component-level models (using a subset of components listed above) and formulate system-level concepts to characterize the control architecture for multiple-cold-plate, active thermal control systems. Validate model performance through static and transient laboratory experiments.

PHASE II: Based upon Phase I results, develop full-scale system-level software tools and control system modeling capability to optimize thermal response of advanced multi-cold plate architectures. Characterize operation, including transient behavior, of a representative thermal control system. Operationally test control system with relevant and/or simulating hardware. Deliver a standalone software toolset with graphical user interface.

PHASE III: Based upon Phase II effort, finalize software toolset and graphical user interface. Provide transition and commercialization plans using the knowledge gained during Phases I and II. Provide support during developmental and operational testing on full-scale radar, weapon, and other systems.

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2. J. Lee and I. Mudawar, “Low-temperature two-phase microchannel cooling for high-heat-flux thermal management of defense electronics,” IEEE Trans. Compon. Packag. Technol., vol 32, pp. 453-465 (2009).

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KEYWORDS: Thermal Management; Thermal Modeling; Active Control; Electronics Cooling; Optimization; Control System Modeling

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-116 TITLE: Affordable Compact HPRF/HPM Attack Warning System

TECHNOLOGY AREAS: Electronics, Battlespace, Weapons

ACQUISITION PROGRAM: ONR Code 35: Counter Directed Energy Weapons Research

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an affordable compact High-Power Radio Frequency (HPRF) attack warning system with recording capability that detects, characterizes and precisely geo-locates HPRF threats while being fully immune to HPRFs. System must have high sensitivity/dynamic range, providing HPRF power, frequency, bandwidth, pulse length and rep rate. The system must also be capable of distributing alerts to key facility decision makers.

DESCRIPTION: Advances in high power microwave threats pose significant dangers to critical naval electronic systems. To mitigate these dangers, a warning system is needed that will cover a broad range of potential HPRF frequencies and large dynamic range of intensities with the ability to survive and be operational under the highest intensities with low false alarm rate. The HPRF sensor should be able to provide frequency information of the attack, which may be wideband pulses (100-500 MHz, pulse widths 2 – 200 ns) or narrowband (500 MHz – 5 GHz, pulse widths 1ns-5μs). It must also measure the approximate power level as well as information about the direction to, and possible range of, the attacker to provide information for possible evasion maneuvers or potential retaliation. It is desirable to obtain HPRF geo-location information with an error of less than 5 degrees in both the azimuth and elevation/declination and provide an approximate target range. The HPRF irradiation may or not be repetitive. The system should be able to survive HPRF field intensities in excess of 50 W/cm2 without damage to the detection system (i.e. sufficiently high damage threshold). The system should be able to detect and characterize the power and frequency of current and anticipated HPRF sources being developed. Peak power and waveform measurements of the HPRF along with historical tracking of background RF irradiation/waveforms should be used to maximize the detector dynamic range and reduce the false alarm rate to levels below 1%. The system should be capable of roughly estimating the direction of attack, and estimated distance, and RF parameters so that facility decision makers can take proper action. The project is subject to technical risks in covering the broad range of potential intensities, possible frequencies and waveforms. The affordable system should be immune to the HPRF attack and have a low SWaP footprint that can be easily integrated into navy platforms (such as helos and UAVs) and their power sources without negatively impacting current system functionality such as power supplies, aerodynamics, weight-balance, and/or cargo/passenger space.

PHASE I: Conceptualize, design, develop, and model key elements for an innovative HPRF Advanced Warning System (AWS) that can meet the requirements discussed in the description section with emphasis on low false alarm rate and on providing accurate direction and range of the attacker; these latter items are important to extend the present state of the art. Perform modeling and simulation to provide initial assessment of the performance of the concept. The design should establish realizable technological solutions for a device capable of achieving the desired geo-locating accuracy for the wide range of HPRF waveforms listed while being immune to the effects of the HPRF irradiation. The proposed design should be an 80% complete solution and include all sub-systems necessary for this innovative HPRF AWS. The proposed brass board system should be designed to demonstrate a path towards providing a compact solution (with low SWaP) that can be easily integrated onto air (e.g. UAVs), ground or nautical platforms. Cost analysis and material development should be included to ascertain critical needs not yet fully developed or readily available given current technology. The design and modeling results of Phase I should lead to plans to build a prototype unit in Phase II.

PHASE II: Phase II will involve the design refinement, procurement, integration, assembly, and testing of a proof of concept brass board prototype leveraging the Phase I effort. The Phase II brass board prototype will be capable of providing frequency information of the HPRF source, which may be wideband pulses (100-500 MHz, 2 – 200 ns) or narrowband (500 MHz – 5 GHz, pulse widths, 1ns-5µs), and measure the approximate HPRF power level as well as provide accurate geo-location information as stated above. This brass board prototype must demonstrate a clear path forward to a full scale concept demonstrator based on the selected technology. Data packages on all critical components will be submitted throughout the prototype development cycle and test results will be provided for regular review of progress. The use of actual hardware and empirical data collection is expected for this analysis.

PHASE III: The performer will apply the knowledge gained during Phase I and II to build and demonstrate the full scale functional final design that will include all system elements and represent a complete solution. The final design should be compact and ruggedized and the sensor should be platform mountable (e.g. exterior of an airborne platform such as a UAV). The device should be applicable for test range use and should be immune to the damage from HPRF. The functional final design will provide notification of attack and capture data for later analysis. The data will provide signal characterization including field strength, frequency, pulse width, and repetition rate. Additionally it will provide for angle of arrival and probable distance. The probe(s) should be immune to HPRF. Data packages on all critical components and subcomponents will be submitted throughout the final development cycle and test results will be regularly submitted for review of progress. It is desirable for the performer to work closely with NAVAIR Program Offices, e.g. PEO (U&W) PMA-263, Navy and Marine Corps Small Tactical UAS and PMA-272 Tactical Aircraft Protection Systems program office to maximize transition and field testing opportunities. The initial use and desire for this final design will be to provide an Affordable Compact HPRF/HPM Attack

Warning System that can be combined with existing Naval UAS or Helicopter assets in a protective configuration for future Directed Energy threats. Working with the Navy and Marine Corps, the company will integrate their prototype HPRF/HPM Attack Warning System onto an existing vehicle for evaluation to determine its effectiveness in an operationally relevant environment. The company will support the Navy and Marine Corps for test and validation to certify and qualify the system for Navy and Marine Corps use. The company will develop manufacturing plans and capabilities to produce the system for both military and commercial markets.

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KEYWORDS: High power radio frequency; high power microwave; directed energy weapons; counter directed energy weapons; advanced warning system; HPRF threats, geo-locating

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-117 TITLE: Low Size, Weight, Power, and Cost (SWAP-C) Magnetic Anomaly Detection (MAD) System

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA-264, FNC SHD-13-05, High Altitude ASW from the P-8 Unmanned Targeting Air System

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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 5.4.c.(8) of the solicitation. 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: Leveraging recent advances in miniaturization of magnetometers, develop a low SWAP-C MAD system for use on small UAVs and helicopters.

DESCRIPTION: Research over the last decade has significantly reduced the Size, Weight, and Power (SWAP) of atomic vapor magnetometers, [1, 2] making these sensors a good match for unmanned Navy vehicles. This topic seeks innovative designs that incorporate such magnetometers into a Magnetic Anomaly Detection (MAD) system, including both the hardware and software to detect, localize, and track a magnetic dipole target from an Unmanned Aerial Vehicle (UAV). Traditionally, MAD systems must account for a variety of noise sources such as sensor noise, platform noise, geomagnetic noise, and movement in gradient fields so this effort must contain additional sensors to remove these noise sources. This MAD system is envisioned to provide a common sensor for use on Tier 1 UAVs as well as being towed from helicopters. The hardware goals are driven by the intended application for small UAVs. As such, the total field magnetometer should be commensurately small: sensor head size <100cc, electronics module <500cc, low-power (<5W total objective), and low-weight (<5 lbs. total). The noise floor should match or improve upon current commercially available sensors at 0.35 pT/rtHz between 0.01-100 Hz with a raw heading error <300 pT, compensated heading error <10 pT (objective), and remove dead zones inherent in traditional total field magnetometer designs.[3] The system should operate in all Earth's field conditions (roughly 25 µT – 75 µT). Proposals should include the performance of the existing total field magnetometer planned for incorporation into the MAD system and describe modifications that would be needed to meet these performance goals. The cost objective should be less than $10k in small quantities (~10/year). To reduce noise, additional sensors are usually included in a MAD system: a 3-axis vector magnetometer to compensate for platform noise, [4] a 3-axis accelerometer, GPS inputs, and other sensors. These additional sensors should be in-line with an overall compact low-power design, but need not be included in the SWAP parameters above.

Software should be able to detect, localize, and track a magnetic dipole target using GPS coordinates that are not necessarily straight and level flight. The algorithms should allow for the possibility of geomagnetic noise reduction with an external reference magnetometer. Computer intensive computations such as heading error correction, noise suppression, and MAD algorithms need not be done in the magnetometer and can be done in an external computer.[5]

PHASE I: Define a concept for a prototype compact MAD system. Demonstrate a total field magnetometer meeting the 0.35 pT/rtHz noise performance goal at 1 Hz in a bench top system. Include a 3-axis vector magnetometer and demonstrate an ability to compensate heading error. Develop software approaches for magnetic dipole detection and localization. Investigate noise reduction techniques to be implemented in the software and identify the associated hardware components.

PHASE II: Based upon the Phase I effort, construct a prototype MAD system and a reference magnetometer. Verify the MAD system survives expected test-flight conditions and meets performance goals in Earth's background field using the reference. Refine the software and integrate it with the hardware. Conduct a flight test to demonstrate the prototype MAD system's performance against a simulated target.

PHASE III: This system will be an integral part of the MAD UAV. Work with the UAV Primes to integrate, test and productionize the MAD system. Conduct operational demonstrate of the system's performance against a relevant target at sea. PMA-264 is the expected transition sponsor of the MAD UAV technology to be deployed on the P-8A for ASW MAD. Tasking would include: additional ruggedization of the system for Fleet use, implementation of cost reduction measures to provide a minimal-cost product for Navy acquisition, and integration of the system onto an ASW vehicle.

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KEYWORDS: Magnetometer; Magnetic Anomaly Detection, Airborne ASW, Sensor, Detection Algorithms, Noise Compensation

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-118 TITLE: Ultra High Density Carbon Nanotube (CNT) Based Flywheel Energy Storage for Shipboard Pulse Load Operation

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: P&E-FY15-03 Multi-Function High Density Shipboard Energy Storage

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. 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 Carbon Nanotube (CNT) based flywheel energy storage system for ultra-high density, high cycle rate, megawatt-scale pulse load energy storage systems.

DESCRIPTION: The introduction of advanced weapons systems such as rail guns, lasers, and other future pulse loads to future warships create power and energy demands that exceed what a traditional ship electric plant interface can provide. This creates the problem of satisfying growing demand for with stored energy, while working within the limited space available aboard ship platforms. Flywheel energy storage systems are potentially attractive due to high cycle life capability, tolerance for military environmental conditions, and capability for buffering multiple stochastic loads. This is provided by the capability to support rapid discharge and charge cycles on a continuous basis. However, prior Navy flywheel installations have been "built in", which do not allow for easy removal and replacement via a hatchable and/or modular installation that is scalable for multi-MW operation. The size and overall design of these flywheel systems are driven by issues such as rotor energy density due to tip speed limitations due to available material strength. Carbon Nanotube (CNT) based macrostructures in the form of conductive fiber and sheets with high strength and resilience provide the potential to improve state of the art flywheel energy storage. For flywheel designs, it is anticipated that CNT based composites can increase the available energy by over 30% as compared to existing state of art composite materials. This results in a potentially thermally, mechanically and dynamically compliant system operating with a tip speed greater than 1000 m/s. Given the infancy of this technology, innovative research is necessary to identify and prove the actual improvements over baseline state of the art composite designs, by applying new means of CNT integration into advanced wheel designs. The U.S. Navy is therefore interested in developing and characterizing the advantages of innovative shipboard flywheel system designs, directed and optimized to the MW scale, which maximize the advantages of CNT material integration. For the purposes of this effort, the below theoretical metrics of the flywheel design will be used as a basis. Continuously online charge-discharge of up to 50% duty cycle (e.g. up to 50% charging, 50% discharging). 26" shipboard hatchable design for easy removal or installation of components. Modular installation and operation capability to multi-MW levels, with relevant bus voltage and power conversion. Operation over the temperature range (40 – 140 F). Provide the capability to last for 60000 hours of online use and support >20000 cycles. The flywheel should be designed such that any the inertial material or other moving parts cannot penetrate into any personnel space under a catastrophic failure.

PHASE I: Determine feasibility and develop a conceptual system design for a CNT flywheel energy storage system and provide comparison against alternative existing metals or composite materials. The comparative design should highlight advantages that CNT components provide with respect to size, weight and performance in a shipboard environment. Perform an initial development effort that demonstrates scientific merit and capabilities of the proposed CNT materials for application in a high speed rotating storage application. Laboratory coupon specimens should be fabricated and characterized.

PHASE II: Fabricate the prototype CNT based components associated with the kinetic energy storage design developed in Phase I to the highest allowable scale given constraints of budget and schedule. Fully characterize and demonstrate capabilities and limitations of the CNT material based component. Update the kinetic energy storage design developed in Phase I based on results.

PHASE III: Based on Phase I and II effort, fabricate full megawatt-scale kinetic energy storage system incorporating CNT materials to support shipboard energy storage pulse power requirements through the existing ONR Multifunction Energy Storage FNC.

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KEYWORDS: Flywheel; carbon nanotube; rotor; high strength materials; pulse power; energy storage; mechanical battery

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-119 TITLE: Guidance System on a Chip

TECHNOLOGY AREAS: Weapons

ACQUISITION PROGRAM: USMC PMM-114 Artillery Fire Support Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: To develop a system on a chip for precision guidance for weapons and vehicles that combines guidance processor, inertial navigation, and motor control and feedback to enable precision weapons and unmanned systems small and efficient enough for the individual warfighter.

DESCRIPTION: Small munitions and individual warfighter launchable unmanned systems place a premium on the volume and weight available to both primary and payload systems. For precision weapons, the current state of the art in guidance systems was developed for larger diameter systems (81mm and above) and are simply too large and consume too much power to meet the needs of future precision weapon roadmaps (targeting 60mm and below). An innovative solution that combines all of the required processing, memory, inertial sensing, and multi-interface capabilities into a single microchip device will enable precision weapons as small as 30 to 40mm in diameter to be realized. For unmanned systems this will help to fully maximize the available payload volume. For both manned and unmanned systems it will decrease power system requirements. The guidance system will reduce cost and supply chain issues through part count reduction and commonality across procurements. Reductions in size, weight, and power of the guidance system will also benefit larger caliber systems. The risk lies in the combining of electronic with different substrates and manufacturing processes. The new guidance system will need to be a printed circuit board (PCB) mountable, self-contained device, no larger than 13mm (L) x 13mm (W). Internal packaging can be single or multiple die, as long as the whole device when properly secured to the PCB can be hardened to survive 50,000g acceleration loads. The embedded inertial sensors should include, at a minimum, 3-axis rate sensor and 3-axis accelerometer, with desire for 3-axis magnetometer. The I/O connections need to include 4 channel motor control (including actuator feedback), external analog sensor inputs, external digital sensor inputs, high speed serial for diagnostic/telemetry data, fuze communications, and re-programming interface.

PHASE I: Define and develop a concept for a Guidance System on a Chip that can meet the requirements listed in the description. Identify concepts and methods for integrating the required components and capabilities, possibly from different substrates and manufacturing techniques, onto a single chip die, or integrated multi-die package.

PHASE II: Complete detailed design and layout of the chip solutions defined in Phase I. Conduct modeling and simulation of the chip designs to reduce fabrication error risk and validate shock survivability of selected packaging solution. Phase II includes first fabrication run of chip(s), with a possible Phase II option concluding with testing the fully packaged device.

PHASE III: Integrate the prototype microchip device design from Phase II into the current USMC Guided Projectile (Mortar, Artillery, Rocket, Shoulder Launched), ONR 30 Guided Projectile S&T, and/or the Hyper Velocity Projectile (HVP) projectile. It will be tested in shock environment, Hardware-in-the-Loop, and live fire testing.

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KEYWORDS: Guidance; System on a Chip; Inertial Sensors; Guided Projectile; Precision Fires; Accelerometer; Rate Sensor

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-120 TITLE: Attack Sensitive Brittle Software

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PEO-SHIPS, PEO-C4I, PMW-130

OBJECTIVE: Develop transformation mechanisms that can be applied to software to achieve "fast-crash" property where successful attacks/compromises will cause the software to cease operating rather than continuing to operate in an unsafe state.

DESCRIPTION: Critical cyber systems are subject to attacks by the enemy. Generally, resilience and survivability are considered desirable properties for software in these systems. They aim to remain operational, though at a degraded state, when they are compromised. However, this is not always desirable. There may be circumstances where it is preferable for the software to be brittle and simply crash when attacks/exploits are successful. This would be the case when integrity and confidentiality requirements are much more important than availability requirements. Compromised or misbehaving software could be much more dangerous than simple unavailability. Another circumstance is when redundant and diversified backup systems are readily available. A faster failure and timely switch-over would minimize the disruption/damage and actually enhance overall resilience. Brittleness would be a plus in these circumstances. The aim is for the crash to occur as soon as possible after a successful attack and program control is lost. The objective of this solicitation is to develop transformation mechanisms for software that increase brittleness and achieve the "fast-crash" property. The transformation mechanisms should be generic and able to be applied to third party software. They should also preserve the functionality of the original software and incur relatively small computational overheads. We are interested in transformations that act on all layers including binary, byte code, and source code. The "fast-crash" property can be defined as the number of instructions/jumps/stack operations that gets executed after control of the program is lost. Compromised software will eventually crash; our goal is to speed up the crash so that malicious behavior cannot take place before it occurs. As such, "fast-crash" should occur within a handful of instruction/branches. Techniques that enhance resilience and survivability of code segments and systems have been an active area of research. We are looking for techniques that do the opposite. There is currently little research that explicitly aims to create brittleness in software. However, it is often the side-effect of some security techniques especially in the context of artificial diversity and randomization. For example, address space layout randomization (ASLR) aims to prevent buffer overflow attacks by making it difficult to reliably jump to a particular exploited function in memory [4,5]. Attempted attacks would crash the program by attempting jumps to invalid addresses. ASLR would be considered an effective "fast-crash" mechanism. We are looking for other mechanisms of achieving the "fast-crash" property against different categories of attacks such as return oriented programming (ROP). We would consider application, customization, or assessment of existing security mechanisms in the context of "fast-crash". However, novel mechanisms will be prioritized especially if they are able to be simpler, lighter weight, and more dependable than mechanisms meant for other purposes. It's important to note that "fast-crash" is different from active integrity verification techniques that directly identify attacks. We are NOT as interested in mechanisms that monitor the system and trigger a crash when attacks are detected. Ideally, the system crash should simply be a byproduct or guaranteed side-effect of a successful attack and compromise. The system should crash quickly and consistently after faults that are associated with deliberate attacks. At the same time, the system should not crash when attacks are not taking place or after random faults. The success of the result will be measured by both the false-positive rate and the false-negative rate. This SBIR topic will also consider active techniques if they are novel, generalized, and easily deployed. Another preference is for techniques that do not require source code and can be applied to raw binaries the military already deploys.

PHASE I: Develop and discuss the approach for the "fast-crash" transformation mechanism. Demonstrate the feasibility and effectiveness of the mechanism on arbitrary code segments. Prototypes of components that demonstrate the concept will be desirable.

PHASE II: Based upon Phase I effort, develop and demonstrate a fully functioning prototype of the "fast-crash" system on the provided experimental platform. Validate its efficacy during normal system operations and in the face of arbitrary attacks.

PHASE III: Upon successful completion of Phase II effort, the performer will provide support in transitioning the technology for Navy use as required. The performer will develop a plan for integrating the product into the Navy's HM&E software control systems and supervisory systems.

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5. Richard Wartell, Vishwath Mohan, Kevin W. Hamlen, and Zhiqiang Lin. 2012. Binary stirring: self-randomizing instruction addresses of legacy x86 binary code. In Proceedings of the 2012 ACM conference on Computer and communications security (CCS '12). ACM, New York, NY, USA, 157-168.

KEYWORDS: Cyber physical systems, Cyber security, Resiliency, Fault tolerant, Control Systems, Critical control system

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-121 TITLE: Compact Air-cooled Laser Modulate-able Source (CALMS)

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: Tactical Aircraft Programs (PEO(T)) / PMA272 ATAPS PE 064272N TAIRCM

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 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an air-cooled, compact laser source with selectable multi-line emission in the ultra-violet (UVA) portion of the spectrum that is scalable in power and able to change modulation state quickly, upon command, from continuous wave to 10 kHz.

DESCRIPTION: Today, flexible compact laser sources in the UVA (315 nm - 400 nm) are not available for lab/field testing or other military applications. Technology solutions to this problem are needed in several key areas: 1) increasing the output power of individual laser modules operating in the UVA spectrum, 2) developing the capability to efficiently combine the outputs of multiple laser modules into a single optical fiber for delivery to an optical pointer, and 3) combining these technologies into a compact system package that is suitable for applications with severe size and weight constraints. State of the art off the shelf diode lasers in this band are 250 mW or less. The ideal system design would be able to accommodate 3 or more lines anywhere within the UVA band, provide greater than 3W power output, be electronically driven from an external pulse source (1-100% duty cycle pulses), permit 2 to 3 orders of magnitude amplitude control, quickly switch between waveforms (DC thru 10kHz), and couple to a 100 micron core fiber output.

PHASE I: Formulate and develop a UVA laser system concept that can accommodate three or more lines anywhere within the UVA band, provide greater than 3W power output, be electronically driven from an external pulse source (1-100% duty cycle pulses), permit 2 to 3 orders of magnitude amplitude control, quickly switch between waveforms (DC thru 10kHz), and couple to a 100 micron core fiber output. If the laser is not truly continuous wave, then pulse repetition frequencies of greater than 100 kHz and pulse widths greater than 10ns are required. The volume of the full system shall not exceed 75 cubic inches. The system concept needs to specify all pertinent design details and explain why all materials chosen are believed to be suitable and capable of meeting the desired specifications. A detailed test plan must be developed explaining how a prototype would be validated during Phase II. The Phase I effort will not require access to classified information. If need be, data of the same level of complexity as secured data will be provided to support Phase I work.

PHASE II: Upon successful completion of Phase I, the Phase I design will be built and validated using the test plan developed in Phase I. The Phase II effort may require access to classified information. If as a result of the firm's proposed effort access to classified data is required during Phase II, the small business will need to be prepared to obtain appropriate personnel and facility certification for secure data access.

PHASE III: The product is expected to transition into military systems. The system could be integrated into existing systems or future developmental programs.

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1. Ultraviolet light progress in semiconductor - UV optical sources benefits security and defense. By John Carrano, Asif Khan, Michael Kneissl, Noble Johnson, Geoffrey Wilson, and Richard DeFreez. Oemagazine, 31 June 2003, SPIE Newsroom. DOI: 10.1117/2.5200306.0004. http://spie.org/x15968.xml

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KEYWORDS: Ultraviolet lasers; Spectral Beam Combining; Coherent Beam Combining; Fiber Coupled; Low SWAP; CW; Pulsed

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-122 TITLE: In-Transit Visibility Module for Lifts of Opportunity Program (LOOP) & Transportation Exploitation Tool (TET)

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: NAVSUP Transportation Exploitation Tool is local prototype seeking to become a program of record.

OBJECTIVE: Develop and demonstrate an In-Transit Visibility (ITV) module that will enhance Lifts of Opportunity (LOOP) planners' ability to accurately and in near-real-time monitor the transportation of critical end items, predict time of arrival and potential hazards to the mission, and provide decision support tools including mission performance metrics and automatically generated alerts if human intervention is required.

DESCRIPTION: The United States Transportation Command (USTRANSCOM) plans and executes worldwide movement of cargo and people at sea, on land, and in the air, launching an average of 1,700 movements a day. Navy Fleet/Force transportation requests within USTRANSCOM are routed to specialists who focus on satisfying requirements using a mode of transportation with minimal coordination between them and their counterparts. To avoid the high cost for dedicated USTRANSCOM Special Assignment Airlift Mission (SAAM) or contracted commercial flights, the Navy developed and implemented a Transportation Exploitation Tool (TET) prototype. TET helps planners find cargo capacity on SAAMs or other conveyances that can support mission requirements resulting in significant cost avoidance for the urgent movement of cargo worldwide. Once a mission is booked, transportation planners and fleet forces require the ability to accurately track urgently needed cargo as it moves from its origin to its destination and through all transportation nodes, and then allow planners to close out the mission. The ITV of critical supplies throughout the movement will have several important benefits: 1) allows team to plan for material handling, and other special equipment and personnel needed to load the cargo at transportation nodes, 2) provides early identification of problems or delays during the mission that may necessitate re-planning, and 3) increased visibility helps ensure critical items are not needlessly re-ordered. Current state of the art for large scale DoD ITV systems use radio frequency identification (RFID) tags and a network of read/write stations (to include satellites). Systems like the Army's Joint-Automatic

Identification Technology (J-AIT) have over 1,900 stations alone. These types of systems are costly and manpower intensive. The limitations the Navy has for manpower and funding requires an innovative solution for an ITV capability using data that is already available. The focus of the ITV module is threefold. First is development of software tools (Intelligent Agents (IAs) and semantic services) that can take disparate sources of data (real-time feeds, near-real-time feeds, manual entry, and historical references) and fuse them to accurately infer location data of transported items with high confidence. Second is development of additional decision support tools to aid planners. This includes automatic generation of alerts and tracking of mission performance metrics. Third and final is development of predictive models that will use the same data sources to anticipate arrival times of logistical items. The capability to predict arrival times (updated as the current location changes) of goods in finer granularity than current methodologies is necessary to facilitate planning. Using machine learning methodologies, the predictive models should be able to learn from previously executed missions to identify trends that support successful mission planning and execution. Challenges include development of a robust IA that can digest large quantities of data and mine pertinent information (specified and inferred) on specific items. Data may need to be semantically connected (for example, connection of the cargo ID to a strategic mission with its flight schedule and inflight tracking data) in order to derive relevant mission data (location, time to arrival, and probability of success for completing the next mission leg). The software tools need to be accurate, reliable, and able to run efficiently on handheld operating systems compatible with the Ozone Widget Framework (OWF). The existing TET system runs as a web service on the NIPRNET/SIPRNET (the Department of Navy's unclassified and classified internal computer networks). For this effort, the ITV module will initially attain static or live data feeds from existing TET services through an existing systems integration laboratory (SIL) environment (the government will ensure access to the SIL for the awarded companies) at The Pennsylvania State University (PSU) Applied Research Laboratory (ARL), independent of Department of Defense (DoD) networks but funded by the government. The SIL environment with virtual machines will allow experimentation and integration without the need for operational security and information assurance certification until the system is actually deployed. Message communications between TET and the ITV service is required; for example an alert of a missed transportation connection would be pushed back to TET to initiate dynamic re-planning of the mission. Examples of communication channels that need to interface with TET/ITV: Marine Corps' Tactical Service Oriented Architecture (TSOA), Naval Tactical Cloud (NTC). Examples of incoming data feeds provided via the SIL: IDE/GTN Convergence (IGC), Global Decision Support System (GDSS), Federal Aviation Administration (FAA), National ITV Server, Global Air Transportation Execution System (GATES), Weather, Coast Guard Automated Information System (AIS) or equivalent. Real time feeds will ultimately be pursued with support from the government.

PHASE I: Define and develop a concept and software architecture for an ITV module that can infer location of a logistical item using available real time feeds, near-real time feeds, and historical data. The ITV module architecture shall support communication with NAVSUP's Transportation Exploitation Tool (TET) to receive mission details, data feeds, and to transmit alerts or other messages back to TET. The performer will define decision support tools to capture critical metrics of current/historical mission performance. These tools require automatically generated alerts for situations that may hinder mission success and that prompt actions from planners. In addition, develop predictive models that provide real/near-real time updates of arrival times for logistical items. The performer will also define an open source widget based approach to enable mobile/handheld devices to interact with the ITV module. At the conclusion of Phase I, the performer should provide a viable path forward for the implementation of the concept ensuring coupling of communication with the TET tool. The small business shall deliver architecture views, describe the software's major functions, describe the user interface, outline data messaging functions, and describe the proposed software development process, schedule, risk, and cost.

PHASE II: Develop and demonstrate a handheld ITV prototype based on Phase I efforts in a SIL environment. The software shall demonstrate all major functionality to include ITV and prediction of arrival of TET missions in execution, implementation of decision support tools (i.e. real-time alerts) , and collection of key performance metrics for use in future analytic models. This includes validating ability of the ITV module to locate an object for a lift of opportunity mission in execution with high confidence to accurately predict arrival times within a low margin of error, using only the data feeds provided to the performer through ONR and PSU ARL. The ability of the module to mine, digest, and derive object location, in the finest granularity possible, in a timely manner (within a few minutes) is necessary to ensure an appropriate planning capability. Alerts and other desired analytical and decision support aspects will also be demonstrated. Phase II will include a government evaluation by transportation planners at NAVSUP in Norfolk.

PHASE III: Phase III will focus on the seamless integration of the ITV module with the TET in a cross domain NIPRNET/SIPRNET environment by transportation planners in Norfolk, VA. This includes refining and implementing enhancements to existing software functions and addition of functions that support transportation planning and ITV. The performer will work closely with NAVSUP and the program of record for the TET application to ensure that both TET and ITV components will work in an efficient and effective manner in a relevant environment during planning missions. This effort includes software verification and validation functions and completion of information assurance tasks necessary for deployment on NIPRNET/SIPRNET.

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KEYWORDS: In-Transit Visibility, Transportation Management Systems, Intelligent Agent, Predictive Models, Logistics, Demand Forecasting, Semantic, Decision Support

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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N152-123   TITLE: Advanced UHF SATCOM Satellite Protection Features

TECHNOLOGY AREAS: Electronics, Space Platforms

ACQUISITION PROGRAM: Navy Communications Satellite Programs, PEO Space Systems, PMW 146

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 5.4.c.(8) of the solicitation. 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 advanced electromagnetic interference protection features for future Ultra High Frequency (UHF) SATCOM satellites.

DESCRIPTION: More than 60 percent of Satellite Communications (SATCOM) users are supported by the Ultra High Frequency (UHF) band. The Navy's Communications Satellite Program Office (PMW 146) acquires UHF SATCOM satellites for the Department of Defense (DoD). The current operational UHF Follow On (UFO) satellites will soon be replaced by the Mobile User Objective System (MUOS) constellation, which should be fully launched by 2017. Soon the Navy will investigate potential next generation UHF SATCOM systems. Acquisition of the system that follows MUOS will likely start in the next few years. Enhanced protection features will be critical for that system. Since the MUOS satellites were designed, it has become apparent that the space domain "is becoming increasingly congested, contested, and competitive" as described in the National Security Space Strategy. The next generation of satellites must be protected from a number of threats including radio frequency interference. Many previous research efforts have developed technology to protect terrestrial UHF SATCOM terminals. These efforts aimed to protect terminals against local interference in the SATCOM downlink (space to ground link) or against interference in the SATCOM uplink (ground to space link) that was re-broadcast to the ground by the satellite transponder. This effort seeks innovative solutions which are resident on the satellite. The goal is to protect the SATCOM uplink at the satellite instead of protecting the terrestrial terminals. CubeSats or nano-satellites are popular among universities and are gaining momentum with commercial and government organizations. They may be an avenue to demonstrate new electromagnetic interference protection features quickly and at low cost. Such a demonstration path, if applicable to a particular interference protection feature, would likely allow the new technology to be tested in space in time for it to be incorporated into the next generation of UHF SATCOM satellites. If the technology is also applicable to nano-satellites, it could find use in emerging nano-satellite programs within DoD.

PHASE I: Determine feasibility and develop advanced electromagnetic interference protection features for future UHF SATCOM satellites. Perform analysis, modeling and simulation, or other calculations to establish performance possibilities. Translate design concepts into a product development roadmap establishing a technical and program pathway to an operational capability demonstration. Tasks under this phase include:
• Develop new electromagnetic interference protection concepts for UHF SATCOM satellites
• Create an initial design of the protection feature(s)
• Characterize and explore system trades
• Predict performance parameters
• Implement early prototype(s) and demonstrate in a laboratory environment if applicable
• Evaluate potential CubeSat or nano-satellite demonstration options, if applicable

PHASE II: Develop a prototype electromagnetic interference protection feature(s) and demonstrate it in a space environment. • Evaluate measured performance characteristics versus expectations and make design adjustments as necessary • Demonstrate the performance of the electromagnetic interference protection feature • Demonstrate the technology in a space environment. This could entail integration with a CubeSat or nano-satellite. Another possibility is laboratory based environmental testing such as thermal vacuum, vibration, radiation and other testing. Capabilities demonstrated (e.g. performance characteristics and/or limitations) in Phase II may become classified.

PHASE III: Based on Phase I and II effort, finalize design and integrate the electromagnetic interference protection technology into future UHF SATCOM systems.

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3. CubeSat Design Specification, http://cubesat.calpoly.edu/

4. Naval Open Architecture. Https://acc.dau.mil/oa

KEYWORDS: Cubesat; nanosat; UHF; SATCOM; protection; resiliency; electronics

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