NAVY
14.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

The responsibility for the implementation, administration, and management of the Navy SBIR Program is with the Office of Naval Research (ONR). The Director of the Navy SBIR Program is Mr. John Williams, john.williams6@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 under each topic from **23 April through 22 May 2014.** Beginning **23 May**, the SITIS system (http://www.dodsbir.net/Sitis/Default.asp) listed in Section 4.15.d of the DoD SBIR Program Solicitation must be used for any technical inquiry.

TABLE 1: NAVY SYSCOM SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	Activity	Email
N142-083 thru N142-089	Ms. Elizabeth Madden	MARCOR	sbir.admin@usmc.mil
N142-090 thru N142-110	Ms. Donna Moore	NAVAIR	navair.sbir@navy.mil
N142-111 thru N142-124	Ms. Lore-Anne Ponirakis	ONR	loreanne.ponirakis@navy.mil
N142-125	Mr. Mark Hrbacek	SSP	Mark.Hrbacek@ssp.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 website at http://www.navysbir.com. Additional information pertaining to the Department of the Navy's mission can be obtained by viewing the website at http://www.navy.mil.

PHASE I GUIDELINES

Follow the instructions in the DoD Program Solicitation at www.dodsbir.net/solicitation for program requirements and proposal submission guidelines. It is highly recommended that you follow the Navy proposal template located at http://www.navysbir.com/submission.htm as a guide for structuring your proposal. Cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings are 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 Offeror's proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

The Navy requires proposers to include, within the **20-page limit**, an option which 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 base amount of the Phase I should not exceed $80,000 and six months; the Phase I option should not exceed $70,000 and six months.**

Due to the timing and 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 not be available, proposed GFE may be considered a weakness in the proposal.

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 time to award goals. 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 award may be terminated. If you are proposing human, animal, or recombinant DNA use under a Phase I or Phase II proposal, you should view the requirements at: http://www.onr.navy.mil/en/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This website provides guidance and notes approvals that may be required before contract/work can begin.

PHASE I PROPOSAL SUBMISSION CHECKLIST:

The following criteria must be met or your 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. The costs for the base and option are 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. 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 base effort should not exceed $80,000 and have a period of performance of six months and the option should not exceed $70,000 and have a period of performance of six months. If proposing direct DTA, a total of up to $5,000 may be added to the Base or Option periods combined.

____6. Upload your Technical Volume and the DoD Proposal Cover Sheet, the DoD Company Commercialization Report, and Cost Volume electronically through the DoD submission site by 6:00 am ET, 25 June 2014.

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

The Navy will evaluate and select Phase I proposals using the evaluation criteria in Section 6.0 of the DoD Program Solicitation with technical merit being most important, followed by qualifications 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.

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

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

The Navy typically awards a firm fixed price contract or a small purchase agreement for Phase I.

In accordance with Section 4.10 of the DoD Instructions, your request for a debriefing must be made within 15 days of non-award notification.

CONTRACT DELIVERABLES

Contract Deliverables (CDRLs), typically progress reports, final reports, and initial Phase II proposals should be uploaded to https://www.navysbirprogram.com/navydeliverables/ as required by the contract.

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. The 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. **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 Department of Navy 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 Department of the Navy (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. The DoN will NOT be exercising this authority for Phase II awards. **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.**

The Navy will evaluate and select Phase II proposals using the evaluation criteria in Section 8.0 of the DoD Program Solicitation with technical merit being most important, followed by qualifications 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. The Navy does NOT participate in the FAST Track Program.

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. The Commercialization Readiness Program (CRP) [formerly the Commercialization Pilot Program (CPP)] 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). A percentage of SYSCOM SBIR funds are dedicated to expand transition funding to further develop SBIR technologies and to accelerate transition for existing Phase II projects, highlighting the Navy's commitment to technology transition.

DISCRETIONARY TECHNICAL ASSISTANCE – The SBIR Policy Directive section 9(b), allows the DoN to provide discretionary technical assistance to its awardees to assist in minimizing the technical risks associated with SBIR projects and commercializing products and processes. Firms may request, in their application for 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.

Approval of direct funding for this discretionary technical assistance will be approved by the DON SBIR office if the firm's proposal clearly identifies the need for assistance (purpose and objective of required assistance), provides details on the provider of the assistance (name and point of contact for performer) and why they are uniquely skilled to carry out this work (specific experience in providing the assistance proposed), and 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 is not subject to any profit or fee by the requesting (SBIR/STTR) firm. In addition, the provider of the discretionary technical assistance 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 your proposal will result in your request for discretionary technical assistance being disapproved. Exceeding proposal limits identified for Phase I ($150,000) without including the required identification of Discretionary Technical Assistance will result in your proposal being REJECTED without evaluation.

If the firm requests discretionary technical assistance in a Phase II proposal, they will be eliminated from participating in the Navy Transition Assistance Program (TAP) and Navy Opportunity Forum or any other assistance the Navy provides directly to firms.

Phase I awardees that propose more than $150,000 in total funding (Base, Option and discretionary technical assistance) cannot receive a purchase order. Purchase orders are a type of Simplified Acquisition Procedure (SAP) intended to reduce administrative costs; improve opportunities for small, small disadvantaged, women-owned, veteran-owned, HUBZone, and service-disabled veteran-owned small business concerns to obtain a fair proportion of Government contracts; 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.

All Phase II awardees not receiving funds for discretionary technical assistance in their award must attend a one-day Transition Assistance Program (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/navytap. 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 – 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 which 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 according 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). The government's prime contractors and/or their subcontractors shall follow the same guidelines as above and ensure that companies operating on behalf of the Navy protect the rights of the SBIR company.

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) 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 before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact your original sponsoring agency before submitting a Phase II proposal to an agency other than the one who sponsored the original topic. (For DoN awardees, this includes other SYSCOMs.)

TRANSFER BETWEEN SBIR AND STTR PROGRAMS – Section 4(b)(1)(i) of the SBIR Policy Directive provide 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 their designated technical monitor to discuss the reasons for the request and the agency's ability to support the request. The transition may be proposed prior to award or during the performance of the Phase II effort. Agency disapproval of a request to change programs shall not be grounds for granting relief from any contractual performance requirement. All approved transitions between programs must be noted in the Phase II award or award modification signed by the contracting officer that indicates the removal or addition of the research institution and the revised percentage of work requirements.

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NAVY SBIR 14.2 Topic Descriptions

N142-083 TITLE: Development of an HSI Module and Material-Design Software to Support Concurrent Design Concept Exploration

TECHNOLOGY AREAS: Human Systems

ACQUISITION PROGRAM: Framework for Assessing Cost and Technology (FACT) Program

OBJECTIVE: Develop a Human Systems Integration (HSI) module and the associated material-design software capable of providing a Model Based Systems Engineering (MBSE) environment that will permit concurrent engineering for the conduct of an analysis of alternatives (AoA). Successful development would enable a real-time heuristic assessment of platform design choices such as human performance elements, including ergonomics (human factors engineering (HFE)), system safety, health hazards, manpower, personnel and training (MP&T), personnel survivability, and habitability, with enough flexibility to apply the HSI domain models most applicable to the system under evaluation and their potential life-cycle impact on acquisition concerns.

DESCRIPTION: Organizations sometimes overlook the inclusion of HSI activities in their systems engineering processes. Thus, "...there has been a continuing concern that, in each phase of development, the human element is not sufficiently considered along with hardware and software elements" (Ref. 1). Over time, this has led the DoD to provide more guidelines mandating or instructing the use of HSI (Ref. 2, 3). Present modeling capabilities are done in a stove-piped fashion when addressing performance, cost, human systems integration and reliability. Each engineering discipline independently assesses the impact of a proposed design change on a system and then passes the impact in a sequential fashion to the next engineering competency to evaluate. This process is time consuming, manpower intensive, and extremely costly. Currently, the acquisition process does not have the capability to assess models for the various engineering disciplines in a concurrent fashion so that collaborative engineering can be conducted. Presently, there are no commercially available technologies that could be directly applied to solve this challenge.

Developing an HSI module and associated material-design software that enables real-time heuristic assessments of HSI design concerns in a concurrent fashion with cost, performance, and reliability achieves a major step forward in streamlining the engineering efforts associated with acquisition and would provide a tool to complement concept exploration (Ref. 4). This effort is unique in that, if successfully developed, it would provide a human systems software tool focused on collaborative engineering, interoperability and data sharing with the emphasis centered on meta-data. This innovative tool does not presently exist and would enable acquisition personnel and associated performers to account for human performance considerations much earlier in the system life-cycle. This, in turn, would reduce the risk of life-cycle system failure, reduce total ownership costs, and potentially enhance systems' operational performance at the human-machine interface. As an example, engineers working on the Survivability Key Performance Parameter (KPP) for a ground tactical vehicle understand that there are second order effects to the design parameters they select for vehicle armor. However, in the conventional process used today, they do not see the tradespace in other KPPs that is impacted by design parameters assigned to meet the Survivability KPP. It is intuitive that adding armor thickness has consequences in terms of the vehicle's interior and exterior dimensions, operator field of view, equipment placement, weight, acceleration, maximum climbing grade, righting moment, and fuel consumption. Similarly, design changes to accommodate human concerns may impact other aspects of the design and overall system performance. To see the corresponding impact on the system as a whole as a result of a design change and make informed, data-driven trade space decisions, the design team needs a federation of engineering, HSI and cost models that communicate using data tagged with precise metadata definitions.

This topic seeks to explore the development of an HSI module and the associated material-design software within the Framework for Assessing Cost and Technology (FACT) Program that would facilitate top-down analysis of HSI system designs through the ability to instantiate many system models (dozens, hundreds, thousands, etc.) by combining the various subsystems and components identified in the Work Breakdown Structure (WBS) of a system. Beginning with the system KPPs (generally threshold and objective performance, although not limited to) and budgetary constraints for procurement and sustainment, this software tool would support an engineering federation that will compare a virtually unlimited number of potential system designs and then provide mechanisms to filter those instantiations based on user-specified criteria. Perhaps the most direct benefit of using this approach is for

concurrent exploration of the design trade-space early in the conceptual design phase in a synthetic environment and to, in real-time, see the effect(s) of design decisions on manufacturing considerations, human concerns, and acquisition factors. This, in turn, would enable the user to eliminate from consideration those system designs that have little or no potential for success. This HSI module and associated material-design software will not seek to replace existing, fine-grained human performance analysis tools, such as IMPRINT or MIDAS, which are used to perform detailed simulation-based analysis of more mature designs in the latter stages of development. Proposed concepts will need to be web-based and accessible from common computer workstations. Open architecture design principles are encouraged to enable maximum flexibility with the need to be able to interface with multiple models and other software design tools.

PHASE I: Develop concepts for an HSI module and associated material-design software within FACT to enable a heuristic assessment of platform design choices and their potential life-cycle impact on acquisition concerns, such as life-cycle costs, and human performance elements, including ergonomics ("HFE"), system safety, health hazards, manpower, personnel and training (MP&T), personnel survivability, and habitability. The company will demonstrate the feasibility of the add-on software tool in meeting Marine Corps needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by analytical modeling, as appropriate. The small business will provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, the small business will develop a scaled prototype for evaluation using the HMMWV program or another program as specified by the sponsor for initial application. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements as referenced in the description. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. The company will prepare a Phase III development plan to transition the technology to Marine Corps use as well as identifying the way forward for user training of the existing HSI module and development of HSI module add-ons which addresses other HSI domains that may not have been incorporated into the Phase I concept.

PHASE III: If Phase II is successful, the company will be expected to provide support in transitioning the technology for Marine Corps use. In accordance with the Phase III development plan, the company will extend the limited scope solution to a wider range of platforms, i.e., design and development of HSI module(s) and associated material-design software for concurrent engineering for the conduct of an AoA. Additional HSI add-ons to the HSI module and the associated material-design will need developing to include HSI domains (i.e., HFE, system safety, health hazards, manpower, personnel and training (MP&T), personnel survivability, and habitability) that were not addressed in the Phase I concept design. The company will provide support for test and validation and qualify the system for Marine Corps use. The company will transition a software package to the Marine Corps that supports generalizable, human-performance concept exploration and provides for user training of this HSI module.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Applications for this technology would be the aviation and automobile industry. HSI saves time and money. Published case studies repeatedly show high Return On In-vestment (ROI) from HSI efforts. For instance, a review by Harold Booher lists an Air Force program that had a 50:1 ROI (i.e., a savings of $50 for every $1 initially spent on HSI), as well as two different Army helicopter programs that had 44:1 and 22:1 ROIs, each (Booher, 2003; see also Commonwealth of Australia, 2010; Liu et al. 2010). HSI processes applied during the acquisition process also mitigate the risk of system underuse, reduced operational performance, or systems failure (e.g., Pew, Mavor, et al., 2007).

REFERENCES:

1. Pew, R. W., Mavor, A. S., and Committee on Human-System Design Support for Changing Technology. (2007). Human-System Integration in the System Development Process: A New Look. National Academies Press: Washington, D.C.

2. Office of the Secretary of Defense. (2009). FY09 Department of Defense Human Systems Integration Management Plan, Version 1.0. Washington, DC: ODUSD(A&T), ODUSD(S&T) Director of Biological Systems. http://www.acq.osd.mil/se/docs/FY09-DoD-HSI-Management-Plan.pdf.

3. Naval Human Systems Integration Management Plan www.acq.osd.mil/se/docs/2009-Navy-HSI-Management-Plan-v2-2-1.pdf.

4. Liu, K. K., Valerdi, R., Rhodes, D. H., Kimm, L., and Headen, A. (2010, April). The F119 Engine: A Success Story of Human Systems Integration in Acquisition. Defense Acquisition University. http://www.dau.mil/pubscats/PubsCats/AR%20Journal/arj54/Liu%2054.pdf.

KEYWORDS: MBSE; HSI; acquisition tool; analysis tool; human performance; HFE; federated model

N142-084 TITLE: In-Situ, Non-Destructive Permethrin Test Device for Military Fabrics and Uniforms

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PM IWS, PdM Infantry Combat Equipment (ICE) Combat Clothing

OBJECTIVE: The objective is to develop an in-situ, real-time test method to enable verification of permethrin content in military fabrics and uniforms by Marines in the field.

DESCRIPTION: Vector-borne diseases remain a significant threat in military and humanitarian operations resulting in reductions in manpower, lost duty days, and decreased combat effectiveness. Personal Protective Measures (PPMs) are the most effective means of protecting Marines from these threats, a key component of which is insect repellent treated gear. Permethrin is an Environmental Protection Agency (EPA) approved synthetic pyrethroid that is both an insecticide and repellent. The Marine Corps Combat Utility Uniform (MCCUU) is permethrin treated to provide protection against biting insects and insect-borne diseases. The initial permethrin content requirement for the MCCUU blouse is 0.104-0.141 mg/cm2 and for the trousers is 0.123-0.170 mg/cm2. Permethrin content is currently measured at the factory and government laboratories where it is determined using a complicated analytical test method. The current laboratory method is a destructive test where samples are cut from various areas of a uniform. The permethrin is then extracted with solvent and measured using a Gas Chromatography-Mass Spectrometer (GCMS) to determine the content. The laboratory lot verification testing typically requires 2 individuals for a total of 9 man-hours for testing unlaundered samples. Individual uniforms are tested initially and after 20 and 50 laundering cycles for first article testing. Laundering 20 cycles requires at least one week time and would require at least 10 additional man-hours. Verification testing is done on samples from every production lot by the manufacturer and sampled randomly by the government after initial vendor certification. Verification testing at government facility typically takes 14-30 days from receipt depending on quantity of lots in testing queue. Unfortunately, the testing process and the required laboratory equipment to perform this testing are not amenable to use outside of a laboratory. Presently, there is no commercially available method of in-situ permethrin testing for clothing. The inability to validate and/or verify suitable permethrin content, allows for a potential increase in exposure of Marines to disease-carrying biting insects in high-risk operational areas as well as the premature disposal of uniforms as individuals err on the side of caution.

The Marine Corps seeks innovative approaches to develop a portable, hand-held, non-destructive permethrin test device and associated methodology to enable non-destructive, in-situ determinations that military uniforms and fabric have the required permethrin content. For all proposed concepts, the correlation coefficient between the two test methods (laboratory using GCMS and proposed in-situ method) should be greater than 90%. The sensitivity of the proposed in-situ measurement method should allow for detection of not only target content but also for decreased content, down to as low as 10% of initial permethrin content. For example, if the original permethrin content is 0.104 mg/cm2, then this method should be able to detect as low as 0.010 mg/cm2. Proposed concepts should focus on the elimination of solvent usage, thus making the apparatus “greener” and not depending on the availability of the appropriate solvent. Proposed concepts shall be robust for field use and compliant with anticipated hot and cold environments with the appropriate moisture and dust protection as specified in MIL-STD-810G and shall be usable by any single individual. Information shall be provided in real-time, (a maximum of 5 minutes) to enable timely analysis for the end user and shall provide the end user the capability to determine the level of protection remaining in the tested material. Proposed concepts need to be compliant with open architecture design protocols to provide the user the ability to test on any military fabric in multiple configurations (i.e., worn or not worn, etc.). Proposers are

encouraged to use COTS components where appropriate and to be mindful that material selection, method of power, etc., should be conducive to in-situ operations in varied operational environments.

PHASE I: Develop concepts for an in-situ, non-destructive, permethrin test device to enable real-time measurement on military uniforms and fabrics. Demonstrate the feasibility of the concepts in meeting Marine Corps needs and establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. The small business will provide a Phase II development plan which will include performance goals, key technical milestones and address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, the small business will develop a scaled prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the in-situ, non-destructive, permethrin test device. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Incremental evaluation results will be used to refine the prototype into a production design that will meet Marine Corps requirements. Company will deliver 3 finalized test device prototypes to USMC for independent evaluation and testing. The company will prepare a Phase III development plan to transition the technology to Marine Corps use.

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 in-situ, non-destructive, production-ready, permethrin test device for evaluation to determine its effectiveness in an operationally relevant environment for lot verification and on the spot uniform testing. The small business will support the Marine Corps with certifying and qualifying the system for Marine Corps use. As appropriate, the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to the military market, this technology would have applications to clothing and gear in other markets including the outdoor clothing and woodland firefighting markets.

REFERENCES:
1. “Insect-repelling ACUs now available to all Soldiers” by David Vergun , J.D. Leipold
http://www.army.mil/article/88171/Army_s_new_ACUs_combat_insect_borne_diseases/.

2. Permethrin Facts (Reregistration Eligibility Decision (RED) Fact Sheet)
http://www.epa.gov/oppsrrd1/REDs/factsheets/permethrin_fs.htm.

3. “Permethrin Factory-Treated Army Combat Uniforms Frequently Asked Questions and Answers.” Aberdeen Proving Grounds, MD: U.S. Army Public Health Command Entomological Sciences, July 2013.
http://phc.amedd.army.mil/PHC%20Resource%20Library/Permethrin_Factory-Treated_Army_Combat_Uniforms_FAQs.pdf.

4. “Armed Forces Pest Management Board Technical Guide No. 36: Personal Protective Measures Against Insects and Other Arthropods of Military Significance.” Armed Forces Pest Management Board Information Services Division, October 2009. http://www.afpmb.org/sites/default/files/pubs/techguides/tg36.pdf.

5. National Pesticide Information Center PERMETHRIN TECHNICAL FACT SHEET
http://npic.orst.edu/factsheets/Permtech.html.

KEYWORDS: Permethrin; Textile Production; Military Clothing; Combat Clothing; Individual Protection

N142-085 TITLE: Protective Helmet Suspension and Retention System

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PM IWS PdM Infantry Combat Equipment (ICE)

OBJECTIVE: Development of a suspension and retention system that improves the protective capabilities of Marine Corps helmets by increasing the blunt impact protection capability during a low velocity impact event and decreasing the ballistic energy transferred through the helmet to the head during a high velocity impact event.

DESCRIPTION: The current helmet suspension system utilizes a pad suspension system that has not been updated since it was fielded in 2006. While the helmet shell material has been and continues to be improved, the helmet suspension and retention systems have not been updated to account for the increased amount of ballistic energy that these improved helmet shells are now able to withstand. Additionally, the current suspension and retention systems were not designed to protect against the head injuries caused by the increased number of blasts from Improvised Explosive Devices. Research has shown that pad suspension systems are more beneficial for low velocity/blunt impact events rather than high velocity impacts and blast events. During a low velocity or blunt impact event, the pad system acts as a cushion for the head by compressing and absorbing the energy from the impact. During a high velocity impact event, a pad system alone does not have enough time to compress, and thus is able to absorb little of the energy from the impact. Additionally, pad systems are susceptible to temperature variations, becoming hard at cold temperature and soft at high temperatures. New concussion data coupled with changes in the operating environment and improvements to helmet shell materials have necessitated a change to the helmet suspension and retention system to better protect the warfighter against head injuries. The Marine Corps is preparing to field a new helmet, the Enhanced Combat Helmet, which provides improved fragmentation and ballistic protection against select small arms over previous helmets. As previously discussed, the increased protection offered by the new helmet shell technology has necessitated improvements to the suspension and retention system in order to dissipate the increased amount of ballistic energy that the improved helmet shell is able to withstand.

For this reason, the Marine Corps seeks to explore innovative approaches to an innovative helmet suspension and retention system in order to improve head protection during both low and high velocity impact events as well as blast events in an effort to reduce and/or prevent concussions and skull fractures caused by blast, blunt and ballistic trauma to the head. This effort presents a challenge in that optimizing performance in one of the areas of blast, blunt, or ballistic protection tends to be counterproductive to optimizing other areas. An additional challenge is the desire to achieve this enhanced protection without impacting the weight, size, stability and comfort of the helmet shell. Concepts proposed should be mindful of the following requirements:

- Integration and attachment: Able to integrate with the existing Marine Corps family of helmet shells without reducing or changing the area of coverage provided by the helmet shell. The desire is to have a single concept that is retrofittable to the family of helmet shells rather than a unique solution for each helmet shell. Proposed concepts shall possess a means of easy attachment, removal and reattachment to the inside of the helmet shell and shall remain firmly in place when attached. Use of the existing retention points is of particular interest so as not to introduce new holes in the helmet shells.

- Comfort: Provide a level of comfort that is greater than or equal to the current suspension and retention system, shall provide a means to manage heat and perspiration buildup inside the helmet, and prevent hot spots/pressure points from developing after prolonged use.

- Stability: The proposed system concept shall provide a level of stability that is greater than or equal to the current suspension and retention system, and shall prevent the helmet from shifting position on the head during routine mission scenarios.

- Blunt Impact: The proposed system concept shall prevent head acceleration from exceeding 150 G at all impact velocities less than or equal to 17.1 ft/sec [T], 20 ft/sec [O] for a minimum of two impacts at temperatures ranging from 32° to 130° F.

- Ballistic Energy Dissipation: The proposed system concept shall not allow the impact force from a ballistic event to exceed an average force impulse of 0.650 lbf-s [T], 0.500 lbf-s [O] when impacted by a projectile with a mass of 124 grains at 1325 ft/s.

- Blast Protection: The proposed system concept shall maintain the position of the helmet on the head during and after exposure to a 5 pound blast at distances greater than or equal to 3 meters.

- Weight and Cost: The weight of the proposed system concept, to include all attachment hardware, shall not exceed 0.50 pounds and not raise the overall center of gravity of the helmet system. The production cost goal of the proposed system should not exceed $100/system.

PHASE I: Develop concepts for a protective helmet suspension and retention system that meets the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs and establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by analytical modeling and bench top testing, as appropriate. The company will provide a Phase II development plan with performance goals and key technical milestones. The company will be expected to, at a minimum, address projected ability to meet the blunt impact and ballistic energy dissipation requirement, stability and comfort considerations taken into account in the design development process, any anticipated manufacturing considerations, as well as projected weight and projected cost.

PHASE II: Based on the results of Phase I and the Phase II development plan, the small business will develop a scaled prototype for evaluation. The prototype will be provided to the Marine Corps for verification and user evaluation to determine its capability in meeting the performance goals defined in the Phase II development plan. System performance including the ability to integrate with Marine Corps helmets will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. The company will prepare a Phase III development plan including a manufacturing plan to transition the technology to Marine Corps use. The company will also develop packaging and an instruction sheet that details the sizing, installation, use and care of the system.

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 finalize the design and corresponding technical data package and provide for user evaluation to determine the systems' effectiveness in an operationally relevant environment. The company will optimize the manufacturing plan as required and support the Marine Corps validation to certify and qualify the system for Marine Corps use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to the military market, the design approach could have applicability in commercial helmets such as motorcycle helmets and sports helmets. The increased blunt impact protection as well as the reduced susceptibility to hot and cold temperatures would make this more robust system attractive to commercial markets.

REFERENCES:
1. Enhanced Combat Helmet, http://ciehub.info/equipment/protective/HelmetEnhancedCombat.html.

2. PM Infantry Combat Equipment (ICE) Website, http://www.marcorsyscom.usmc.mil/sites/pdmice/Armor.asp.

3. "Expanding Helmet Design Methodologies Through Brain Functional Area Representative Threat Models," Proceedings of the ASME 2013 International Mechanical Engineering Congress & Exposition, IMECE2013 November 15-21, 2013, San Diego, California IMECE2013-64959, available at www.dodsbir.net/sitis/.

4. "Impact Response of US Army and National Football League Helmet Pad Systems," 4 January 2011 William C. Moss and Michael J. King Lawrence Livermore National Laboratory Livermore, CA 94550 LLNL-SR-464951. www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA536266.

5. (Removed by TPOC on 5/20/14. See Ref. 6 which replaces previous Ref. 5.)

6. Purchase Description for the Enhanced Combat Helmet, GL-PD-09-04K (Version K), 13 December 2013, 80 pages, uploaded in SITIS 5/20/2014.

KEYWORDS: Helmet; Head Protection; Suspension System; Retention System; Blunt Impact; Ballistic Energy Dissipation

N142-086 TITLE: Ad-Hoc Ground Based Counter-Fire System

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PM Armor and Fire Support Systems, Ground Counter Fire System Program

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop improved, advanced-processing algorithms, to be utilized in the Command Post, of the Ground Counter Fire Sensor (GCFS) system to enable the gathering and processing of sensor data from either static or dynamically placed listening posts. Proposed systems shall utilize all available information from multiple vehicle sensor platforms to locate and identify indirect fire platforms.

DESCRIPTION: The mission of the GCFS system is to provide the Point of Origin (POO), Point of Impact (POI) of rockets, artillery, mortars, and IED's, as well as identify the type of firing platform. The current GCFS system utilizes multiple remote Listening Posts (LP) that include an acoustic array placed on the ground, metrology sensors to measure the environmental conditions at the listening posts, and a radio to communicate information between the listening posts and the Command Post (CP). These remote listening posts must be emplaced, maintained, and repositioned by a team of Marines. This is costly in terms of manpower, maintenance, and training. The current GCFS system requires a team of 10 Marines and one High Mobility Multipurpose Wheeled Vehicle (HMMWV) to operate and maintain the system. This new approach would reduce the number of Marines to 3 and eliminate the need for a HMMWV.

The USMC is interested in augmenting or replacing the existing GCFS with a more flexible system that permits the attachment of acoustic sensors directly onto maneuver platforms. This will reduce the number of Marines required to support the system and free-up Marine teams from having to set up listening posts (microphone arrays with a weather station and comms) in hostile areas. The GCFS Program Management Office (PMO) is interested in exploring the development of improved, advanced-processing algorithms for use at a CP in anticipation of the dynamic placement of microphone arrays on vehicles. These microphone arrays would 'tag along' with the Marines that use the vehicles during normal military operations and would have varying configurations and would be easily relocated as required by the user. The intent is to replace the current listening posts with a Relocatable Listening Posts (RLP). For the purpose of this topic, RLP's will consist of a microphone array attached to a vehicle, a weather station to determine local atmospheric conditions, a self-location device, a microphone orientation device (determines True North to orient the microphone array), and a communications device. Additionally, the CP will have access to terrain data that describes the area that the GCFS covers.

The GCFS Program is interested in innovative approaches in the development of advanced-processing algorithms to be utilized in the CP, able to gather and process data from either static LPs such as those GCFS currently utilize, but also utilize RLP's of varying configurations. Proposed concepts would also permit asynchronous reporting as each RLP and LP could report an event at different times because of latency due to the speed of sound. Furthermore, proposed concepts should address the challenge of RLPs dropping off or being added to the network as Marines using the vehicles maneuver them on the battlefield. Performers will be responsible for determining the data required from each LP and RLP for their proposed concept in order to meet GCFS performance requirements. Examples of this information could include, but is not limited to, LP/RLP location, configuration, orientation, event report time, event bearing, uncertainty surrounding event bearing, local weather conditions, and possibly others that the performer determines. Proposers should employ open architecture design concepts as practicable when proposing concepts for consideration.

The following is a set of tasks that proposed algorithm concepts will be expected to accomplish:
• Utilize data from up to 12 total listening posts, composed of a mix of RLP's or static LP's.

• Determine the POO/POI and time associated with all events covered by the GCFS mission. Deconflicting multiple reported bearing angles from multiple Listening Posts and determining accurate POO/POI is viewed as a key technical challenge for this effort. Since acoustic sensor arrays can locate a sound event in bearing only and not the source location, correlation and deconfliction of many intersecting bearing angles to the correct point of origin is very challenging. This is compounded by asynchronous reporting of acoustic events (due to speed of sound) and effects of weather and terrain.

o Determine the POO (POO with 90% probability, of any indirect firing platform that could potentially fire upon a listening post. Put another way, if a firing platform could potentially fire upon and hit a listening post, the GCFS system must be able to locate that firing platform.)

o Determine the POO and POI location to an accuracy of 2% of range between the closest listening post.

• Display the information on an overlay map for utilization by an operator.

• Store the POO/POI information.

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. The Phase II effort will likely require secure access, and the contractor will need to be prepared for personnel and facility certification for secure access.

PHASE I: Develop concepts for improved, advanced-processing algorithms for use in the GCFS system that meets the requirements as highlighted in the description. The company will demonstrate the feasibility of the concepts in meeting Marine Corps needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. The small business will provide a Phase II development plan with performance goals and key technical milestones and that will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, develop prototype processing algorithms within a software environment that permits evaluation of the algorithms. These algorithms will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements as outlined in this document.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the technology for Marine Corps use. The small business will develop a plan to determine the effectiveness of the developed algorithms for use at a CP for the GCFS system in an operationally relevant environment. The small business will support the Marine Corps with certifying and qualifying the system for Marine Corps use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology is applicable to monitoring areas of potential civil unrest, including the locating of IED events, shots fired, and discriminating between non-threat background events (such as vehicle backfires) from actual threat events. The ability to have on-board sensors that are able to network together as part of a greater system could be used by police departments to determine the location of shots fired.

REFERENCES:

1. Ground Counter Fire Sensor System (GCFS) Digital Communications Capability, Solicitation Number: M6785411I6014. This link has a description of the required capabilities of the current GCFS system: https://www.fbo.gov/index?s=opportunity&mode=form&id=b2136191b88ba5380cd2a4768921d4df&tab=core&_cview=0

2. Ground Counter Fire System, Naval Surface Warfare Center Dahlgren, http://www.navsea.navy.mil/nswc/dahlgren/Warfighter/GCFS/default.aspx.

KEYWORDS: GCFS; Ground Counter Fire Sensor; maneuverable assets; point of origin; point of impact; processing algorithms

N142-087 TITLE: Expeditionary Portable Oxygen Generation System

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: PM Combat Support Systems (CSS), PdM Combat Support Equipment (CSE)

OBJECTIVE: The objective is to develop a portable oxygen generation system that consumes less electrical power, and has a compact cube/size and reduced weight. This objective is in support of the expeditionary medicine requirements of the Marine Corps.

DESCRIPTION: The Forward Resuscitative Surgical System (FRSS) provides an expeditionary surgical capability for the surgical stabilization of injured warfighters. Portable Oxygen Generation (POG) is a core technology for Marine Corps medical operations. For expeditionary medical applications, POG systems are used to produce medical-grade oxygen from air. The oxygen is used for patient ventilation, anesthesia, refilling oxygen bottles, etc. (Ref. 1). Presently, the FRSS uses two On Site POGS (Ref. 2). The current power demand of these POGS can exceed 1800 W, often creating a power overload of the FRSS electrical generators. Additionally, the current technology's space and weight are 34.35 cu ft. and 644 lbs. This footprint creates an increased burden on the logistics chain. While the currently used On Site POGS do produce oxygen at the concentration levels desired, they are considered too heavy, bulky and/or are not robust enough in design to properly facilitate the mission of the FRSS. Oxygen bottles are used in limited circumstances; however, due to their finite storage capacity they too create a logistics burden that is not sustainable as a primary solution for the provision of oxygen. Commercially available systems, such as the Oxygen Generating Systems International's OG and OGS series or the PCI DOCS series, do not produce the required output, or are too heavy or big, not man-portable, and are not intended to operate in harsh environments. Improvements may be realized with the application of some advance technology concepts such as, but not limited to, new compressor technologies (reduced power consumption, size), alternative/lighter material systems, or running on alternative power sources such as batteries (Ref 3, 4).

The Marine Corps seeks innovative approaches in the development of a smaller, lighter, man-portable (2-4 personnel), and more energy efficient (requiring reduced electrical and mechanical power to operate) oxygen generation system capable of producing medical-grade oxygen for patient administration and oxygen bottle refilling. Proposed concepts should have a total weight that does not exceed 350 lbs., and a volume that does not exceed 20 cubic ft. The maximum operational power should not exceed 1200 Watts with a start-up surge power that does not exceed 1250 Watts. Proposed concept should be able to produce United States Pharmacopeia (USP) 93% oxygen, at flow rates of 10–15 Liters Per Minute (LPM) as well as be able to produce up to 2200 PSIG to enable the refilling of D-size oxygen bottles. Proposed concepts shall be expected to operate in all climates and environments that may be encountered by USMC forces and shall not exhibit operational degradation at ambient temperatures between 125°F and -40°F. Proposed concepts must be able to operate in all humidity levels up to 100 percent and must be resistant to the effects of salt/water spray, and extreme sand and dust conditions to the extent outlined in MIL-STD 810F/G (Ref. 2, 5). Successfully developed technologies shall be employed in all FRSSs and shall have the ability to be transported in all tactical cargo and medical vehicles including Marine Corps rotary aircraft.

PHASE I: The small business will develop concepts for an improved expeditionary portable oxygen generation system that meets the requirements highlighted in the description. The company will demonstrate the feasibility of the concepts in meeting Marine Corps needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. The small business will provide a Phase II development plan with performance goals and key technical milestones, and will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, the small business will develop a scaled prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the expeditionary portable oxygen generation system. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. The company will prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the technology for Marine Corps use. The small business will develop a plan to determine the effectiveness of the expeditionary portable oxygen generation system in an operationally relevant environment. The small business will support the Marine Corps with certifying and qualifying the system for Marine Corps use and shall also submit the system for proper

Food and Drug Administration certification. As appropriate, the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The potential for commercial application and dual use is high. The proposed system would be easily portable and well suited in areas where limited power is available. The expeditionary portable oxygen generation system can be used in medical facilities of various sizes, emergency management agencies, disaster aid and humanitarian aid agencies, and municipal fire and rescue squads.

REFERENCES:
1. Arnold, Mark, "U.S. Army Oxygen Generation System Development." NATO, 15 November 2013. http://ftp.rta.nato.int/public/PubFullText/RTO/MP/RTO-MP-HFM-182/MP-HFM-182-18.doc.

2. On Site Gas Systems, "Portable Oxygen Generation (POGS)," http://www.onsitegas.com/portable-oxygen-generators.

3. "Hybrid System For Separating Oxygen From Air," Sandia National Laboratories, 12 March 2013. http://techportal.eere.energy.gov/technology.do/techID=489.

4. Staiger, Chad L., et al., "Hybrid System for Separating Oxygen from Air," Patent Number: 7,875,101, Issued 25 January 2011, http://patft.uspto.gov/netacgi/nph-ParserSect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearchbool.html&r=1&f=G&l=50&co1=AND&d=PTXT&s1=7,875,101.PN.&OS =PN/7,875,101&RS=PN/7,875,101.

5. Department of Defense., MIL-STD-810G, Department of Defense Test Method Standard: Environmental Engineering Considerations and Laboratory Tests, 31 Oct 2008, http://www.atec.army.mil/publications/Mil-Std-810G/Mil-std-810G.pdf.

KEYWORDS: oxygen generation; medical oxygen; portable oxygen; POG; expeditionary medical; energy efficient

N142-088 TITLE: Insulating Barriers for Softwall Shelters

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PM Combat Support Systems (CSS), PdM Combat Support Equipment (CSE)

OBJECTIVE: Develop an improved insulating barrier system that provides increased insulation (R-value) to all softwall shelters, fielded by the Marine Corps, while reducing packed cube/size and weight over current insulating barrier designs.

DESCRIPTION: Marine Corps operational requirements now address the reduction of fossil fuel consumption and improvements to energy efficiency (Ref. 1, 2). One method of addressing the requirement is by reducing electrical power consumption, packed cube/size and weight of operational equipment, and insulation qualities of softwall shelters. The Marine Corps currently employs radiant (insulating) barriers in one line of softwall shelters (Expeditionary Shelter System, Medium) (Ref. 3, 4). The insulating barrier is a separate, interior liner installed inside softwall shelters and there is currently only one commercial source (Ref. 3). These barriers provide an additional insulation value of R-4 consisting of layered textiles that insulate radiant heat (interior) and reflect radiant heat (exterior). The increase in insulation lessens the thermal load required to maintain temperatures inside the shelter. However, the current barriers are thick (packed cube volume of 33.25 cu ft) and heavy (weight of 110 lbs). This, in turn, negates some of the energy savings because there is now a greater logistical burden associated with the transport storage of the current barriers due to the additional space and weight constraints. Fuel consumption could potentially be reduced by employing barriers that have greater R-value as well as decreased storage (packed cube size) and weight characteristics over the currently used technologies.

The Marine Corps seeks innovative approaches in the application of new material systems to improve upon the insulation capabilities (R-value) of softwall shelter insulating barrier systems while decreasing the packed cube/size and weight by a minimum of 25%. Proposed concepts should be man-portable by 2-4 personnel, durable, and capable of being deployed and stored for up to 15 years without degradation or damage. Proposers should be mindful that the R-value of proposed insulating barrier concepts should be no less than 4 with an objective of 8. The insulating barrier thickness shall be no more than 0.25"/6.35 mm with an objective of at least 0.125"/3.175 mm, when packed. Proposed concepts should weigh no more than 12 ounces per square yard with an objective of 8 ounces per square yard. Proposers should be mindful of the desire for insulation barrier concepts that exhibit material properties that promote a reduction in fossil fuel consumption, associated electrical power and packed physical size. Critical to the operational requirements of the Marine Corps is the ability to improve energy efficiency and reduce its logistical footprint to extend our expeditionary capabilities.

Any materials system concepts developed for this effort shall meet the following standards:

• AATCC 30 Antifungal Activity, Assessment of Textile Materials: Mildew Resistance of Textile Materials (Test Methods I & IV) (Ref. 5)
• CPAI-84, Specification for Flame-Resistant Materials Used in Camping Tentage (Ref. 6)
• ASTM D6413, Standard Test Method for Flame Resistance of Textiles (Ref. 7)

Proposed concepts shall be able to function in all climates and environments that may be encountered by USMC forces. To ensure this, the proposed solution will have to pass applicable tests outlined in MIL-STD 810F/G (www.everyspec.com). There shall be no significant degradation in the material system's performance when ambient temperatures are between 125° F and -40° F, to the extent outlined in MIL-STD 810F/G. This is viewed as being one of the more challenging aspects in the development of a viable technology solution. The new technology shall be capable of being employed in all Marine Corps tactical soft shelters and shall have the ability to be transported in all tactical ground and air vehicles. Proposed concepts shall be required to meet associated industry safety standards.

The insulating barrier and associated components must be made with materials that are grown, reprocessed, reused, or produced in the United States, as per 10 U.S.C 2533A–Requirement to Buy Certain Articles from American Sources; Exceptions (Berry Amendment).

PHASE I: The small business will develop concepts for an insulating barrier system that meets the requirements described above. The company will demonstrate the feasibility of the concepts in meeting Marine Corps needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. The small business will provide a Phase II development plan with performance goals and key technical milestones, and will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, the small business will develop a scaled prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the insulating barrier system. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. The company will prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the technology for Marine Corps use. The company will develop an insulating barrier system for evaluation to determine its effectiveness in an operationally relevant environment. The small business will support the Marine Corps with certifying and qualifying the system for Marine Corps use. As appropriate, the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The potential for commercial application and dual use is high. The insulating barrier system can be used in new building construction and renovations. Insulating barriers can be used in soft walled shelters employed by emergency management agencies, disaster aid and humanitarian aid agencies, and municipal public safety organizations.

REFERENCES:

1. Marine Corps Expeditionary Energy Office, Marine Corps Expeditionary Energy Strategy and Implementation Plan, March 2011, http://www.hqmc.marines.mil/Portals/160/Docs/USMC%20Expeditionary%20Energy%20Strategy%20%20Implementation%20Planning%20Guidance.pdf.

2. "Panama City Engineers Develop Tools to Reduce Energy Consumption," Currents, Fall 2013, http://greenfleet.dodlive.mil/files/2013/11/Fall13_Panama_City_Reduce_Energy.pdf.

3. HDT Engineered Technologies website, 28 Jan 2014, http://www.hdtglobal.com/site_media/uploads/files/HDT_Radiant_Barriertemp.pdf.

4. RDECOM, "Department of Defense Standard Family of Tactical Shelters (rigid/soft/hybrid)," Joint Committee on Tactical Shelters (JOCOTAS), 17 May 2012, http://nsrdec.natick.army.mil/media/print/JOCOTAS.pdf.

5. American Association of Textile Chemists and Colorists, AATCC 30 Antifungal Activity, Assessment of Textile Materials: Mildew Resistance of Textile Materials, 1946, http://www.aatcc.org/technical/test_methods/scopes/tm30.cfm.

6. "A Specification for Flame-resistant Materials Used in Camping Tentage," Industrial Fabrics Association International,1995, https://secure.ifai.com/ifai.com/store/item/198.

7. ASTM International. "Standard Test Method for Flame resistance of Textiles," 2013, http://www.astm.org/Standards/D6413.htm.

KEYWORDS: insulating barrier; radiant barrier; tents; softwall shelter; thermal insulation; energy efficient

N142-089 TITLE: Foldable High G-Force Resistant Patient Litter

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PM Combat Support Systems (CSS), PdM Combat Support Equipment (CSE)

OBJECTIVE: Develop a litter that can be folded for one-man carry, is lightweight, and resilient enough to withstand the G-force of a rotary wing and tilt-rotor aircraft while transporting a patient and their associated medical equipment.

DESCRIPTION: Medical devices are designed to function in environmentally controlled locations, such as hospitals, and not in the harsh, dynamic environment of aircraft. However, the same medical devices, including those used by the Marine Corps (Ref. 1-3), used to care for patients in a hospital environment are often the most capable devices for patient care during transport from one facility to another. The current patient litter used by the Marine Corps is the Talon II rated for a payload of 1200 lbs (Ref. 1). The Talon II is foldable for carrying by one man. It can be configured for transport aboard all Marine Corps rotary and tilt-rotor aircraft; however, it is not able to meet the Joint Enroute Care Equipment Test Standard (JECETS) for acceleration and crash. The JECETS document describes the test procedures for air worthiness for medical equipment that will be used on board United States military transport vehicles during enroute patient care (Ref. 4, 5). Equipment such as ventilators, physiological monitors, suction devices, oxygen tanks, and mounting brackets are all attached to and carried with the patient litter. These Patient Movement Items (PMIs) can weigh from 50–200 lbs. each. Add the weight of the patient (Ref. 6), and the litter is required to sustain a combined weight of 400 lbs., or more. During transport missions, commonly referred to as medical evacuation (MEDEVAC) and aeromedical evacuation (AE) missions, the litter will be subjected to forces as much as 12 times the weights discussed, for a period of up to one minute. Failure of medical devices, such as patient litters, during in-flight medical care may result in exposing patients and aircrew to hazardous situations, including equipment becoming unsecured within the aircraft cabin. Commercially available solutions such as backboards and rigid litters can sustain higher G-forces than foldable litters; however, they are not robust enough in design to be able to meet JECETS requirements or robust enough for use in Marine Corps applications.

For these reasons, the Marine Corps seeks the application of advance materials and structural design concepts to develop innovative approaches in the design of a foldable, patient litter capable of meeting the airworthiness testing of JECETS and the environmental tests of MIL-STD 810G (Ref. 6). The litter must accommodate and support the weight of the patient and any associated PMI. Proposed concepts must also maintain structural integrity when subjected to the forces identified in the JECETS for up to one minute and must have an expected life of at least 5 years. Cube and weight of the litter, when folded for carry, shall not exceed 1 cubic foot and 17 lbs. Proposed concepts have the added technical challenge of the need to be fully operable in the challenging environments and climates encountered by Marines in the field. Proposed concepts shall operate in all climates and environments that may be encountered such as arctic, desert, jungle, and coastal and shall not operationally degrade when ambient temperatures are between 125°F and -25°F. Proposed concepts must be able to fully operate in all humidity levels up to 100 percent and must be resistant to the effects of salt/water spray, and extreme sand and dust conditions to the extent outlined in MIL-STD-810G. Proposed material systems shall be structurally resilient; however, they must also be lightweight in order to meet the Human Engineering lift requirements of MIL-STD 1472G (Ref. 7).

PHASE I: The small business will develop concepts for an improved patient litter that meets the requirements highlighted in the description. The small business will demonstrate the feasibility of the concepts in meeting Marine Corps needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. The small business will also provide a Phase II development plan with performance goals, key technical milestones, and a technical risk reduction strategy.

PHASE II: Based on the results of Phase I and the Phase II development plan, the small business will develop a scaled prototype for evaluation. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for patient litters. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. The company will prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the technology for Marine Corps use. The small business will develop a plan to determine the effectiveness of the new patient litter in an operationally relevant environment. The small business will support the Marine Corps with certifying and qualifying the system for Marine Corps use. When appropriate the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The potential for commercial application and dual use is high. Beyond the Marine Corps application, there are applications for humanitarian aid and disaster relief. Municipal safety organizations may also use these litters for patient movement.

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2. Impact Instrumentation, Emergency Products Catalog,
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KEYWORDS: patient litter; patient movement; enroute care; medical transport; air worthiness; foldable litter

N142-090 TITLE: Crew Role-player Enabled by Automated Technology Enhancements (CREATE)

TECHNOLOGY AREAS: Air Platform, Human Systems

ACQUISITION PROGRAM: PMA 205

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop a software application/suite that provides a synthetic crew role player to support complex crewmember interactions during dynamic training events.

DESCRIPTION: Current Navy crew training requires the assembly of an entire crew or the use of Subject Matter Experts (SMEs) to support crew training. While training benefits from the additional costs associated with bringing a full crew together (e.g., crew coordination, team building), some individual training could benefit from the added realism provided by crew interaction. For example, when attaining skills associated with crew roles, team members often conduct a series of training events in Part Task Trainers (PTTs). During these events, the emphasis is on the crew member's individual skills; however, many tasks associated with their role may rely on inputs from other crewmembers. Developing a software application/suite that provides a synthetic role-playing capability will serve to enhance the training pipeline and potentially avoid costs and provide value added without the use of training aids.

In order to successfully implement a synthetic role-player capability for Navy crew-based training, a technology solution that integrates speech capabilities (i.e., recognition, understanding, synthesis), SME level tactical domain information, reaction to multitasking and high stress situations, and relay of information via means other than speech communication (e.g., software inputs), are required. However, current technologies have not been developed to interact in this manner.

The initial use case for the proposed technology would be to supplement training for the Tactical Officers (TACCOs) in the P-8A PTT. TACCOs are responsible for synthesizing information from multiple sensor operators in order to make tactical decisions about how to pursue targets of interest. Inputs from sensor operators can include identification of other forces in the area (e.g., blue, red, green, surface, land, air, subsurface), identification of targets, and management/employment of sensors.

In order to successfully implement a synthetic role-player capability for Navy crew-based training, a technology solution that integrates speech capabilities, SME-level tactical domain information, reaction to multitasking and high-stress situations, and relay of information via means other than speech communication.

PHASE I: Design and prove feasibility of an architecture for a synthetic role-player, incorporating appropriate component technologies and input/output requirements for overall training system. Designed solution must support the High-Level Architecture (HLA) communication protocol. Appropriate Information Assurance (IA) guidelines should be considered in initial design.

PHASE II: Develop prototype synthetic role-player, providing proof-of-concept integration of all component technologies, and demonstrate appropriate outputs necessary to stimulate simulation systems. Appropriate IA guidelines should be assessed and considered when implementing the prototype system to minimize or avoid rework in future phases of the project.

PHASE III: Transition effort to commercial developers and government research and development facilities or acquisition platforms responsible for providing training systems. Specifically for Navy use, package a software application/suite that provides a synthetic crew role player capability for use in aviation simulation training.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Advances in synthetic role players are applicable to the gaming community, as well as other venues such as smart phone applications and digital tutoring technologies.

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KEYWORDS: Synthetic Role Playing; Simulation; Training; Integrated Speech Technologies; Part Task Trainer (PTT); Crew Training Environment

N142-092 TITLE: High Power Battery for Long-Range Air-to-Surface Missile

TECHNOLOGY AREAS: Weapons

ACQUISITION PROGRAM: PMA 201

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and

services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop a high-voltage reserve battery with increased pulse power densities compared to existing batteries used in air-launched weapon applications.

DESCRIPTION: Greater ranges, longer flight times, and higher electrical needs from onboard components place increasing demands on batteries used in tactical missiles. However, the space and weight available to accommodate batteries is very limited. The technologies currently in use cannot supply the electrical capacity to meet projected weapon needs. The heat generated by many current thermal batteries also impacts other subsystems and creates safety concerns. These issues may be addressed by recent advances in a variety of battery technologies --including thermal, chemical reserve, and lithium--that have potential to offer significantly increased power densities and improved safety at lower costs than currently deployed battery systems.

The purpose of this topic is to develop and demonstrate improved battery technology compatible with the requirements of air-launched weapons. Such batteries must perform in severe captive carriage and free flight environments following an extensive period of storage. Performance and environmental requirements for the application include:

- Shelf life of 20+ years under extreme climate storage conditions from -40 to +72 degrees Celsius.

- Ability to operate in climate extremes from -54 to +72 degrees Celsius. Up to 10 minutes of power can be made available to heat the battery before launch (weapon station power available for heating a reserve battery is 250 Watts maximum). The battery shall be active after a rise time of no more than 1 second.

- Ability to provide both 28 Volts Direct Current (Vdc) and 56 Vdc output for no less than 800 seconds under a prescribed load profile. The 28 Vdc tap shall support a peak current of 20 amperes (amps). The 56 Vdc tap shall support a peak current of 40 amps. Both voltage taps shall supply a 1.9 amp-hour capacity.

- Goal of providing an overall power density of 200 Watts-second/gram for the complete assembled battery.

- Ability to operate after exposure to a captive carry random vibration environment from 20-2000 Hertz (Hz), 11.3 g's RMS with spikes of 0.2 g2/Hz @ 250 Hz and 0.027 g2/Hz @ 611 Hz.

- Threshold requirement is a battery envelope not to exceed 8 inches by 8 inches by 6 inches. Objective requirement is a battery envelope not to exceed 8 inches long x 4.5 inches diameter. Weight shall not exceed 13 pounds.

- Battery shall not vent or become distorted under storage or operational environments, and the case temperature must not exceed 720 degrees Fahrenheit under any load condition.

- A price goal is $2,000-$3,000 per unit for a production quantity of 400-700 per year.

PHASE I: Identify, design, and develop a concept meeting the specified requirements. These solutions shall be demonstrated as lab experiments or as single cell testing.

PHASE II: Design, fabricate, and test prototype battery assemblies meeting the generalized performance requirements and dimensional limits. These prototype batteries should produce the same voltage levels as defined in the requirements, i.e. both a 28 VDC section and a 56 VDC section. A minimum of 40 prototypes (100 batteries is the preferred goal) shall be constructed and subjected to preliminary environmental and safety testing to demonstrate that the reliability and producibility challenges have been overcome.

PHASE III: Finalize the design and fabricate and test a sample quantity of batteries meeting the performance requirements, envelope, and weight of an actual missile application. These batteries will be subjected to a full suite of non-operational and operational environmental testing plus U.S. Navy Safety Testing required for transition to a program of record.

The contractor shall identify staffing, facilities, and any other infrastructure required to support quantity production of this style of battery technology when transitioned to a program of record.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Though Navy requirements for long-term storage and operational environments are generally much more severe than commercial applications, high voltage batteries are increasingly important to the portable electronics industry. This research may also apply to the safety concerns caused by thermal runaway in commercial battery applications. High voltage batteries are required in a number of other DOD applications including ejection seats and robotics.

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KEYWORDS: Thermal Battery; Cathode; Anode; Reserve Battery; Missile Power; Lithium

N142-093 TITLE: High-Power Mid-Infrared Quantum Cascade Laser Array with Continuous-Wave Output Power Exceeding 100W

TECHNOLOGY AREAS: Air Platform, Chemical/Bio Defense, Electronics

ACQUISITION PROGRAM: PMA 272

OBJECTIVE: Develop a quantum cascade laser (QCL) platform with emission at MidWave IR Wavelengths based on a stack of actively–cooled QCL bars. The output power of the architecture of the laser platform should be scalable to hundreds of Watts in continuous-wave (CW) mode while maintaining excellent beam quality for directional infrared countermeasure (DIRCM) applications.

DESCRIPTION: Compact, high-power, reliable mid-wave infrared (MWIR) scalable laser platform operating in CW regime are highly desirable and critical for current and future Navy applications. Individual QCLs with several Watts CW output power have been demonstrated throughout most of the MWIR wavelength range [1, 2]. To increase the aggregate output power level of the laser sources, one can combine the multiple laser beams using either coherent beam or spectral beam combining technique. However, the beam-combined output power scales with the output power of each of the individual QCLs or QCL array within a beam combing scheme.

Therefore, to scale the aggregate beam-combined output power level of the laser sources up to the range of a few hundred of Watts to meet the future needs of DIRCM, an innovative QCL array source at MWIR Wavelength with power exceeding 100 Watts at room temperature (RT) before beam combining is desired. One potential approach to achieve the goal is to fabricate and assemble multiple QCL laser bars in a stack. A similar approach has been successfully implemented with near-infrared (NIR) diode bars and 2-dimensional stacks with raw CW output reaching 1 kiloWatt has been demonstrated [3]. However, adapting this technology from NIR diode laser array for QCL array poses many difficult challenges. For example, QCLs have higher thermal impedance, require significantly higher electrical drive voltage than NIR diode lasers, and the wall-plug efficiency of QCLs is at most 20% compared to ~60% for NIR diode lasers at RT operating at CW mode. The efficient removal of heat for QCL bar is almost six times the amount of typical NIR laser bar stack. Therefore this project is seeking the improvement of the thermal impedance of the QCLs for much better thermal conduction, and also novel actively cooling techniques that are even better than the state-of-the-art techniques such as micro-channel or micro-impingement cooling.

The need for heat removal of such a large amount exacerbates mechanical stress of the QCL stack assembly. This could lead to catastrophic failure of the QCL bar if not carefully managed and requires, for example, the selection of coefficient of thermal expansion-matched materials for the heatsinks, submounts and soldering materials. These problems are further multiplied in the case of actively cooled two-dimensional QCL stack assembly.

The goal for this program is to develop an innovative two-dimensional QCL bar stack assembly of which the RT output power can be readily scaled up to hundreds of Watts operating at CW mode. The individual emitters must have a stable output beam profile with M2< 1.5 in both fast- and slow-axis directions. The proposed approach needs to address issues such as heat extraction and mechanical stress at the chip as well as at the subsystem level. The overall reliability of the laser source needs also to be studied. Approaches that include, for example, ways to address electrically each individual emitter and/or ways to beam-combine the output of the array elements with superb combined beam quality are highly desirable and should be discussed in the proposal.

PHASE I: Design a CW QCL platform based on two-dimensional bar stack assembly capable of exceeding 100 Watts while maintaining excellent beam profile with M2< 1.5 in both directions and stable for each individual array element. The output power and wall-plug efficiency must be modeled as function of laser elements. The approach proposed must be compatible with scaling the power up to 1000 Watts. The heat extraction, mechanical stress and the reliability at level of individual emitters, bars and the entire stack as a whole must be evaluated and mitigation solutions should be presented.

PHASE II: Fabricate, demonstrate and deliver a prototype based on the design of Phase I that produces CW output power more than 100 Watts while maintaining excellent beam profile (M2< 1.5 in both directions) and stable for each individual array element.

PHASE III: Perform extensive laser module reliability and durability testing. Develop a cost-effective manufacturing process for technology transition to system integration for field deployment in a Navy platform.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The DoD undoubtedly has a need for advanced, compact, robust and low-cost MWIR lasers for applications such as current- and future-generation DIRCM, LIDAR and chemicals and explosives sensing. The commercial sector also can significantly benefit from this crucial, game-changing technology development in the areas of detection of toxic industrial gases, environmental monitoring, and non-invasive medical health monitoring and sensing.

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KEYWORDS: Laser Array; Qcl; micro-channel cooling; mid-infrared; lasers; aircraft protection

N142-094 TITLE: Adaptive Radar Modes for Signature Exploitation

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: PMA 299

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is “ITAR Restricted”. The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award

resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Adapt existing Navy airborne maritime surveillance radars to include transmitted waveforms matched to exploit target specific signature characteristics to enable classification on the basis of those signatures.

DESCRIPTION: Littoral operations frequently involve a large number of benign marine vessels that may be intermingled with vessels of significant interest. This topic seeks innovative approaches for vessel classification based on the identification of constituent components of a radar generated target feature vector which may include non-geometric target attributes. The dimensionality of the feature vector should support unambiguous classification to the greatest degree possible. The expectation is the identification of a robust vector space which will increase separation and improve probability of correct classification. The approach may employ feature adaptation and selection based upon relevant operational scenarios. The approach should be able to extract elements of the feature set from both non-imaging and imaging radar modes. The approach should not require significant operator involvement in the identification and extraction of the feature vector. Advances in the understanding and exploitation of target radar signatures offer opportunities for improved target search and classification needed in this topic. In general these advanced approaches are not being utilized by current systems in the field. The desired approach should be feasible for integration with legacy Navy maritime surveillance radar systems such as the APS-153 and APY-10 as part of an effort to dramatically improve maritime situational awareness. Document all research, development designs with detailed descriptions and specifications of the designs, processes, and performance.

PHASE I: Detail and demonstrate the feasibility and approach of extending existing legacy systems such as the APY-10, APS-153 and ZPY-4 to include a target signature exploitation capability in transmit and receive. Develop concepts and evaluate technical feasibility.

PHASE II: Further develop designs provided in Phase I to provide sufficient detail that legacy radar systems can be modified to provide target classification capability. Conduct limited modification and tests in multiple environments to demonstrate performance with respect to intended use. Expand the design characteristics addressed during the Phase I effort. Deliver a detailed report concerning required modifications including estimated cost to integrate this technology into candidate radar systems; key characteristics required in existing legacy systems for extension to additional capability; and of modified legacy systems along with the documented algorithms.

PHASE III: Finalize and update selected legacy systems to include the new target classification capability.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Coastal surveillance and air traffic control radar systems could leverage this technology for improved performance in the presence of non-cooperative contacts.

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KEYWORDS: Maritime Surveillance; Signature matched; aspect matched; target classification; diverse waveform transmission; high resolution

N142-095 TITLE: Air Vehicle Communication in a Denied Environment

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: PMA 265

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Design a low space, weight, and power (SWaP), innovative, encrypted, digital data link to support Wideband (WB) Radio Frequency (RF) and/or Laser Communications (Lasercom) (also known as free space optics (FSO) communications in a denied environment).

DESCRIPTION: A rising challenge in communication is the ability to ensure critical RF operations in the presence of RF Interference (RFI) sources such as radars, jammers, etc. These RFI environments can be generated from either adversaries or fratricide (friendly jamming). Recent advancements in both WB RF (2 gigahertz (Ghz)–15 Ghz) and Lasercom technologies could be used to overcome many of the challenges. WB RF and/or Lasercom technologies can be used for providing anti-jam and low probability of interception and detection (LPI/LPD) communications. Recent advances in spread spectrum communications techniques such as frequency hopping and direct sequence spread spectrum have allowed for significant developments for supporting RF diversity and managing spectral bandwidths. These communication systems employ software defined modems (SDM), power amplifiers, and directional antennas. Lasercom's primary advantages for military applications are covertness, lack of RFI from any RF sources, immunity to jamming, lack of frequency allocation requirements (allowing operation in all national and international waters), and high bandwidth. A digital data link, operating at electro-optic/infrared EO/IR sensor system frequencies, that supports encryption and two-way communications is desired. In addition, this topic seeks innovative techniques that utilize the digital data link communication signals in near-real-time so as to affect timely adjustments to changes in RF environments.

PHASE I: Define and develop concepts for a wide band waveform capable of anti-jam communications at optical frequencies. Compare innovative techniques against existing techniques and quantify the performance differences. Analyze the implementation issues and determine the theoretical feasibility of each technique in steady and varying RF environments.

PHASE II: Produce prototype hardware based on Phase I concept. Develop models and simulation techniques to show achievable performance. Mechanize the waveform generation scheme and demonstrate its performance in a controlled environment. Validate the selected technique, or techniques, and demonstrate advantages.

PHASE III: Transition the developed technology to F/A-18 and F-35. Insert the technology into suitable candidate communication system identified by the Navy and effect transition of the new communication technique into that system.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Communication through Jamming technology has applications in many military, police, civil defense, search and rescue, and industrial use wherever critical communications can be intentionally or inadvertently interfered with. Application by drug enforcement agency to communicate in a hostile environment as well as through unintentional interface in foreign environments will allow for continuity of command and control. The technology will also find multiple applications in cyber warfare environment to counter unknown threats from hostile sources.

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KEYWORDS: Communications; Command And Control; Electronic Warfare; Jamming; Notch Filtering; Lasers Communications

N142-096 TITLE: Low Cost Information Assured Passive and Active Embedded Processing

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Electronics

ACQUISITION PROGRAM: PMA 264

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is “ITAR Restricted”. The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the “Permanent Resident Card”, or are designated as “Protected Individuals” as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Design, develop and demonstrate an Information Assurance/Anti-Tamper (IA/AT) advanced sonar processing capability to be embedded in sonobuoys.

DESCRIPTION: Currently, sonobuoy signals are processed by on-station rotary or fixed wing aircraft which requires continuous sonobuoy surveillance by the on-station aircraft. The existing radio frequency (RF) telemetry has minimal IA security between the sonobuoy and the on-station aircraft. To enhance the RF IA telemetry the sonobuoy data needs to be reduced in volume by ten orders of magnitude using advanced active and/or passive signals using in-buoy processing techniques for the respective sonobuoy. The existing RF telemetry link between the sonobuoy and air platforms will continue to use the very high frequency (VHF) RF sonobuoy spectrum using a coherent Gaussian frequency shift keying (GFSK) modulation. To improve the sonobuoy eight hour acoustic signal processing life the sonobuoy needs to autonomously store and process this data when air platforms are out of radio range or otherwise not present for up to seventy-two hours. AT techniques will need to be addressed for the protection of in-buoy algorithms coefficients, processed data and stored data while the sonobuoy is in the water. The cost for the proposed IA/AT improved sonobuoy is: Goal–less than $150.00, threshold $270.00.

The specific IA/AT technical areas of consideration for the GFSK telemetry data are: Global Positioning System (GPS) tagged recordings of sonar signal streams; beamformed, multiplexed and/or element level acoustic data; active and passive streaming data signals; detection threshold selected by the in-buoy processor; active sonar detections; passive tripwire tagging; and in-buoy modeling results for the sensed ocean currents and sea state.

A successful solution may be used in AN/SSQ-53F, AN/SSQ-62E, AN/SSQ-101A, and/or AN/SSQ-125 sonobuoy and will undergo an at-sea demonstration.

PHASE I: Design and demonstrate feasibility of an IA/AT capability embedded in an "A" size sonobuoy in accordance with the parameters in the Description. Perform a preliminary power budget, data throughput, RF link analysis, in-buoy signal processing requirements and in-buoy data storage analysis for implementation into the four buoys.

PHASE II: Develop a prototype sonobuoy for demonstration. The prototype sonobuoy demonstration will use simulated acoustic data which will contain active and/or passive signals in a wide range of acoustic conditions and sea states (international scale 1-5) to show the improvements over an existing sonobuoy. Refine the power budget, data throughput, RF link analysis, in-buoy signal processing requirements and in-buoy data storage analysis completed in Phase I.

PHASE III: Develop and manufacture low cost elements for transition and inclusion into the existing sonobuoy designs. Perform an at-sea demonstration of the prototype buoys with the new capabilities. Scale up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Other applications of information assured data include Homeland Defense, Industrial Perimeter Security, Home Security, Ultra-light Unmanned Air Vehicles (UAV), and aids for hearing impaired or visually impaired persons.

REFERENCES:
1. Kurzweil, R., 2012, How to Create a Mind: The Secret of Human Thought Revealed, Viking Adult: ISBN-13: 978-0670025299; ISBN-10: 0670025291.

2. Waite, A.D., 2002, Sonar for Practicing Engineers, Third Edition. John Wiley & Sons Ltd., ISBN 10: 0-471-49750-9 (P/B); ISBN 13: 978-0-471-49750-9 (P/B).

3. Holler, R., Horbach, A., & McEachern, J., 2008, The Ears of Air ASW: A History of U. S. Sonobuoys. Navmar Applied Sciences Corp: ISBN 978-0-615-20113-9.

KEYWORDS: Anti-Tamper; Information Assurance; In-buoy Processing; Acoustic Tripwires, sonobuoy, sonobuoy telemetry

N142-097 TITLE: Innovative Tactical Bulk Fuel Delivery System Restraint System

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Human Systems

ACQUISITION PROGRAM: PMA 261

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OBJECTIVE: Develop and demonstrate an innovative restraint system for the CH-53K tactical bulk fuel delivery system.

DESCRIPTION: The tactical bulk fuel delivery system (TBFDS) is an air transportable system capable of range extension and offload fuel delivery. Internally carried by the CH-53K, the system has a maximum design capacity of 2,400 gallons. Each system contains provisions for two refueling points. The forward area refueling equipment (FARE) pump is rated at 120 gallons per minute (gpm) allowing for dual point operations at 45 gpm and single point operations at 75 gpm. The TBFDS consists of three 800 gallon tank assemblies.

The TBFDS tank is of composite structure with an internal bladder. It is approximately a 60 inch (in) cube with a 33 in centered circle that must remain free of restraints due to fitting locations on the top side of the tank. The three tanks are separated by 20 in.

The CH-53K cargo floor is roughly 300 in in length and incorporates a 463L rail locking system on an 88 in bias; 20,000 pound (lb) (20k) and 10,000 lb (10k) tie-down rings are utilized for securing loads in the cargo compartment. There are six rows of rings down the floor establishing a 20 in grid; the 20k rings are located along each side wall while the 10k rings comprise most of the internal four rows. There are twelve 20k ring locations that have been placed within the internal rows, comprising three 60 in squares.

Cargo ring ultimate retention strength for crash loading is defined as 1.5 times the ring rating.

The 463L rail locking system may be employed in conjunction with the cargo rings to secure the TBFDS.

Existing systems are cumbersome, requiring empty fuel tanks and excessive man power to on and offload in the event of a down aircraft. Current restraint capabilities restrict the volume of fuel to be safely carried during operations.

An innovative CH-53K TBFDS restraint system that reduces crew efforts and weight while increasing operational capability, reliability, maintainability and affordability is sought. It shall be practical to manufacture, install and remove and capable of restraining the TBFDS to NAVAIR crash g-load requirements +/- 20 g longitudinal, +/- 20g vertical, and +/- 10 g lateral (20/20/10) and NAVAIR environmental requirements to include MIL-STD 810G.

The TBFDS restraint system shall be capable of the following:

1. Restraining the TBFDS to the NAVAIR crash acceleration loading requirements (20/20/10) applied separately without failure.

2. Restricting translational movement of the TBFDS tank with any amount of fuel loading throughout the CH-53K flight, ground, and landing operation envelope, under slosh conditions, due to aircraft vibration and under crash acceleration loading as specified above. Translation of the tank under flight, ground, and landing operational envelope, under slosh conditions, due to aircraft vibration is not acceptable. Under crash acceleration loading translation is limited to not impacting aircraft structure or other cargo (Threshold), or no translation (Objective).

3. Limiting gross deformation of the top of the tank to ensure that tank connections to the fuel system are not dislodged throughout the CH-53K flight, ground, and landing operational envelope, under slosh conditions, and due to aircraft vibrations.

4. MIL-STD 810G will be used to verify solution for the environmental compliance within the CH-53K operational envelope to include vibration, salt/fog, sand/dust, humidity, and temperature.

5. Address ease of on/offload and human factors.

6. Provide credible analytical and/or experimental verification of the concept as appropriate to demo feasibility.

PHASE I: Develop an innovative approach to restrain the CH-53K TBFDS. Concept must address ease of on/offload and be capable of restraining the TBFDS to NAVAIR crash g-load requirements (20/20/10) as demonstrated through analysis and verification using validated models/simulation.

PHASE II: Fully develop the concept and demonstrate practical implementation of a production scalable prototype TBFDS restraint. Evaluate the prototype restraint through demonstration testing under conditions representative of a military aircraft cargo compartment.

PHASE III: Transition the system concept to the CH-53K platform and demonstrate adaptability to other fleet platforms through modification.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: An innovative TBFDS restraint system can be adapted for transition onto other airframes or be utilized in guiding future platform designs, which will improve capabilities, safety, and reliability.

REFERENCES:

1. Robertson Aviation Crashworthy Extended Range Fuel Systems, July 2008, Helicopter Support, Inc. A Sikorsky Aerospace Services Company.
http://www.sikorsky.com/StaticFiles/Sikorsky/Assets/Attachments/Mission20Downloads/SAS008July2008.pdf

2. Trafford, M., Klein, S., and Meiranke, D., 2011, Qualification and Full-Scale Test of the Airbus A400M Barrier Net. SAE International, 4(2):710-723.

3. Viisoreanu, A., Rutman, A., and Cassatt, G., Analysis of an Aircraft Cargo Net Barrier Using MSC/NASTRAN. Boeing Commercial Airplane Group, http://web.mscsoftware.com/support/library/conf/auc99/p04999.pdf.

4. Avery, J., 1965, Cargo Restraint Concepts for Crash Resistance, US Army Aviation Materiel Laboratories, www.dtic.mil/cgi-bin/GetTRDoc?AD=AD0618493.

5. A Study of Helicopter Crash Resistant Fuel Systems, Federal Aviation Administration, 2002, www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA401697.

KEYWORDS: Fuel; Safety; Cargo; Affordable; Crashworthy/Survivability; Lightweight Restraint

N142-098 TITLE: Universal Decoder for Airborne Generated Data

TECHNOLOGY AREAS: Air Platform, Information Systems

ACQUISITION PROGRAM: PMA 209

OBJECTIVE: Develop and demonstrate an adaptive off-aircraft software module capable of decoding airborne data files from raw binary or vendor specific formats into an open format.

DESCRIPTION: Modern military aircraft generate volumes of digital data as time correlated observations measuring the aircraft state, subsystem performance, airframe stresses, and other parameters, which are collected and stored on the aircraft during flight. This data is routinely stored in crash survivable media designed to provide a record of the flight in the event of a mishap, as well as downloaded periodically onto various media for off-vehicle analysis in support of the spectrum of Maintenance, Operations, Safety, and Training (MOST) functions. No standard format is currently prescribed for this type of airborne data storage, which results in limitations in reading, interpreting, and aggregating the data. As such, post-mishap data reconstruction efforts can face extensive and unacceptable delays while determining the specific data format for a particular storage device. Additionally, applications designed to be system (or platform) agnostic that provide off-vehicle data analysis can be extremely challenged in an environment where the input data structure is unknown or unique. This problem is not only faced by the applications mentioned above–in general, any process by which stored data from multiple sources or applications is manipulated to produce a coherent output is subject to the same types of limitations if multiple input data formats are used.

To mitigate this shortfall in capability, innovative research is needed to develop a software module that is capable of converting data designed to be downloaded or otherwise mined from aircraft (data contained within crash survivable media in particular, however, all data in general) using multiple intrinsic data formats to a standard, easily usable format for off-vehicle PC based analysis by text editors, spreadsheets, and analysis software. Ideally, the software module would be capable of performing this translation with no or minimal knowledge of the input data structure and encoding format. A truly novel approach in which software can independently analyze input data records using metadata or some other method, and apply the appropriate translation algorithms is desired. Specific characteristics include (but should not be limited to):

1. Ability to adapt to data frame structures such as character delimited, synch word offset, and any others identified and agreed upon by initial project research (as a minimum).
2. Ability to decode raw formats such as linear offset, polynomial, table lookup, and others identified and agreed upon by initial project research (as a minimum).

3. Translate raw binary data into commonly encountered encoding schemes such as the American Standard Code for Information Interchange (ASCII), real or two's compliment numbers, Extensible Markup Language (XML), or Hierarchical Data Format Five (HDF5) (as a minimum).
4. Be internally adaptive to time-stamped and non-time-stamped record formats; fixed and multi-frame record formats; frame and sub-frame synch word values; header/footer, self-describing, and data-only record formats; word length; frame/record length; sub-frame formats; periodic and adaptive record formats; commercial aviation (ARINC) data formats; numeric, character, and enumerate data formats; and other characteristics as determined by initial project research (as a minimum).
5. Execute as standalone or callable subroutine/applet responsive to runtime user input or batch mode input to designate input file set.

PHASE I: Design and prove feasibility of a software module that autonomously senses and translates commonly used military and commercial aviation data formats into an open format that provides for easy import into text editors, spreadsheets, and analysis software.

PHASE II: Design, develop, and demonstrate the software module. Validate it for accuracy and efficiency using government supplied data.

PHASE III: Finalize a software module that meets operational requirements. Integrate, test, and transition the technology as appropriate, which includes but is not limited to the Military Flight Operations Quality Assurance (MFOQA) Program of Record developed by PMA-209. Develop commercialization plans for potential private sector applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has relevance in any application where flight data is collected, stored, or analyzed-particularly at safety agencies where flight data recorder analysis or (Military) Flight Operations Quality Assurance ((M)FOQA) is performed, or aircraft maintenance facilities where health and usage monitoring is performed. The encoded nature of flight data, even when non-proprietary, render it difficult to interpret outside of vendor supplied software, which is typically expensive and virtually impossible to aggregate for third party analysis unless there is access to computer programming expertise. This software would mitigate that limitation.

REFERENCES:
1. Federal Aviation Administration (FAA) Advisory Circular AC No. 20-141B, "Airworthiness and Operational Approval of Digital Flight Data Recorder Systems," August 2010.

2. Sudolsky, M., "ARINC 573/717, 767, and 647A: The Logical Choice for Maintenance Recording and IVHM Interface Control or Frame Updates," Annual Conference of the Prognostics and Health Management Society, 2009, https://www.phmsociety.org/node/46.

3. ARINC Characteristic 767-1, Enhanced Flight Recorder, May 2009, https://www.arinc.com/cf/store/catalog_detail.cfm?item_id=1220.

4. ARINC Characteristic 717-15, Flight Data Acquisition and Recording System, July 2011, https://www.arinc.com/cf/store/catalog_detail.cfm?item_id=1641.

KEYWORDS: Flight Data; Data Format; Data Decode; Data Translation; Binary Data; Decode Logic

N142-099 TITLE: Tactical Airplane Noise Reduction via Advanced Automated Computational Airframe Aft-End Integration Technologies

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: JSF-Prop

OBJECTIVE: Demonstrate and validate noise reduction capability associated with automated shaping of tactical airplane/engine nozzle interface region to increase near-field mixing.

DESCRIPTION: Noise generated by military exhaust systems presents a community noise problem and becomes a target identifier during strike operations. Exhaust-system acoustic calculations typically assume constant ambient velocity conditions and thus do not capture potential impacts on the nozzle exit-plane flow field due to the local airframe geometry. Furthermore, the bulk of engine acoustics testing is performed with uninstalled engines, either with or without external airflow. Airframe aerodynamic design typically incorporates a low-to-moderate fidelity exhaust plume for thrust/drag computations, with emphasis on cruise conditions where drag/range is the dominant concern for key performance parameters KPPs. The engine/airframe design/testing process does not take advantage of mixing benefits achievable with airframe/nozzle/plume acoustics concurrent design. Although pre-production ground/flight testing does capture the resultant system acoustics level, such testing occurs when the design is extremely difficult to modify.

Recent high-fidelity computational fluid dynamics (CFD) calculations of current state-of-the-art tactical aircraft/nozzle systems at operational conditions and power settings show a substantial increase in plume mixing in the nozzle near-field due to certain airframe features that locally increase exit-plane shear effects. This suggests that consideration of airframe/exhaust geometry modifications for next generation tactical aircraft may be able to magnify such shear mixing to reduce acoustic levels at noise-critical operational conditions and power settings.

The development and demonstration of a computational technology and methodology tool for the concurrent automated shaping of aft airframe and nozzle geometries to reduce tactical aircraft jet noise more than 3dB without any performance penalties (e.g., drag, thrust) is desired. The proposed technologies should inherently capture airplane performance, operability and acoustics effects into an automated optimization framework with high-fidelity CFD and acoustics tools. Generic airframe and generic engine parameters are adequate for this stage of development, as a successful product should easily be configurable to a current naval platform in future efforts.

PHASE I: Demonstrate feasibility that the developed concept can produce a new design for a legacy tactical aircraft/nozzle configuration that results in reduced noise levels (>3dBs) for two points in the mission envelope without adversely impacting critical aerodynamic performance parameters at other key points. Develop a scale-model test plan for validation of the design space.

PHASE II: Conduct the test plan developed in Phase I and compare data to predictions. From this comparison, identify two airframe/exhaust design modifications that meet or exceed current critical performance parameters (noise reduction >3dBs with no change in aircraft performance). Apply this geometry optimization methodology to a selected non-axisymmetric vehicle/exhaust concept to generalize those features and dimensions that can be exploited for noise reduction.

Include data/prediction comparisons to validate the levels of noise reduction resulting from the design process; and parametric plots showing the key geometric features and dimensions for which high levels of noise control can be achieved, for both axisymmetric and non-axisymmetric representative configurations.

PHASE III: Transition to Navy aircraft applications for improved exhaust and aft airframe integration for reduced noise environmental impact. Applications considered should include growth versions of legacy F18 and F35 systems as well as future tactical concept vehicles. In addition, the developed concepts may transition to commercial airliner designs as they have direct application to wing, nacelle, struts and landing gear integration with the gas turbine engine powerplants of those transports for reduced noise environmental impact.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Developed technologies will also be directly applicable to commercial air transports noise reduction.

REFERENCES:

1. Martens, S. and Spyropoulos, J. T., June 14-18, 2010, Practical Jet Noise Reduction for Tactical Aircraft, GT2010-23699, 2010 ASME/IGTI Turbo Expo, Glasgow, U.K.

2. Nichols, J.W, Lele, S.K., Ham, F.E., Martens, S. and Spyropoulos, J.T., 2013, Crackle Noise in Heated Supersonic Jets, Journal of Engineering for Gas Turbines and Power, Vol. 135, pp. 051202-1.

KEYWORDS: Tactical Aircraft Acoustics; Noise Reduction Technologies, Aircraft Aft-End integration, Aircraft Optimization, Nozzle Integration, Large Eddy Simulation (LES)

N142-100 TITLE: Ruggedized, Ultra-Compact, High Dynamic Range, Dual-Output Wideband Electro-Optic Modulator

TECHNOLOGY AREAS: Air Platform, Electronics

ACQUISITION PROGRAM: JSF-MS

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OBJECTIVE: Develop and package a new ultra-compact, wideband, dual-output electro-optic modulator for radio-frequency (RF) photonic link applications on air platforms.

DESCRIPTION: The replacement of the coaxial cable used in various onboard RF/analog applications with RF/analog fiber optic links requires ruggedized, high dynamic range, dual-output wideband electro-optic modulators. Current airborne military communications and electronic warfare systems require ever increasing bandwidths while simultaneously requiring reductions in size, weight and power (SWaP). Replacement of the coaxial cabling will provide increased immunity to electromagnetic interference, reduction in size and weight, and an increase in bandwidth and power but requires an innovative modulator to complete the system.

The desired electro-optic modulators used in RF/analog fiber optic links must be compatible with distributed feedback (DFB) lasers with greater than 100 mWatts of single-mode fiber coupled optical power. These modulators must have dual outputs for use with balanced photo detector receivers which would enable a higher link gain, a lower noise figure and a higher spur free dynamic range, as required in Navy electronic warfare and radar systems. A bandwidth of up to 40 GHz is required and it must be compatible with emerging systems out to 100 GHz. A fourfold reduction in SWaP requirements as compared to current electro-optic modulators must be achieved without any degradation in device performance. A major challenge is to develop a new compact dual-output modulator packaging approach that can achieve uncooled operation over a minimum temperature range of -40 to +100 degrees Celsius. This key criterion must be met without sacrificing modulator bandwidth and drive voltage efficiency, while demonstrating low optical insertion loss at fiber-coupled DFB laser powers up to 200 mWatts, and higher in the future. A ruggedized package that has a height less than or equal to 5 mm, a volume of approximately 2.5 cubic centimeters is required. The packaged modulator 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 dual-output wideband electro-optic modulators that meets the requirements outlined. Develop a modulator fabrication process, packaging approach, and a modulator test plan. Demonstrate feasibility of the modulator with a supporting proof of principle bench top experiment.

PHASE II: Optimize Phase I dual-output modulator and package design. Test prototype modulator to meet modulator design specifications in a Navy air platform representative of a relevant application environment. The prototype modulator should be tested in an RF photonic link over temperature with the objective performance levels reached. Demonstrate a prototype fully packaged modulator for direct insertion into analog fiber optic transmitters.

PHASE III: Perform extensive modulator reliability and durability testing. Transition the demonstrated technology to Naval Aviation platforms and interested commercial applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology would find application in commercial systems such as fiber optic networks and telecommunications.

REFERENCES:
1. McKinney, J.D., Godinez, M., Urick, V.J., Thaniyavarn, S., Charczenko, W. & Williams, K.J., 2007, Sub-10-dB Noise Figure in a Multiple-GHz Analog Optical Link, IEEE Photonics Tech. Lett., Vol. 19 Issue 7.

2. Noguchi, K., Mitomi, O., and Miyazawa, H., 1998, Millimeter-wave Ti:LiNbO3 optical modulators, Journal of Lightwave Technology, 16(4), 615-619.

3. Islam, M.S. et al., 2002, High power and highly linear monolithically integrated distributed balanced photodetectors, Journal of Lightwave Technology, 20(2), 285-295.

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

KEYWORDS: Ultra-Wideband; Electro-Optic Modulator; Dual-Output; Extended Temperature Range; Analog Fiber Optic Links; Balanced Photodetector

N142-101 TITLE: Atmospheric Ice Detection and Avoidance System for Fixed and Rotary Wing Aircraft

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: PMA 266

OBJECTIVE: Develop an ice detection/avoidance system for aircraft that minimizes space, weight, power and cooling (SWaP-C) integration concerns and detects potential icing conditions along a flight path up to 20 miles from the aircraft.

DESCRIPTION: Current ice detection systems can only detect ice accumulation on the aircraft itself, and/or detect temperature conditions that may result in potential icing–they do not have the ability to analyze the water composition at a safe stand-off distance from the aircraft, thus preventing the ice build-up in the first place. An Ice Detection/Avoidance system that is capable of distinguishing between ordinary cloud droplets (that can cause only rime icing) and drizzle droplets, which cause dangerous clear icing that may spread beyond the deicing equipment of an aircraft, is desired. It is critical that this new system be able perform this ice detection capability at a safe operating distance from the potential icing area (up to 20 miles) and provide range and bearing to allow adequate time for pilot action to maneuver away from the inclement weather. The Ice Detection/Avoidance system should be capable of measuring the amount of water in the atmosphere, temperature of liquid droplets in the atmosphere (including whether the water is super-cooled), and recognizing the difference between liquid droplets and frozen water to determine whether potential icing conditions along the route exist. Passive microwave systems used in meteorological satellite programs have met with success in determining water composition and temperature in clouds. However, the current size of such systems is not compatible with aircraft use and would need to be miniaturized for low SWaP-C aircraft applications.

System weight should be no more than 15 pounds to include antennas; power should be less than 100 watts, antenna size should not exceed 12 inch diameter with flush mounting, and avionics size should be less than 120 cubic inches. The system should not require external air cooling and should be capable of operating at sustained operating temperatures of 120 degrees Fahrenheit.

PHASE I: Develop and prove feasibility of a design for the ice detection/avoidance system. Include modeling and simulation of the system's detection capability of varying water composition (water droplet size and temperature variation) found in the atmosphere from surface to 40,000 feet.

PHASE II: Develop an ice detection/avoidance system prototype and perform lab demonstration. Conduct flight testing on a surrogate test aircraft; this includes providing a test aircraft, installation of the test system, flight test costs, and any range test costs associated with the flight testing of this system.

PHASE III: Productionize ice detection/avoidance system hardware and mature remaining algorithms. Finalize and transition system to appropriate Navy fixed wing, rotary wing and UAV platforms. Develop manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has wide applicability to both government and commercial aviation as a safety of flight system.

REFERENCES:
1. Jackson, D. and Goldberg, J., Ice Detection Systems: A Historical Perspective, SAE Technical Paper 2007-01-3325, doi:10.4271/2007-01-3325.

2. Lawmakers Press FAA on SLD Icing, Air Safety Week, 24(9), 2010, Retrieved from http://www.aviationtoday.com/regions/weur/Lawmakers-Press-FAA-on-SLD-Icing_66785.html.

3. Prata, A. J. & Bernado, C., 2012, System and Method for Detecting Adverse Atmospheric Conditions Ahead of an Aircraft, WIPO Patent Application WO/2013/091902, Retrieved from http://www.sumobrain.com/patents/wipo/System-method-detecting-adverse-atmospheric/WO2013091902.html.

4. Vivekanandan, J., 1998, Ice Detection Using Radiometers, US Patent No. 5,777,481, Retrieved from http://www.freepatentsonline.com/5777481.html.

5. Lines, R. T., Savage, R. C., and Cole, J., 2001, Microwave Icing Avoidance System, International Application No. PCT/US2000/031207, Retrieved from http://patentscope.wipo.int/search/en/detail.jsf?docId=WO2001035119&recNum=1&maxRec=&office=&prevFilter=&sortOption=&queryString=&tab=PCT+Biblio.

KEYWORDS: Ice detection; Ice avoidance; Weather Avoidance; Aircraft Icing Conditions; Microwave System; Safety Systems

N142-102 TITLE: Micro Identification Friend or Foe (IFF)

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics

ACQUISITION PROGRAM: PMA 213

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is “ITAR Restricted”. The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the “Permanent Resident Card”, or are designated as “Protected Individuals” as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Design and develop a micro Identification Friend or Foe (IFF) transponder system, with capability for Modes 1, 2, 3/A, C, 4, 5, S, and automatic dependent surveillance-broadcast (ADS-B) in/out, that meets the space, weight, and power (SWaP) requirements for Group 2 Unmanned Aerial Vehicles (UAVs).

DESCRIPTION: Current IFF transponder systems were designed many years ago to the requirements of manned aircraft. They are large, heavy, and consume too much power for many applications in today's smaller, unmanned aircraft. Crypto appliqués currently available are also too large and heavy for small UAVs. The successful concept

will be an IFF transponder system, compliant with Air Traffic Control Radar Beacon System IFF Mark XII System (AIMS) 03-1000B and RTCA (previously known as Radio Technical Commission for Aeronautics and now known only by the initials) DO-260B, contained in a package of less than 7 cubic inches (threshold), with an objective target of 3.5 cubic inches.

Civilian IFF systems have made some progress, one example being a Mode 3/A, C, S package of about 3.5 cubic inches, but it has no capability for encryption or modes 1, 2, 4, 5 or Automatic Dependent Surveillance Broadcast (ADS-B). The technical challenge for this project is to miniaturize the crypto package, which is currently about four times the target volume. In addition, both civil air traffic control (ATC) modes (3/A, C, S) and military modes (1, 2, 4, 5) must be included, as well as power handling capabilities and aircraft bus communication circuits, all while hardening the entire package to operate in the military unpressurized fighter environment.

Minimum required performance standards will be defined by the UAV Annex to AIMS 03-1000B, but with developer's discretion to meet the full set of requirements defined by AIMS 03-1000B. It will have capability for Modes 1, 2, 3/A, C, 4, 5, S, ADS-B in/out, and provisions for Mode 5 Level 2 Broadcast when available. The microtransponder system should be capable of receiving and retaining the applicable encryption keys for all encrypted IFF modes. Use of aircraft power is required, but the transponder must be capable of operating on battery power for extended periods, enabling military IFF capability in small military UAVs with a possible extension to dismounted soldiers. Output power will be at the discretion of the developer but should be at least 250 watts (peak) and be capable of being amplified for longer range operations. Input and Output should include DC power in, RF signal in/out, and aircraft communications with the flexibility to use a variety of protocols that may include Ethernet, MIL-STD-1553, or RS-232. The product must meet the standard military environmental requirements for unoccupied carrier based aircraft spaces to 50,000 feet. The dominant trade will be between range and volume. The successful concept should optimize the output power in a package that meets the size requirements. To put the crypto in an appliqué or embed within the module will be a design decision, and allocation of the limited volume between the components is up to the designer. Any Phase I company selected to move onto Phase II will need the ability to obtain a security clearance.

PHASE I: Determine the technical feasibility of a high level design, and required parts and processes to manufacture. Develop the external interface control specifications, module level functional allocation to internal components, and SWaP requirements. Estimate the output power available and feasibility of meeting the full set of AIMS 03-1000B requirements. Demonstrate the capability to produce component level product layout on a scale compatible with the final objective design criteria.

PHASE II: Produce and demonstrate flyable prototype hardware based on Phase I work. Complete laboratory testing in a relevant environment, per MIL-STD-810 [5].

PHASE III: Integrate the system into lead platform. Demonstrate compliance with certification requirements in a relevant operational environment, per MIL-STD-810 [5].

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Without the military modes, the concept will be applicable to sense and avoid capability in small UAVs. This technology complies with the Federal Aviation Administration (FAA) initiatives to integrate UAVs into the National Air Space and is vitally important for full scale commercial UAV employment.

REFERENCES:

1. Reference is unavailable at this time and has been removed by TPOC. Please see new Reference 8 which has been uploaded in SITIS and is now available for view/download.

2. RTCA DO-260B, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance–Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B), 13 December 2011.

3. MIL-STD-461F, Requirements for the Control of Electromagnetic, Interference, Characteristics of Subsystems and Equipment, 10 December 2007.

4. MIL-STD-464C, Electromagnetic Environmental Effects Requirements for Systems, 1 December 2010.

5. MIL-STD-810G, Environmental Engineering Considerations and Laboratory Tests, 31 October 2008.

6. MIL-STD-1472G, Department Of Defense Design Criteria Standard: Human Engineering, 11 January 2012.

7. MIL-STD-704C, Aircraft Electrical Power Characteristics, 30 December 1977.

8. McCumbee, R. (20 April 2012). IFF Mark XIIA System Overview. DOD AIMS User's Conference. (Uploaded in SITIS on 6/5/14.)

KEYWORDS: Transponder; UAV; AIMS; ADS-B; Micro IFF; Embedded Crypto

N142-103 TITLE: Innovative CH-53K Cargo Floor System

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: PMA 261

OBJECTIVE: Develop, demonstrate, and integrate an innovative cargo floor system for the CH-53K.

DESCRIPTION: Existing cargo floors are heavy and have limited durability, impacting mission range and operational and support costs. Current aircraft have aluminum floors which provide the required durability at the cost and limitations of higher weight materials.

An innovative CH-53K cargo floor system that stresses durability, low weight, operational capability, reliability, maintainability, manufacturability, and affordability is sought. Thermoset and thermoplastic composite alternative flooring materials have been previously evaluated by industry and are offered as examples only; all innovative flooring materials will be considered. Solutions capable of meeting all technical requirements while reducing total floor weight to less than 1,500 lb are sought. Final design technical requirements include:

The total floor dimensions are 8.5' x 44'. It is comprised of many individual floor system sections. The final design has to be capable of 12,500 hours of service without replacement, be comprised of both treadways and walkways, and to easily integrate to existing tiedown rings, roller rails and trays, 436L rail locking system, and guide rails. It shall meet the standards required in FM 55-450-2, MIL-STD-810G, MIL-HDBK-1791 and MIL-STD-1366E.

The floor system must support 300 lb/ft^2 for palletized cargo and 5,000 lb per axel for vehicles. Floor design must support restrained cargo subjected to downward forces resulting from applications of flight and landing load factors, including the effects of rotational accelerations, at each cargo station. The amount of restraint that must be used to keep the cargo from moving in any direction is expressed in units of gravity, or g's. The following dynamic and static restraint criteria have been established for this aircraft: 4 g's forward direction, 3 g's aft direction, 3 g's vertical direction and 3 g's lateral direction.

PHASE I: Design and develop an innovative CH-53K cargo floor system as described above. Demonstrate the feasibility by conducting analyses to prove proposed solution is capable of supporting 300 lb/ft^2 and has a total floor weight less than 1,500 lb.

PHASE II: Finalize the Phase I design and develop representative critical cargo floor system sections including a treadway section, roller section and walkway section for the CH-53K. Evaluate the prototype floor sections through demonstration testing under conditions representative of a military aircraft cargo environment.

PHASE III: Perform qualification and certification testing and transition the developed cargo floor system to the CH-53K, other military platforms such as V-22, and industry for use in commercial transport such as truck trailers, cargo containers, and railway cars.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: An innovative cargo floor can be transitioned into other airframes or be utilized in future design ideas, which will improve capabilities, safety, maintainability, reliability and reduce operational cost to any fleet. Improvements to floor design could also be utilized by other military platforms such as the V-22.

REFERENCES:
1. FM 55-450-2, 05 June 1992, Army Helicopter Internal Load Operations.

2. MIL-STD-810G, 01 Jan 2000, Environmental Engineering Considerations and Laboratory Tests.

3. MIL-HDBK-1791, 14 Feb 1997, Designing for Internal Aerial Delivery in Fixed Wing Aircraft.

4. MIL-STD-1366E, 31 Oct 2006, Interface for Transportability Criteria.

KEYWORDS: Safety; Durability; Cargo; Cost; Floor; Platform

N142-104 TITLE: Effective Measures of Training Display System Performance

TECHNOLOGY AREAS: Air Platform, Human Systems

ACQUISITION PROGRAM: JSF-Trng

OBJECTIVE: Develop an objective and efficient measurement toolkit for conducting validated acceptance tests for simulation training display systems.

DESCRIPTION: Over the past decade, the ability to measure essential display system attributes has advanced to the point where the simulation training industry has multiple suppliers who offer automated display calibration systems, capable of accurate geometry and channel-to-channel co-alignment. Several of these systems can also measure and correct edge blending, electro-optical response (gamma), color, and uniformity. Recent publications describe reasonable new metrics for mirror distortions, motion-induced blurring, uniformity, and Night Vision Goggles (NVG) stimulation capability. Despite these significant advances, the typical acceptance tests used to certify training display systems are still manual, incomplete, time consuming, and often inconsistently applied across programs.

Innovative metrics and measurement procedures are needed to support the certification of simulation training devices in the field. Respondents are expected to focus their initial efforts on those metrics that are expected to correlate most strongly with training task performance and provide the greatest return on investment. Candidate metrics include: system resolution, sampling artifacts, update rate, motion-induced blur, contrast, luminance, geometry, mirror distortion, electro-optical response (gamma), color, NVG stimulation (infrared (IR) balance), and uniformity. Where practical, the metrics and procedures should correspond with those currently in use in the simulation training industry. Correlation with training effectiveness or task performance must be demonstrated for metrics that deviate from standard practices.

The proposed system must be capable of being rapidly set up (e.g., less than two hours) at the real eyepoints within a display system, without having to significantly reconfigure the device (i.e., remove cockpit seats). The measurement system must be capable of dealing with the challenges associated with window bars and other obstructions that may interfere with measuring the entire field of view of the display system. To assure applicability across a wide range of display system suppliers, the measurement system may not use sensors or components embedded within the display system. Where practical, the measurement system should support factory acceptance testing for major system components, such as display screens, mirrors, projectors, and image generators (anti-aliasing), prior to integration into the training device. Ideally, candidate test patterns will be defined in a way that allows for their installation or implementation on any of the image generators commonly used for simulation training. The measurement system should require no more than a total of 8 hours of training to become proficient, and should contain embedded help functions and documentation. An effort should be made to minimize the number, cost, and complexity of the components in the measurement tool kit, and a practical shipping container(s) for everything required for a site visit should be included.

PHASE I: Develop and prove feasibility of a concept that includes detailed descriptions of the system components and draft procedures for the on-site measurement and computation of metrics. Identify at least five of the candidate metrics listed above and conceptually demonstrate feasibility of the implemented system.

PHASE II: Design, construct, test, and refine a complete working prototype of the measurement system that is capable of measuring and computing at least five of the candidate metrics. Demonstrate the abilities of the system in two separate simulation training facilities and in both rotary and fixed wing training devices; one training simulator should have a real display and one should have a collimated display. Demonstrate the developed system's ability to measure and compute at least four of the candidate measurements. Conduct validation studies for any new metrics that are proposed as predictors of system performance.

PHASE III: Fully productize and transition the display measurement toolkit to the modeling and simulation community; develop and provide a one-day training course designed for the simulation certification personnel who will use the kit.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This has the potential for several commercial products. The toolkit can eventually be manufactured, calibrated, and supported by various equipment vendors, particularly those dealing with measuring instruments. The toolkit should have great flexibility across various systems.

REFERENCES:
1. Desjardins, D. D., & Meyer, F. M., 2012, Military Display Performance Parameters, Paper presented at the SPIE Defense, Security, and Sensing.

2. Ewart, R. B., & Harshbarger, J. H., 1975, Measurement of Flight Simulator Visual System Performance. Paper presented at the SPIE Simulators and Simulation.

3. Keller, P. A., 1997, Electronic Display Measurement: Concepts, Techniques, and Instrumentation, New York: Wiley.

4. Lloyd, C. J., 2012, Effects of Spatial Resolution and Antialiasing on Stereoacuity and Comfort. Proceedings of the AIAA Modeling and Simulation Technologies Conference, Minneapolis, MN.

5. Lloyd, C. J., Williams L., Pierce B., 2011, A Model of the Relative Effects of Key Task and Display Design Parameters on Training Task Performance, Proceedings of the IMAGE Society Annual Conference, Scottsdale, AZ.

6. Lloyd, C. J., Nigus, S., Ford, B. K., Linn T., 2010, Proposed Method of Measuring Display Systems for Training with Stimulated Night Vision Goggles. Proceedings of the IMAGE Society Annual Conference, Scottsdale, AZ.

7. Long, J.L., Lloyd, C. J., Beane, D.A., 2010, Practical Geometry Alignment Challenges in Flight Simulation Display Systems, Proceedings of the IMAGE Society Annual Conference, Scottsdale, AZ.

8. Lloyd, C. J., 2002, Quantifying Edge-Blended Display Quality: Correlation with Observer Judgments, Proceedings of the IMAGE Society Annual Conference, Scottsdale, AZ.

9. SID, 2012, Information Display Measurements Standard: IDMS Version 1.03: Society for Information Display.

KEYWORDS: Validation; Effective Measures; Training Display; Automated Testing; Display System Calibration; Measurement System

N142-105 TITLE: Intelligent Multi-Computing-Platform for Complex Tactical Manned and Unmanned Engagement Planning and Data Distribution

TECHNOLOGY AREAS: Air Platform, Human Systems

ACQUISITION PROGRAM: PMA 281

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Design and develop software to be used on intelligent modern handheld device(s) to optimize mission planning across distributed computing environments to support multiple manned and unmanned platforms.

DESCRIPTION: Current tactical engagement planning is accomplished via manual query, data collection, manual data entry and data distribution, in a memory-limited mission planning architecture with extremely restricted data sharing and data access. In many daily operational scenarios, multiple tactical platforms/operators require similar data in unique configurations to be machine usable during tactical operations. Additionally, to facilitate synchronized human readable data that must be available during flight, all critical data must be manually reformatted and printed in multiple copies, with unique configurations for each operator. The overall planning process creates a labor intensive operational environment. The planning process currently uses a Joint Mission Planning System (JMPS) laptop (e.g. F/A-18) to generate various output files in different formats, including PowerPoint files, mission plans for Electronic Knee Boards (EKB), and aircraft data loads. There is very limited machine-to-machine communication between JMPS laptops supporting dissimilar aircraft (e.g. E/A18-G, E-2). The mission planning process also collects data from various other sources that includes, but is not limited to, weapons data, weather data, divert information, etc.

The newly developed software should significantly expedite and unify the operational mission planning process, currently occurring in a diverse, human-centric distributed environment (consisting of systems such as white boards, paper maps, paper target folders, and time intensive programs like JMPS). The handheld device(s) will not only be used to enter mission plan requirements, but also to receive completed mission plans that could be updated during mission planning and execution as required. The proposed software should be capable of automatically adjusting the format of mission plans based on the specific devise. An additional goal is to investigate the most effective, secure interface between the remote device(s) and the appropriate JMPS laptop/server. The overall result of this project would vastly change the mission planning world and significantly improve unit level planning without having to re-code the entire JMPS system.

PHASE I: Identify and develop a conceptual software technique to conduct collaborative mission planning in a manned and/or unmanned environment, using a handheld device(s) and an associated JMPS system. Define an optimal interface between the remote handheld device(s) and the associated JMPS laptops/servers. Identify the cost impact (additional software development effort) to JMPS to facilitate an interface for the remote computing interaction.

PHASE II: Develop a prototype using the conceptual technique and demonstrate the overall mission planning process with emphasis on information assurance, which will be critical in the subsequent phase and eventual integration. Provide appropriate software documentation.

PHASE III: Implement and demonstrate the mission planning process using a handheld device(s) in an operational exercise, and ensure that software is ready for information assurance certification.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Anticipate that the result of this development be applicable in the following commercial and government markets with particular focus:

1. Commercial aviation industry
2. Commercial package delivery businesses
3. Homeland security-FEMA, etc.

REFERENCES:

1. Menner, W. A., 1997, The Navy's Tactical Aircraft Strike Planning Process, Johns Hopkins APL Technical Digest, 18(1), 90-104.

2. Wood, D., Hughes, E., Special Operations Data Quality Issues, Proceedings of the Seventh International Conference on Information Quality (ICIQ-02), http://mitiq.mit.edu/ICIQ/Documents/IQ%20Conference%202002/Papers/SpecialOperationsForcesDataQualityIssues.pdf.

3. Damilano L., Guglieri G., Quagliotti F., Sale I., Lunghi A., 2013, Ground Control Station Embedded Mission Planning for UAS, Journal of Intelligent and Robotic Systems, 69(1-4), 241-256.

4. DOD Directive 8500.01E, Information Assurance, https://acc.dau.mil/CommunityBrowser.aspx?id=22214.

KEYWORDS: Human Computer Interface (HCI); Data distribution; Interoperability; Handheld Devices; Joint Mission Planning System (JMPS); Electronic Knee Board (EKB)

N142-106 TITLE: Mitigation of Military Communication and Radar System Interference from Current and Future Fixed and Mobile Wireless Broadband Systems

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: JSF-MS

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop communication and radar waveforms to mitigate interference from fixed and mobile wireless broadband systems now operating within the same frequency bands as these military systems.

DESCRIPTION: Worldwide, the transfer or approval for secondary use of frequency spectrum to the private sector has been shown to adversely affect the operation of many military communication and radar systems utilizing the same frequency band. For example, unlicensed–national information infrastructure (U-NII) devices are now permitted to operate on a non-interference basis in frequency bands allocated to primary Federal services including Radiolocation and Aeronautical Radio navigation. U-NII devices provide short-range, high-speed unlicensed wireless connections for, among other applications, Wi-Fi-enabled radio local area networks, cordless telephones, and fixed outdoor broadband transceivers used by wireless internet service providers. While these U-NII devices are required to operate with spectrum sharing technologies intended to limit electromagnetic interference (EMI), other communication and radar systems have been shown to be adversely impacted. Specifically reference 1 identifies a number of risk elements due to the likelihood of harmful interference from large numbers of U-NII devices to protected federal systems. The report goes on to discuss potential risks for federal airborne, ground-based, and shipborne radar systems and the fact that U-NII regulations were not developed to detect airborne signals. A variety of advanced time-frequency domain techniques utilizing distinct waveforms of different durations over different spectral bandwidths offer the potential to reduce interference from these secondary use systems. Balancing the level of interference mitigation provided by the new waveforms with the ease and cost of integration into candidate communication and radar systems is an important consideration. The work to be accomplished under this topic will have a primary focus on U-NII interference mitigation approaches for airborne radar systems but be extendable to airborne data link systems.

PHASE I: Demonstrate, via detailed simulation, the operational performance and interference mitigation of advanced waveform designs suitable for use in Navy airborne radar systems operating in the presence of U-NII devices.

Develop a detailed integration and implementation plan showing how the techniques might be integrated into the radar system and extended for use in airborne data link systems. The small business will provide a Phase II development plan with performance goals and key technical milestones, integration approaches, and technical risk reduction addressed.

PHASE II: Further develop and refine the approaches demonstrated in Phase I. Implement and demonstrate the technique's operational performance in an EMI environment on a candidate airborne radar system provided by the Navy.

PHASE III: Fully mature, test and integrate the technology into the radar system. Work with the applicable Navy Program Office and original equipment manufacturer (OEM) to facilitate transition planning and execution.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic has direct utility to a wide variety of commercial and military communication and radar systems.

REFERENCES:
1. Department of Commerce, 2013, Evaluation of the 5350-5470 MHZ and 5850-5925 MHZ Bands Pursuant to Section 6406(b) of the Middle Class Tax Relief and Job Creation Act of 2012, Retrieved from http://www.ntia.doc.gov/files/ntia/publications/ntia_5_ghz_report_01-25-2013.pdf.

2. Department of Defense, 2008, Strategic Spectrum Plan, Submitted to the Department of Commerce In Response to The Presidential Spectrum Policy Reform Initiative, Retrieved from http://www.ntia.doc.gov/files/ntia/publications/dod_strategic_spectrum_plan_nov2007.pdf.

KEYWORDS: Communications; Radar; Electromagnetic Interference; Waveform Design; Spectrum Allocation; EMI Mitigation

N142-107 TITLE: Advanced Arresting Gear Cable for Lighter Weight and Longer Service Life

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PMA 251

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop an arresting gear cable with half the weight and double the service life of the current steel cable.

DESCRIPTION: Aircraft are recovered aboard aircraft carriers by means of the aircraft tailhook engaging a cable which is connected to an arresting gear engine below the flight deck. The arresting gear engine absorbs the aircraft's kinetic energy, stopping the aircraft on the flight deck. The cable is a critical component to successful recoveries. The current cable is steel and is approximately 65 percent of the effective mass of the current arresting gear system.

The Navy needs a lighter weight replacement to the existing steel cable with a higher strength-to-weight ratio than steel. Such a cable would significantly improve the performance of the arresting gear engine, enabling increased bring-back weight of the aircraft, reduced wind-over-deck required for recovery, and increased safety margin. This is especially important in order to push the trade space envelope for future aircraft, i.e. allow for heavier aircraft with faster approach speeds to operate off of carriers.

The objectives of the new cable would be to double the service life of the current cable with a maximum weight of 2 pounds (lbs) per foot and a minimum tensile strength of 220,000 lbs before breaking. The cable must also be able to be terminated.

Service life is defined by the number of cycles on a two-sheave testing machine. The current cable achieves a minimum of 7,600 cycles at 98,000 pound tension wrapped around 28 inch sheaves. The new cable must achieve a minimum of 15,200 cycles under the same conditions. The current arresting cable is 1-1/2 inches in diameter and 1,150 feet in length; proposals must address whether the new cable can be manufactured in adequate lengths. A different cable diameter could be considered (i.e., a cable that is not compatible with current sheave throat dimensions), if the benefits are significant enough to justify a service change to the arresting gear. Because the cable must wrap around multiple sheaves, cable construction must be such that the individual strands can move freely with respect to each other to maximize flexibility and bend-over-sheave performance.

Cable terminations must have an efficiency of 95 percent, i.e., have a tensile breaking strength equal to 95 percent of the breaking strength of the cable, with resistance to tensile load distributed equally over all strands. Cable termination efficiency may be traded off for increased tensile strength such that the combined cable/terminal assembly has a minimum tensile strength of 210,000 lbs. Special consideration will be given to proposals that can exceed this strength requirement, thereby increasing our operating factor of safety. Past research and testing have shown that certain synthetic material fibers compress in the cross-sectional direction under tensile load and exhibit a tendency to pull away from epoxy-filled sockets. A termination solution would need to address this phenomenon, either by developing/testing a fiber that does not compress, by proposing a novel epoxy or termination methodology. For novel termination methods, in the field termination technique should be considered to allow shipboard terminations while underway.

Approximately 250 feet of the cable will be subject to abrasion against flight deck non-skid during every arrestment cycle (Non-skid spec: MIL-PRF-24667C). Any new cable must be resistant to non-skid abrasion over the service life of the cable. Additionally, the cable is exposed to a salt-water environment and other elements such as flight deck cleaners, fuel, hazardous chemicals, and heat from aircraft exhaust. Preservation of the cable material should be considered. The current cable has exposure limitations and must be removed under special circumstances where chemical exposure is unavoidable. Therefore survivability against every chemical is not a requirement; however an understanding of compatible and incompatible materials to develop necessary procedures is highly desirable.

The references document previous testing with synthetic materials, but the topic is open to any technology approach.

PHASE I: Define technical issues related to the cable concept in the arresting gear application. Determine the feasibility of the concept by proving whether the cable will meet the strength, service life, weight, termination and abrasion resistance objectives through analysis and/or targeted lab demos that address specific technical issues.

PHASE II: Develop full scale prototype cables with terminations. Test service life on a two sheave tester. Test tensile strength on a tensile tester. Test abrasion resistance. Propose shipboard termination procedure. Address manufacturability and provide defendable estimates for production cost. Address lubrication and preservation of the cable to protect it from salt water, aviation fuel, flight deck cleaner, and aircraft exhaust heat.

PHASE III: Qualify the cable through testing at Lakehurst shore-based arresting gear facilities. Build production quantities of cable for transition to the carrier fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Cables of this size and magnitude find numerous applications in the commercial sector, including bridges, elevators, mining, amusement parks, ski lifts, ship moorings, and building construction/cranes.

REFERENCES:

1. Wire Rope Users Manual, 4th ed., Wire Rope Technical Board.

2. Sloan, F., Bull, S., and Longerich, R., 2005, Design Modifications to Increase Fatigue Life of Fiber Ropes. OCEANS,2005. Proceedings of MTSS, 1, 829-835, doi:10.1109/OCEANS.2005.1639856.

3. Sloan, F., Nye, R., Liggett, T., 2003, Improving Bend-over-Sheave Fatigue in Fiber Ropes, OCEANS 2003, Proceedings, 2, 1054-1057, doi:10.1109/OCEANS.2003.178486.

KEYWORDS: Advanced Materials; Cable Termination; Arresting Gear Cable; Advanced Fibers; High Tensile Strength; Bend Over Sheave

N142-108 TITLE: Electronic Thermally Initiated Venting System (ETIVS) Trigger and Thermal Sensor

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

ACQUISITION PROGRAM: PMA 259

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Design and develop high temperature mixed signal integrated circuit designs suitable for implementing an in-line Electronic Thermally Initiated Venting System (ETIVS) trigger and thermal sensor to replace existing out-of-line devices on current and future weapons systems.

DESCRIPTION: Current Thermally Initiated Venting Systems (TIVS) consist of a thermal sensor, trigger, out-of-line blocking device, initiator, transfer energetic, and a linear shaped charge. A TIVS reduces the reaction violence of munitions exposed to cook-off events by scoring the case of the rocket motor, but not penetrating the case and igniting the propellant. The TIVS trigger is intended to function when the rocket motor is placed in extreme temperature conditions that cause the rocket motor to cook-off, both with slow heating rates (e.g., Slow Cook-off or "SCO") and fast heating rates (e.g., Fast Cook-off or "FCO"). Technologies needed to implement an ETIVS trigger and thermal sensor are desired to increase the flexibility in application, safety and reliability of state-of-the-art TIVS designs. Technology development should be focused on integrating the thermal sensor, trigger and safety features of the TIVS using electronic circuits to form a compact ETIVS device.

The ETIVS device does not currently exist, but is based on existing mechanical TIVS technology and will be a safety-critical device that controls the initiation of energetic materials. This requires implementation of a safety critical design methodology with requirements similar to those laid out in MIL-STD-1901A and MIL-STD-1316E. The safety critical nature of the ETIVS device will necessitate the respondents working closely with technical representatives from the US Navy Safe-Arm Fuzing community during all stages of the development.

Guidelines and Metrics:
• The ETIVS device needs to sit unpowered but support function during cook-off events, i.e., the device must support reliable TIVS operations in fast heating and slow heating (6 to 45°F/hour), as well as non-uniform heating environments.
• The ETIVS device must be tunable for multiple temperatures.
• The ETIVS device needs to integrate onto missile airframes of 5" to 21" diameter with minimum form factor and mass impact. Preference will be given to devices that can easily be integrated into small diameter air-launched platforms.
• The ETIVS device must have no single point of failure and lock out operation after planned ignition event with less than 1 x 10-6 probability of failure in either the TIVS triggering or operational lock-out modes.
• The ETIVS device needs to be capable of surviving tactical missile environments (air and surfaced launched).
• A lock-out during planned flight events, including acceleration of approximately 10g's, is required. This detector must output a signal that is persistent through the time when the rocket motor burns out. The acceleration detector must function without an external power source or an internal battery. It is preferred, but not required, to implement

this acceleration detector using electronic circuit components. Similar logic controls to account for aero-heating environments are desired.

• The ETIVS device will require two independent thermal sensor technologies. Both sensor technologies must measure rocket motor case temperatures up to and including 600°F (316° C). Off the shelf temperature sensing technologies are preferred, but custom solutions are acceptable.

• Multiple temperature sensors may be distributed along the rocket motor case, necessitating small size and low mass thermal sensor technologies to ease integration. Low cost sensor technologies are preferred, but the priority is small size and low mass.

• The ETIVS device will require a variety of mixed-signal electronics. Proposed circuit elements must be operational to 350°F (177° C) with long term storage across the military temperature range of -67°F to 257°F (-55° C to 125° C).

• The ETIVS device will be self-powered using a thermally activated power source. There must be an externally accessible indicator, preferably a visual indicator, which activates when the power source has been activated. Thermal battery technology suitable to implement this power source is currently in development at China Lake. Alternative thermally activated power source technologies may be proposed, but development will not be funded under this solicitation.

• ETIVS solutions must address affordability and producibility using current manufacturing technologies, as well as performance and overall packaging.

PHASE I: Determine technical feasibility of the ETIVS logic circuitry, thermal sensors, self-powering or parasitic power functions and lock-out device under different heating rates and possibly under centrifuge acceleration. These sub-elements may be demonstrated through simulations that demonstrate operation to at least 350°F (177° C).

PHASE II: Continue development of the ETIVS functionality using the circuit elements demonstrated through simulations in Phase I. Demonstrate a prototype integrated package in representative slow and fast heating rates, centrifuge lock-out trials and self-power features. Integrate the ETIVS sensor and trigger with an optional linear shaped charge during these demonstrations. Deliverables for Phase II include a briefing to Fuze and Initiation Safety Technical Review Panel (FISTRP) for technical assistance in approach.

PHASE III: Finalize the prototype design and transition into a Navy system application that meets form factor and environmental conditions. Provide a final design full ETIVS trigger and thermal sensor for motor level Insensitive Munitions (IM) testing to be conducted by the Government at Naval Air Weapons Center Weapons Division China Lake.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Emerging markets in the commercial sector demand sensor conditioning and other mixed signal application circuitry be placed in extreme temperature environments, such as down oil wells and in hot sections of engines. Technology developed during this effort will be directly transferrable into these emerging markets.

REFERENCES:

1. MIL-STD-1316E - Fuze Design, Safety Criteria For, July 1998.

2. MIL-STD-1901A - Munition Rocket and Missile Motor Ignition System Design, Safety Criteria For, June 2002.

3. MIL-STD-1911A - Hand-Emplaced Ordnance Design, Safety Criteria For, July 1998.

4. STANAG 4170 Rev.3 - Principles and Methodology for the Qualification of Explosive Materials for Military Use, February 2008.

5. MIL-STD-331C - Fuze and Fuze Components, Environmental and Performance Tests For, June 2009.

6. JOTP-52 - Guidelines for the Qualification of Fuzes, Safe and Arm (S&A) Devices, and Ignition Safety Devices (ISD), February 2012.

7. MIL-STD-882E - DoD Standard Practice - System Safety, May 2012.

8. MIL-STD-2105D - Hazard Assessment Tests for Non-Nuclear Munitions, April 2011.

9. AOP-7 Ed. 2 - Manual of Tests for the Qualification of Explosive Materials for Military Use, June 2003.

10. Graham, K. J., January 2010, Mitigation of Fuel Fire Threat to Large Rocket Motors by Venting. AFRL-RZ-ED-TP-2010-368.

KEYWORDS: Fuzes; Insensitive Munitions; Rocket Motors; High-Temperature Electronics; Safety Device; Thermally Initiated Venting System (TIVS)

N142-109 TITLE: Micro Towed Magnetic Anomaly Detection (MAD) System for Rotary Wing and Vertical Take-Off Unmanned Aerial Vehicles (VTUAVs)

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA 266

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop a small Space, Weight and Power (SWaP) towed Magnetic Anomaly Detection (MAD) system that will deploy, tow, and recover a small MAD sensor compatible with rotary-wing manned (M60R/S) and Vertical Take-Off Unmanned Aerial Vehicle (VTUAV) (Fire Scout MC-8C) platforms.

DESCRIPTION: The current reeling machine, tow cable, and tow body designed for the AN/ASQ-81 MAD system are too large and too heavy for use by the MH-60R/S much less the MQ-8C. Recent Small Business Innovation Research (SBIR) programs and commercial Independent Research and Development (IR&D) funds are developing magnetometers that are much smaller than the AN/ASQ-81 magnetometer currently used on the SH-60B and have increased performance over the ASQ-81. This small SWaP magnetometer development now enables the development of MAD systems that can be towed by the small VTUAVs such as Fire Scout MQ-8C and also the small SWaP would enable integration of a towed MAD system into the MH-60R/S and future rotary wing platforms which are payload constrained.

Innovative concepts for the development of a small SWaP non-magnetic tow body, non-magnetic tow cable, and reeling machine are sought. The tow body that houses the MAD sensor must be stable while being towed at air speeds that range from 50 to 140 knots and also during the deployment and recovery phase. Stable in this context is that when the towing aircraft is in straight and level flight with constant airspeed, the tow body shall maintain roll, pitch and yaw excursion to less than +/- 0.5 degrees and altitude excursion to less than +/- 6 inches and during deployment and recovery there shall be no instability that can result in damage to the tow body, reeling machine or host aircraft. The tow body and tow cable must be constructed from non-magnetic materials so the permanent and induced magnetism and eddy current magnetic noise do not corrupt the magnetometer signals.

The reeling machine should be a modular design and should be a "smart" unit i.e. receives commands from the host aircraft over the data bus (MIL-STD 1553 or Ethernet, exact interface defined in Phase II) and executes the function accordingly and reports status. The unit will be integrated to standard stores interfaces on Fire Scout and MH-60R/S. The system's electrical interface shall follow MIL-STD-1760E Aircraft/Store Electrical Interconnection System or the standard MQ-8C interface for external payload (Interface documents will be provided in Phase II). All control of the operation and status of the reeling machine should be through the stores data bus interface and the primary interface defined Discrete Lines. The reeling machine shall, under command from the host aircraft, automatically deploy the tow body to a pre-determined selected length up to 300 feet. The reeling machine shall report the deployed cable length and provide a positive stop (cable brake or mechanical equivalent) while the tow body is deployed. On command, the reeling machine shall retrieve the tow body to the stow position and shall provide a positive latch

mechanism of the tow body so as the tow cable is not the primary mechanism for securing the tow body to the reeling machine in the stowed configuration. The reeling machine should report status of the latch, reel-out, tow tension, and reel-in, events as well as any other significant status such as reeling machine Built In Test (BIT), motor torque warning, or under/over tension warning. The reeling machine should also provide a mechanism to cut the tow cable in the event of an emergency such as unstable tow body flight, fouled tow cable or primary reeling machine failure. The reeling machine should assume the availability of MIL-STD-704F standard 28 Voltage Direct Current (VDC) power as defined under the Primary Interface Signal Set in MIL-STD-1760E.

The reeling machine shall provide the signal pass through of control and status data of the MAD sensor system to the host platform. The MAD system to be used is at the discretion of the proposing company.

The reeling machine should attach to the aircraft as defined by MIL-STD-8591 Airborne Stores, Suspension Equipment and Aircraft-Store Interface (Carriage Phase) using 14 inch lug spacing, 100 pound (lb) weight class or platform specific interface. Exact interface will be designated in the Phase II and appropriate interface documents provided.

From previous work and current status of the small magnetometers, a realistic goal for the towed MAD Bird is 10 lbs or less (weight + drag) and the reeling machine should be less than 40 lbs.

PHASE I: Develop a complete Micro Towed MAD system conceptual design to meet the listed requirements in the description. Establish a method and the feasibility of designing and fabricating a prototype model in Phase II. Provide estimates of SWaP of the reeling machine, weight, diameter, and design criteria of the tow cable (conductors, strength member, overall construction, etc.), size, weight and drag of the tow body and pertinent information on the MAD system selected.

PHASE II: Design and fabricate the proposed Micro Towed MAD system prototype proposed in Phase I. Build tow body models and test stability in flight test or wind tunnel environment. Ground test the complete Micro-Towed MAD system to demonstrate operation including reel out, reel-in and MAD system control and data transfer. Attain TRL-5 "Component and/or breadboard validation in relevant environment. Relevant Interface Design Documents will be provided as Government Furnished Information (GFI).

PHASE III: Integrate and ground and flight test the Micro Towed MAD system on Naval Air Systems Command (NAVAIR) R&D MH-60R/S and/or MQ-8C aircraft. Assist in obtaining flight clearance for use on NAVAIR R&D aircraft. Develop Engineering Development Models and environmental qualify. Transition the Micro Towed MAD to the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: High performance small SWaP towed magnetometers will find application in geophysical survey systems used for oil, mineral, water, and geophysical mapping and exploration.

REFERENCES:
1. MIL-STD-1760E, "Aircraft/Store Electrical Interconnection System," 24 October 2007.

2. MIL-STD-704F, "Aircraft Electric Power Characteristics," 12 March 2004.

3. MIL-STD-8591, "Airborne Stores, Suspension Equipment and Aircraft-Store Interface (Carriage Phase)," 12 December 2005.

4. Federation of American Scientists Military Analysis Network, 1999, SH-60 LAMPS MK III Seahawk, Retrieved from http://www.fas.org/man/dod-101/sys/ac/sh-60.htm.

5. Air Anti-Submarine Warfare ASW Sensors, (http://www.globalsecurity.org/military/systems/aircraft/asw3.htm).

6. Underwater Detection and Tracking Systems. Fundamentals of Naval Weapons Systems, Ch. 9, Retrieved from http://www.fas.org/man/dod-101/navy/docs/fun/part09.htm

KEYWORDS: Mad; Asw; Magnetometers; Tow Body; Fire Scout; Tow Cable

N142-110 TITLE: High Power, Long Endurance Battery

TECHNOLOGY AREAS: Chemical/Bio Defense, Sensors

ACQUISITION PROGRAM: PMA 264

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop a high power battery capable of 6500 watts.

DESCRIPTION: Innovative research into increasing the capacity of high pulse power batteries for "A" size sonobuoy applications is desired. The current available technology is at 4500 watts. Current research is pushing towards 5500 watts, but this still falls short of Navy need. A 6500 watt battery technology that would integrate into the existing system within the design requirements and form factor described below is desired.

The battery should be able to meet Navy environmental and safety requirements.

Battery specification list should include but not be limited to the following areas of design:

• Safety (Safety requirements governing the system including specific test criteria and pass/fail criteria)
• System interface (Form factor/space claim, mechanical connection points, electrical connections, surrounding components, heat profile)
• Active environment (Min/Max Potential, Current, Power, Time, Temperature, Pressure, Environmental impact, Bio/environmental degradation after use and disposal, non-venting)
• Storage environment (Min/Max Potential, Time, Temperature, Pressure) six year shelf life without recharging and meet requirements stated in this topic
• Cost (Production/Delivery Schedule, Cost Target, Expected total acquisition quantity for the life of the platform)

Battery Chemistry: Any chemistry. Must be certifiable for use on Navy Aircraft
Battery Length: 7.15 inches
Battery Diameter: 4.55 inches
Battery Weight: 8.6 Kg
Watts: 6500
Watts-Hours: 355
Open Circuit Voltage: 145
Normal Operating Voltage: 105
Minimum Loaded voltage: 70V
Amps During Discharge/Pulse: 50-70A
Pulse Load: 200 total pulse-seconds of 6500 watts constant pulses at a 10 percent max duty cycle at 0°C
Battery nominal endurance: 8 hours Standby/200 Ping-Sec at 10 percent duty cycle
Battery shelf life: 6 Years Active Storage
Estimated battery unit cost at manufacturing level/USD: <$650.00

PHASE I: Determine, design and demonstrate feasibility of a viable battery that meets or exceeds the requirements specified. Identify technological and reliability challenges of the design approach, and propose viable risk mitigation strategies.

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

PHASE III: Finalize the design, fabricate and conduct operational testing of a battery integrated into the existing sonobuoys meeting all specifications and assist in obtaining certification for flight on a NAVAIR R&D aircraft.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Compact, high power batteries have potential use in aircraft and unmanned aerial vehicles (UAVs), unmanned underwater vehicles (UUVs) and unmanned surface vehicles (USVs) where there are significant limitations on the form factor and the need for high power.

REFERENCES:
1. Linden, D, 1984, Navy Primary and Secondary Batteries, Handbook of Batteries and Fuel Cells.

2. Keller, P.B., Smith, P.H., Winchester, C.S., James, S.D, and Zoski, G.D, 1996, Sonobuoy Battery Development, Proceedings 37th Power Sources Conference, Cherry Hill, NJ, p. 321.

3. Winchester, C.S, Dejarnette, H., Keller, P.B., Cubbison, D., Sink, M., Charlton, S., Zoski, G., Gottwald, J., & Keuneke, C., 2002, Development and Performance Demonstration of a Very-High Power Sonobuoy Power Source, Proceedings of the 40th Power Sources Conference, p. 21.

4. Naval Sea Systems Command, 1988, Technical Manual for Batteries, Navy Lithium Safety Program and Procedures, Publication No. S9310-AQ-SAF-010.

KEYWORDS: Airborne, High Power, Battery, Endurance, Shelf Life, Storage

N142-111 TITLE: Wide-Angle Acoustic Beam Steering with Arrays of PiezoCrystal Tonpilz Transducers

TECHNOLOGY AREAS: Materials/Processes, Sensors, Weapons

ACQUISITION PROGRAM: FNC ATT for Surface Ship Defense Against Complex Salvo & Full Sector Defense

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Design, build, and test an array of piezocrystal Tonpilz SONAR transducers that can be steered over large angles with high directivity and low sidelobe levels.

DESCRIPTION: The Tonpilz design for SONAR transducers is widely used in large arrays in acoustic systems for undersea threat detection, weapons guidance, communication and the like. Exploiting single crystal piezoelectrics in Tonpilz transducers has led to single transducer elements with enhanced bandwidth, sensitivity, and source level in a smaller, lighter package when compared with legacy piezoceramic elements. [Ref 1 & 2] This topic addresses the next step, namely, building these single elements into large arrays with good array directivity and low sidelobes when steered over large angles, both in transmission and reception. Critical issues to be addressed include: element uniformity in large scale production, an array mounting structure that prevents element-to-element crosstalk, and minimizing coupling of elements mediated through the medium itself (seawater). [Ref 3 & 4]

PHASE I: Analyze what is required for a full array of piezocrystal Tonpilz transducers to have high directivity with low sidelobes both on transmission and reception. Devise a cost-effective means to meet these requirements and

demonstrate the validity of the analysis and candidate solution with a small sub array. Targeting the analysis and solution at a specific SONAR array system would be a big plus.

PHASE II: Identify a candidate SONAR array and design, build, and test a full array of single crystal piezoelectric Tonpilz transducers that can be steered to large angles with low sidelobe levels.

PHASE III: Insert the piezocrystal array technology into a spectrum of Navy SONAR systems for threat detection, weapons guidance, communication and the like.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In parallel to most Navy SONAR systems there are analogues in civilian commercial SONAR where undersea acoustic arrays are used for sea floor exploration, navigation, communication, and the like. Indeed, the commercial opportunities may initially be more fast-moving and lucrative than the present Fleet insertion opportunities.

REFERENCES:
1. J. M. Powers, M. B. Moffett, and F. Nussbaum, "Single crystal Naval Transducer Development" in Proceedings of the 2000 12th IEEE International Symposium on Applications of Ferroelectrics, vol. 1, pp. 351-354, 2000.

2. Mark B. Moffett, Harold C. Robinson, James M. Powers, and P. David Baird, "Single-Crystal Lead Magnesium Niobate-Lead Titanate (PMN/PT) as a Broadband High Power Transduction material" Journal of the Acoustical Society of America, vol. 121, p. 2591, 2007.

3. Charles H. Sherman and John L. Butler, "Transducers and Arrays for Underwater Sound," Springer, 2007.

4. William S. Burdic, "Underwater Acoustic System Analysis" Prentice-Hall, 1984.

KEYWORDS: SONAR array; wide-angle beam steering; Tonpilz transducer; low array sidelobe levels; high array directivity; transducer array crosstalk; acoustic beamforming; single crystal piezoelectrics; PMN-PT; PIN-PMN-PT

N142-112 TITLE: Single-Transceiver Dynamic Spectrum Access (ST-DSA)

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: Exchange of Actionable Information at the Tactical Edge

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is “ITAR Restricted”. The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the “Permanent Resident Card”, or are designated as “Protected Individuals” as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Provide existing and emerging single-transceiver radios with the ability to autonomously and dynamically access and manage spectrum to increase spectral efficiency and network throughput, thereby meeting information exchange needs in future naval communications networks.

DESCRIPTION: Dynamic Spectrum Access (DSA) is a process by which radio frequency users dynamically select available frequencies for transmission/reception from an allocated pool or as secondary users on a not-to-interfere basis. DSA has the potential to improve network performance by reducing self-interference and boosting spectral efficiency by reducing idle bandwidths.[1] DSA has been demonstrated on man-packable multi-transceiver radios. In DARPA’s Wireless Network after Next (WNaN) program, one transceiver senses the spectrum and coordinates with the other end of the link while the second transceiver transfers the data.[2] Although the DSA sensing and coordination are typically designed for in-band simultaneous multi-transceiver operation, the high-throughput man-packable naval radios to be fielded do not have this capability.

Implementing DSA on a network of single transceivers is challenging. The spectrum sensing must be integrated with the existing waveform management and payload traffic.[3] The conventional approach allocates a specific time in each frame for DSA sensing and coordination. In contrast, this SBIR topic seeks innovations for DSA systems to boost network performance and spectral utilization while operating in the same band as the network traffic. One approach exploits recent progress in single-aperture simultaneous transmit and receive (STAR) designs.[4,5] These STAR systems reduce the convergence time because the time allocation for in-band sensing is not required. However, link quality is degraded due to interference of the DSA system with the network traffic—both systems simultaneously operate in the same frequency band. Regardless of the DSA approach, this topic seeks DSA systems that deliver frequency selection and transitions within 500 ms while maintaining network performance on a MANET consisting of 20 or more nodes where each node is a single transceiver. A network scenario of particular interest is a platoon-sized dismounted patrol in an urban environment. Exceptional solutions will minimize transceiver power usage and latency while maximizing network throughput.

PHASE I: Develop a technical description and simulation of a DSA system operating on MANET where each node is a single transceiver operating in the same frequency band. Perform modeling and simulation to map the network performance enhancement that an ideal DSA system delivers in comparison to conventional network schemes (e.g., [6], [7]).

PHASE II: Extend the simulation of Phase I to address non-idealities of the DSA system and the degradation of the network performance. Develop prototype nodes with fixed links to serve as a laboratory testbed to assess the DSA algorithms and associated hardware. Down select from the DSA systems developed in Phase I accounting for the integration issues.

PHASE III: Integrate the prototype developed in Phase II with a 20 node MANET, test the complete system, and integrate into the FNT FY14-03 FNC program for transition into a tactical radio acquisition program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial Wireless Networks

REFERENCES:
1. G. Fend, A. Radhakrishnan, M. Y. ElNainay, Q. Chen, C. W. Bostian, and A. B. MacKenzie, “Software Radio-Based Decentralized Dynamic Spectrum Access Networks: A Prototype Design and Experimental Results,” IEEE Global Telecommunications Conference., pp. 1-6, 2010.

2. J. Redi and R. Ramanathan , “The DARPA WNaN network architecture,” Military Communications Conference., pp. 2258-2263, 2011.

3. F. Perich, E. Morgan, O. Ritterbush, M. McHenry, and S. `D’Itri, “Efficient dynamic spectrum access implementation,” Military Communications Conference., pp. 1887-1892, 2010.

4. C. H. Cox and E. I. Ackerman, “Photonics for simultaneous transmit and receive,” IEEE Microwave Symposium Digest., pp. 1-4, 2011.

5. C. H. Cox and E. I. Ackerman, “Demonstration of a single-aperture, full-duplex communication system,” IEEE Radio and Wireless Symposium., pp. 148-150, 2013.

6. Ozgur Oyman and Argyaswami J. Paulraj [2007] Power-Bandwidth Tradeoff in Dense Multi-Antenna Relay Networks, IEEE Transactions on Wireless Communications, 6(6).

7. Daji Qiao, Sunghyun Choi, and Kang G. Shin [2002] Goodput Analysis and Link Adaptation for IEEE 802.11a Wireless LANs, IEEE Transactions on Mobile Communications, 1(4).

KEYWORDS: Single-transceiver dynamic spectrum access; dynamic spectrum access; simultaneous transmit and receive; photonics

N142-113 TITLE: Expeditionary Cyber Network (X Net)

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: Communications Electronic Sensing and Attack System II (CESAS II)

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: This effort seeks to develop a man-packable, wireless, micro-server that can be networked with other similar servers to create a rapidly deployable tactical cloud with a computing cluster capability to support Company and below sized units to alleviate the need to reach-back to a C2 node for real-time assessments during tactical operations.

DESCRIPTION: Today's warfighter has access to a wide array of organic and inorganic sensor platforms that can be employed to collect enemy information to improve battlefield situational awareness. Upon collection, this intelligence is raw and has little value to the warfighter. Depending on the mission-type and processing systems available, the intelligence data can sometimes be processed and analyzed at the tactical edge to inform critical decisions, but a more likely scenario exists. The data is normally transferred back to a C2 cell for analysis. Once transferred, the warfighter then waits for the data to be analyzed while their adversaries continue to maneuver to gain a tactical advantage. This process of survey, transfer, analyze, and assess is in many cases too slow to support the asymmetric threats we face today.

Current solutions including the implementation of cloud architectures at the tactical edge seek to address this problem. However, they focus on Battalion and above sized units and data processing occurs in various C2 nodes on the battlefield. With this architecture, the warfighter still has to wait for a supporting unit to conduct the real-time analysis. The technology developed in this SBIR will eliminate the waiting time required for remote analysts to provide tactical assessments.

The micro-server and memory module proposed for this effort should weigh between 5 and 7 lbs fitting in a form factor to minimize size & weight while ensuring maximum heat dissipation. Since the concept of operations (CONOPS) is to deploy multiple micro-servers across the battlespace, the performer should also develop an algorithm to ensure efficient task management across the suite of servers deployed. To ensure data integrity and security at the tactical edge, the small business will need to develop secure techniques for manual & remote "zeroing."

The minimum technical specifications for the wireless, micro-server are listed below:
1. Server should operate a Linux Operating System to enable use of existing tactical software tools
2. Server should contain the most efficient number of processor cores to meet size, weight and power requirements
3. Server should have a frequency agile, dual front end software defined radio (SDR) with a range of 400 MHz to 3 GHz attached to enable tactical communication and data distribution
4. Server should be anti-tamper and have Manual or Remote "Zeroing"
5. Server memory module with 2 Terabytes of storage should be solid state, high temperature rated
6. Server should use a battery that efficiently draws power based on workload and can be re-charged via multiple power source that may be available at the tactical edge

PHASE I: During Phase I, the performer should develop a systems engineering model to investigate potential designs for the micro-server and assess performance under varying environmental conditions and tactical mission sets. At a minimum, the input variables for the model should include size of server, form factor, input data, tactical data links, data classification, power requirements, information assurance, number of processors, ambient outside air temperature, and storage available. The model should also evaluate the design to support multiple servers distributed across the battlespace to form a tactical edge computing cluster.

At the conclusion of this phase, the small business should recommend a design to meet warfighter requirements as provided in the description in a comprehensive report. The report should include detailed systems diagrams for the micro-server and an overview of the comparative and trade-off analysis performed to guide the engineering of the system. The small business will also be required to provide an end-of-phase brief demonstrating the use of the model in designing the system.

This work will be at the UNCLASS level.

PHASE II: During Phase II, the performer will construct and engineer the micro-server designed and analyzed in Phase I. The small business will be required to demonstrate the capabilities of the server in a controlled experiment as designated by the Principal Investigator (PI). System cooling, intelligent data distribution and processing, information assurance (IA), and power are the four key scientific challenges the performer will need to address during Phase II.

During the latter part of this phase the performer will begin the IA certification process. The secure memory module will be a key enabler for this effort as it will allow the warfighter to deploy with extensive databases collected during previous missions to employ more accurate predictive models supporting real-time battlefield decisions. To guarantee the security of the overall module, collected data and software used to conduct analysis, the performer will ensure the module is anti-tamper and designed to be Federal Information Processing Standard (FIPS) 140-2 Level 2 validated. The connection to the Naval Tactical Cloud must be 256-bit/WPA2 encrypted. The performer will also need to employ a mission-based manual and remote "zeroing" capability. Mission-based triggers for manual zeroing could be based on geo-location from server module, failure to comply with specific procedures when in use, or the health of the warfighter assigned to a module.

At the completion of this phase, the small business should deliver two working prototypes of the wireless micro-server. These prototype systems should participate in an operational demonstration where the small business collects performance data. The small business will provide a detailed report on the system performance during the operational demonstration. The report should include recommended system modifications.

This work will be at the UNCLASS level.

PHASE III: If development of a prototype server is successful in Phase II, the small business will begin this phase by making the modifications recommended in the end of Phase II report. Once those modifications are made, another operational demonstration will be scheduled to validate the modifications.

Following validation, the small business will begin the commercialization of the system to ensure the micro-server is secure and can operate within existing DoD network infrastructures. Commercialization will include testing and evaluation to ensure the micro-serve meets Military Standard 810 (MIL-STD 810) and Military Standard 461 (MIL-STD 461). For MIL-STD 810, testing will ensure the server can operate in harsh environmental conditions. For MIL-STD 461, testing will ensure the electromagnetic compatibility of the system and potential for integration and use with CESAS II. In addition, the small business will be required to complete the IA certification process started in Phase II to ensure the system is secure and can safely connect to existing network architectures, including the Electronic Warfare Services Architecture (EWSA).

This work will be at the UNCLASS level.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This processing capability would also be usable by other law enforcement agencies to include the Federal Bureau of Investigation (FBI), Customs and Border Patrol (CBP), Local/State Police, and Department of Homeland Security (DHS).

REFERENCES:

1. De Niz, Dionisio and Moreno, Gabriel, 2012, An Optimal Real-Time Voltage and Frequency Scaling for Uniform Multi-Processors, Pennsylvania: CMU Software Engineering Institute.

2. Fan, K.; Kudlur, M.; Dasika, G. and Mahlke, S., 2009, Bridging the Computation Gap between Programmable and Hardwired Accelerators, NC: 2009 Proceedings of International Symposium of HPCA.

3. Petcher, Adam; Khazan, Roger, and Utin, Dan, 2011, A Usable Interface for Location-Based Access Control and Over-the-Air Keying in Tactical Environments, MD: MilComm 2011.

KEYWORDS: Cloud Computing, WPA2, Federal Information Processing Standard (FIPS) 140 Level 2, Software Defined Radio (SDR), Processor Cores, Solid State Hard Drive

N142-114 TITLE: Spectrum Monitoring Payload for ScanEagle Unmanned Aerial Vehicle

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: PMW-120

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop instrument package (including antenna system) for ScanEagle unmanned aerial vehicle (UAV) that facilitates sampling the electromagnetic (EM) field from emitters of opportunity in the 100 MHz–10 GHz range.

DESCRIPTION: A variety of tools exist to estimate EM propagation. Nonetheless, the processing chain (weather models, EM propagation models, etc.) does not produce an estimate of the state of the EM propagation environment that is coherent in time and space with the true environment. ONR 322 MM and PMW-120 investments have resulted in the development of a variety of techniques for inference of the characteristics of the propagation medium from sampling of the EM Field via shipboard radars and communications, processes referred to as refractivity-from-clutter (RFC) [1, 2] and refractivity-from-radio (RFR). [3, 4] Efforts are underway as well to fuse these new forms of data with background fields of atmospheric refractivity generated by numerical weather prediction models. A significant gap in the EM field measurements is that the Navy normally lacks high-quality observations (e.g., accurate measurements of power normalized for the effect of antenna patterns, etc.) at altitudes above those associated with shipboard antennas.

The objective of this research is to enable operational forces to capture measurements of the EM field for this kind of processing at heights through and then above the marine atmospheric boundary layer (MABL). Successful execution of this SBIR topic would support a proof-of-concept demonstration for a spectrum monitoring capability for the ScanEagle unmanned aerial vehicle (UAV). The ScanEagle is already employed for carrying meteorological (as well as other) payloads. Functionally, the spectrum monitoring capability would do the same thing a desk-top spectrum analyzer would do if controlled by a computer to measure received power for a dozen or so targeted signals of opportunity.
There are two significant challenges though. One challenge is that the size weight and power (SWaP) characteristics of a desk-top spectrum analyzer are an order of magnitude off from meeting the requirements for being a ScanEagle payload. A second challenge is development of an antenna subsystem that is able to negate the effects of the 3-D pattern of the antenna elements across a broad frequency range. For example, the designer may opt for using a number of glue-on or tape-on patch antenna elements on the wings and fuselage of the ScanEagle; the sampling and signal processing strategy might include random phase and amplitude offsets in the addition of the array element signals. Again, the goal is minimizing the variability induced by the complex nature of the antenna pattern, not to maximize the gain per se. A related goal is that the signal processing is not overly dependent upon the antenna placement; i.e., the displacement of an antenna element by a small amount (e.g., 1") would not have an adverse impact on the performance of the system.

The offeror will design a spectrum monitoring capability that possesses the following attributes:
• Functionally similar to a spectrum monitoring capability that would be achieved using a computer-controlled spectrum analyzer.

• Insomuch as possible, utilize Standard Commands for Programmable Instruments (SCPI) for loading mission configuration.
• Have size, weight and power (SWaP) characteristics that are compatible with the ScanEagle UAV.
• Designs who's SWaP allows concurrent operation of meteorological payloads or integrates a low SWaP meteorological payload including an appropriate humidity sensor in order to calculate observed modified refractivity profiles is considered a bonus.
• Have sensitivity approaching that of high-end desk-top units.
• Withstand up to 24 hours immersion in salt water.
• Interface with UAV GPS and navigation system to appropriately tag EM power measurements.
• Antennas are part of the design. The antenna subsystem must largely negate the effects of the direction of the EM field relative to the aircraft's orientation.
• Addresses bandwidth conservation for payload data (i.e., data transferred to ground station during mission).

The trade-space for the development should take advantage of the following:
• Ultra-fast sampling is not required; a nominal target is sampling power at 10 center frequencies each minute.
• The frequency range is 100 MHz to 10 GHz.
• Frequencies higher than 10 GHz is considered a bonus.
• Performance throughout frequency range does not have to be uniform as long as it is known.
• The ability to measure phase information and angle-of-arrival is considered a bonus.
• On-board versus on-ground processing of signals.

PHASE I: Define and develop a concept for a Spectrum Monitoring Payload System for ScanEagle Unmanned Aerial Vehicle that can meet the performance requirements and the SWaP constraints listed in the description.
• Systematically explore the trade space for the monitoring package payload and the antenna subsystem.
• Evaluate components and explain the rationale for the associated design decisions (i.e., low-noise amplifier, modification of off-the-shelf gear, etc.).
• Show how the design will minimize SWaP.
• Provide a detailed description of the data and power interfaces to the ScanEagle.
• Provide a detailed description of the antenna system.

PHASE II: Produce a prototype package that works with a ScanEagle UAV. This will be an all-up system whose spectrum monitoring plan is configured by users before the mission. The package will be installable in a UAV, and utilize the UAV's onboard connections. The antennas for the package shall be assessed to ensure acceptability for installation.

PHASE III: The spectrum monitoring payload will be productized as an enhancement to the Airborne LIDAR package that is the subject of a Technology Transition Agreement between NAVOCEANO and PMW-120. The productization shall include:
• Addressing performance issues identified in Phase II.
• Improving SWaP to facilitate simultaneous use with Airborne LIDAR.
• Design changes to reduce manufacturing and maintenance costs.
• Documentation to support use by naval operational personnel.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Telecom industry could use technology to lower cost of field measurements used in antenna site studies.

REFERENCES:
1. Karimian, Ali, Caglar Yardim, Tracy Haack, Peter Gerstoft, William S. Hodgkiss, and Ted Rogers, Towards assimilation of atmospheric surface layer using weather prediction and radar clutter observations, AMS Journal of Applied Meteorology and Climatology, 52, 2013.

2. Karimian, Ali, Caglar Yardim, Peter Gerstoft, William S. Hodgkiss, and Amalia E. Barrios, Refractivity Estimation from Sea Clutter: An Invited Review, Radio Science, 2011.

3. Peter Gerstoft, Donald F. Gingras, Member, L. Ted Rogers, and William S. Hodgkiss, "Estimation of Radio Refractivity Structure Using Matched-Field Array Processing", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 48, No. 3, March 2000.

4. Rogers, L.T., "Likelihood Estimation of Tropospheric Duct Parameters from Horizontal Propagation Measurements," Radio Science, (32) 1, 1997.

KEYWORDS: Spectrum; propagation; unmanned; payload; swap; telemetry

N142-115 TITLE: High-Performance Deformable Mirror Technology Test and Evaluation Platform

TECHNOLOGY AREAS: Sensors, Weapons

ACQUISITION PROGRAM: Solid State Laser Maturation Program and High Energy Fiber Laser FNC

OBJECTIVE: Develop and demonstrate a technology capable of characterizing the real-time performance of Micro Electro Mechanical Systems (MEMS) or scalable Deformable Mirrors (DM) used in Adaptive Optics (AO) systems for compensation of atmospheric effects of laser beam propagation through turbulent atmospheres, imaging and in free-space communication. This topic addresses the need for real time DM special and temporal surface evaluation metrology not the DM or wavefront sensor technology.

DESCRIPTION: Develop a measurement tool for evaluating and assessing the performance of DM systems. Of special importance are the following performance parameters: response time, structural dynamic of the entire MEMS or DM module, errors related to hysteresis, and non-linearity in the response of the wavefront correction module. The test-technology to be developed under this effort should support:

Desired Features:
• Large stroke, in excess of 10 micron
• Ability to accommodate reflective or scattering surfaces
• Capable of addressing speed in excess of 20 kHz at the displacement rate of 20 nm/µs or greater
• Applicable to higher-order deformable mirrors with large actuator counts (>1000) and high actuator densities (actuator spacing <3 mm)
• Characterizing in-plane and out-of-plane surface displacement

Required Features:
• Ability to accommodate total apertures up to 3”
• Spatial resolution < 500 um
• Detectable full-aperture sag : 25 micron.
• Pixel stroke precision: < 0.01 micron
• Usable on diffuse or mirror-like surfaces with the reflectivity ranging from 0.5% to 100% (glass/fused silica, metal or dielectric coated mirrors)

PHASE I: Develop theoretical concepts and demonstrate a DM metrology tool which is capable of characterizing high-speed MEMS or DM response. Feasibility and its validation shall be established by material testing simulation backed by theoretical modeling. Final report should convince that the proposed product can be properly designed to address the above desired and required features and be achieved if Phase II is awarded. The small business will provide a Phase II development plan addressing technical risk reduction.

PHASE II: Based on Phase I results, design and develop prototype technology for evaluating the performance of deformable mirrors or MEMS arrays, and demonstrate its performance against a calibrated AO system. The offerer shall closely work with Navy engineers engaged with the development of laser weapon systems along with suitable industry partners to identify and implement technology transition to military and civilian applications. A fully operational system is required by the end of Phase II.

PHASE III: Phase III shall address the commercialization of the product developed as a prototype in Phase II. The final product shall meet the objectives set above and demonstrate measurement on DMs under development. The small business is expected to work with suitable industry partners for this transition to military programs and civilian applications by identifying the expected final state of the technology, its use, and the platform it will be used on.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: An effective AO system capable of controlling high laser power would be of interest to wielding community. Deep turbulence correction for imaging purposes and laser propagation is of interest in a large number of communication and laser sensing applications including astronomy and remote surveillance. Other non-military applications include medical imaging, global environmental monitoring, and video surveillance.

REFERENCES:

1. E. Steinhaus, S. G. Lipson, "Bimorph piezoelectric flexible mirror", J. Opt. Soc. Am., Vol. 69, No. 3, pp. 478-481, 1979.

2. F. Forbes, F. Roddier, G. Poczulp, C. Pinches, G. Sweeny and R. Dueck, "Segmented Bimorph Deformable Mirror," J. Phys. E: Sci. Instrum., 22, pp. 402-405,1989.

3. L. Beresnev, M. Vorontsov, P. Wangsness, "Pocket Deformable Mirror for Adaptive Optics Applications," Proc. of AMOS Technical Conference, Maui HI, 2006.

4. D. Guzmán, F. de Cos Juez, F. Lasheras, Deformable Mirror Model for Open-Loop Adaptive Optics Using Multivariate Adaptive Regression Splines, Opt. Express, 18, pp. 6493-6505, 2010.

KEYWORDS: Adaptive optic system; deformable mirror; atmospheric turbulence; Micro Electro Mechanical Systems (MEMS)

N142-116 TITLE: Affordable, Scalable, Ocean Energy Harvesting System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Battlespace

ACQUISITION PROGRAM: PMS 406

OBJECTIVE: Develop and demonstrate at sea an affordable, scalable, energy harvesting device capable of extracting energy from the internal ocean thermal gradients to produce electrical power for naval missions.

DESCRIPTION: The endurance of underwater vehicles and stationary platforms has traditionally been limited by power considerations. Away from the surface, sea floor and coastlines the only renewable energy source in the ocean interior is the thermal energy associated with the small temperature differentials in the water column. Historically, Ocean Thermal Energy Conversion (OTEC) has been limited to large scale, surface-based power plants due primarily to the large amount of supporting structures like working fluids, generators and pipes [1], making their deployment in ocean probes and underwater gliders [2] unfeasible. Recent developments in high performance phase change materials [3] offer one of potentially many approaches to the development of a small footprint OTEC device that can function as the power source [4] for underwater gliders or to replenish the batteries of underwater charging stations. Since both underwater devices operate in the ocean interior, extracting energy from the thermal gradients in the surrounding environment in which they are continuously immersed offers the most convenient route to extending their endurance with minimal mission interruption and manned support. Additionally, since these new thermal engines require minimal supporting structures compared to conventional OTEC, the potential exists to develop large scale underwater energy harvesting systems, as opposed to the conventional floating, land-based or hybrid OTEC systems. These underwater power stations would support all current and future underwater missions with higher power requirements than probes and gliders.

PHASE I: Develop conceptual designs for a scalable energy harvesting system that can operate (1) at 0.25W in a compact form factor for integration into an underwater glider as well as (2) a 2kW underwater power station. The design principles should culminate in identifying the material and engineering requirements needed to be met by the proposed system in both of these modes, and outline any associated technical risks. Supporting modeling and simulation efforts should include performance and efficiency comparisons to state-of-the-art systems and incorporate real world conditions such as varying ocean temperature, salinity, geographical location and seasonal fluctuations. The 0.25W compact form figure should be built and demonstrated in a lab environment. Calculations should be

extensible enough to estimate the basic operating requirements of a 2kW power station. Additionally, cost estimates of materials, manufacturing and maintenance of each unit should be produced.

PHASE II: Develop 2nd generation prototype systems from Phase I effort. Initial testing to evaluate actual performance against predicted performance in Phase I should be done under laboratory conditions. Prototype performance should be optimized to meet the specifications for field testing. For the high power stationary system, charging schemes should be tested, which may include docking of underwater gliders.

PHASE III: Integrate and test the small power source as a direct replacement for the battery of a SLOCUM glider and/or an ARGO float. Deployment of the large power source in the deep ocean will be carried out for an extended period to assess average energy production.

Upon successful completion of the Phase II prototype it is expected that the transition sponsor would test the system for an extended period of time in a relevant operational scenario to mature the technology to a TRL 9.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Marine Survey

REFERENCES:
1. Coastal Response Research Center, National Oceanic and Atmospheric Administration, “Technical Readiness of Ocean Thermal Energy Conversion (OTEC)” Report, Nov 3-5, 2009.

2. Wood, Stephen, "Autonomous underwater gliders," Underwater Vehicles, 499-524, 2009.

3. Jack A. Jones, Yi Chao, and Thomas I. Valdez, "Phase Change Material Thermal Power Generator," Jack A. Jones; Yi Chao & Thomas I. Valdez, US patent 7987674, issued 2011-08-02.

4. NASA/Jet Propulsion Laboratory, "NASA Demonstrates Novel Ocean-Powered Underwater Vehicle," Science Daily, http://www.sciencedaily.com/releases/2010/04/100405142152.htm.

KEYWORDS: Ocean Thermal Energy Conversion; Phase Change Materials; Slocum Glider; Argo Float; Autonomous Underwater Gliders; Unmanned Underwater Vehicles; Energy Harvesting

N142-117 TITLE: Components for a Deep Drifting Sonobuoy

TECHNOLOGY AREAS: Air Platform, Information Systems, Sensors

ACQUISITION PROGRAM: Next generation Airborne Passive System FNC

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is “ITAR Restricted”. The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the “Permanent Resident Card”, or are designated as “Protected Individuals” as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Objectively identify and subsequently demonstrate designs for critical components of an affordable, persistent passive acoustic capability for a deep-drifting environmental data measurement device with low latency in data exfiltration, long duration operability, and which is rapidly deployable in a standard A-size sonobuoy form factor.

DESCRIPTION: The acoustic measurement array within the deep drifting sonobuoy will operate at a depth of approximately 3 miles while tethered to a surface float for an operating life time of approximately 1 month, and ideally more. It will autonomously process acoustic measurements made at those deep depths and send messages which summarize the information up a tether and out over an r-f link to a remote receiver. Critical components are: the tether which physically supports the passive acoustic array and processor and over which contact messages are

transmitted to the r-f link at the surface; the batteries which power the sensor array, and communication and message transmission components; the signal processor electronics, and the array of acoustic sensors which are not the focus of this topic. All components must fit into an A-size form and result in an affordable unit. Innovative solutions which reduce size, weight, power (i.e. improve energy efficiency), and costs of critical components while meeting minimum operational performance and service life requirements are desired.

PHASE I: Perform analysis, modeling, and/or simulation of candidate sonobuoy designs based upon promising technology alternatives for the component technologies which will comprise the sonobuoy. Specifically, this effort should deliver well characterized, objective estimates for the expected level of performance from design alternatives for those components to provide an objective basis for estimating the corresponding space, weight, and cost penalties so that constraints, such as the A-size form factor, can be enforced at the scale of the individual sonobuoy. This process of objective quantitative analysis should clearly identify critical components within the constraints of a device that must perform for 30 days and be deployed from an A-size volume. The resulting information regarding the expected limitations of the sonobuoy components should be used to propose and justify a candidate sonobuoy design whose purpose will be to serve as a demonstration device that validates the feasibility of an acceptable design for each of the critical technologies.

PHASE II: Fabricate and test a prototype deep-drifting environmental measurement sonobuoy that validates models for expected performance of the critical components identified in Phase I. The specific intent is to validate the feasibility of a successful implementation for the critical components, each at a physical scale that is appropriate to all of the other components of the sonobuoy in an A-size form factor.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the components for the deep drifting sonobouy for Navy use in the Next Generation Airborne Passive System FNC. The small business will develop a plan to determine the effectiveness of critical components of the sonobuoy in an operationally relevant environment. The small business will support the Navy with certifying and qualifying the system for Navy use. When appropriate, the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technologies developed under this project have potential uses in seismology, marine mammal detection and tracking, in anti-terrorism and drug-interdiction systems.

REFERENCES:
1. R. D. Gaul, D. P. Knobles, J. A. Shooter, and A. F. Wittenborn, Ambient Noise Analysis of Deep-Ocean Measurements in the Northeast Pacific, IEEE J. Ocean. Eng. 32(2), 497 512 (2007).

2. R. A. Holler, A. W. Horbach, and J. F. McEachern, The Ears of Air ASW, A History of U.S. Navy Sonobuoys (Navmar Applied Sciences Corporation, Warminster, PA, 19874).

KEYWORDS: Sonobuoy, acoustic sensor, tether, r-f data exfiltration, high energy density battery, environmental noise, preparation of the undersea battlespace

N142-118 TITLE: Co-Site Interference Mitigation for Wideband Receivers

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics

ACQUISITION PROGRAM: Future EW programs including SIRFSUP FNC, an FY15 start

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as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Provide >50 dB of steep skirted spectral rejection, tunable over many octaves, and ideally of tunable bandwidth to reject signals that would otherwise desensitize the receiver.

DESCRIPTION: Enemy jammers and co-site interferers impair the ability of wide band, sensitive receivers to operate effectively. These receivers are essentially needed for continuously monitoring the entire radio frequency (RF) spectrum (DC to >100 GHz) by our military. Significant advances have been made recently to increase the receiver's instantaneous bandwidth and sensitivity. However, their dynamic range is still insufficient to withstand these unwanted signals. A solution will enable STAR, simultaneous transmission and reception. A "system on a chip" combination of a set of tunable analog band-reject filters with sensitive and wide band RF digitizers is sought. The analog filters should have variable rejection bandwidth and minimal passband attenuation so as not to deteriorate the overall receiver sensitivity. The desired tuning speeds are < 1 microsecond. Integration of the filters with the digitizers will improve their performance and decrease size, weight and power (SWaP), but they also must match the linearity of the RF digitizers. If subspectral channelization is proposed, the ideal channels would span approximately 0-6 GHz, 6-20 GHz, and 20-110 GHz.

PHASE I: Determine the technical feasibility of the approach defined in the Phase I proposal to meet the performance requirements listed in the description for at least one of the indicated sub-channels. This feasibility could be demonstrated by actually making an integrated chip and measuring that. Alternatively and more likely, the parts that would be combined in the actual chip would be combined by either full numerical simulation using calibrated empirical models of the devices or first principle analytical models of their performance. The Phase II proposal must define the design concepts to be used and key component technological milestones, and relate these to the projected performance for all the proposed spectral channels. Assuming Phase I base is successful, during the Phase I option move the design of the first channel unit toward experimental reality and begin testing as time and funding allows.

PHASE II: Produce prototype hardware based on Phase I work that delivers the wideband tuning performance indicated in the description. Design, manufacture, integrate, and demonstrate the operation of a prototype in order to establish its performance parameters through experimentation at the contractor facility. Offer a test demonstration at a CONUS government facility to US Government researchers and user representatives. The prototype must include provision of a mechanism for determining the desired location of the notch filter and for achieving tuning of the filter to that spectral location. It is possible that the Phase II will include some classified work.

PHASE III: Complete design optimization across the entire spectrum while simultaneously integrating the Phase II developed co-site interference rejection system prototype into a military transceiver/receiver system of wide band character. Demonstrate its improved jamming resistance against narrowband, inherently wideband, and a combination of such jammer types, bursty and continuous wave in operation. Transition into an FNC or directly into a program of record would follow.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: As the density of commercial wireless signals continues to increase, spectral sharing schemes such as Dynamic Spectral Allocation will become more ubiquitous and the time allowed to respond to a forced carrier center move will drop. While changing spectral positions, the proposed tunable filters will allow continued data through-put rather than requiring suspension of service ("Make then break"). The wide bandwidth of the tuning range will allow a single unit to service the multiple bands required to provide service worldwide at a low system assembly cost.

REFERENCES:
1. https://ece.uwaterloo.ca/~mingyu/publications/HTSdiplexer09.pdf.

2. IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES, Vol. 61, No. 9, September 2013.

KEYWORDS: Tunable filters; wide band RF systems; adaptive systems; reconfigurable analog filters; co-site interference; jamming

N142-119 TITLE: Ultra Sharp Fiber Architectures for Ceramic Composites

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: Navy Strategic Systems Program Office; DARPA Tactical Technology Office

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: This project will seek to develop high-temperature ceramic composite materials for hypersonic wing leading edges, wing sections and nose sections. Project goals are erosion-free response of nose tips and leading edges at 4500°F.

DESCRIPTION: Key challenges are the need to provide erosion free sharp leading edges and nose tips capable of 30 minute operation at temperature of 4500°F. Fiber materials and fiber architectures are sought with capability of providing leading edge radius goal of 0.04 inches to support efficient hypersonic flight. The state of the art in ceramic matrix composites is nose tip and leading edge radii of approximately 0.5 inches by using 1 – 2k fiber tows. Woven, braided or needled 3D or pseudo 3D fiber are sought to support the sharp leading edge requirement. Phase I goals include identification of fiber architectures and processing methods required to produce the needed cell sizes and fiber placement for the leading edge shape and cross section. Fiber sources and strategies for processing/infiltration of precursors for producing ceramic composite structures need to be identified. The fiber size, chemistry, and architecture, along with processing methodologies, shall be demonstrated with mechanical and thermal testing of coupon size samples. Phase II goals should include fabrication and testing of 6" scale wing leading edges, wing sections and/or nose tips.

PHASE I: Assess legacy processing technologies and develop novel fiber architecture fabrication concepts for sharp radius of curvature (0.04" goal) fiber preforms with appropriate cell size, towards the goal of producing continuous reinforcement for ceramic composites. As the approach is developed, feasibility should be shown through proof of concept demonstrations of small scale preform processing, and initial composite processing studies.

PHASE II: Optimize and scale up the preform manufacturing process developed in Phase I to 6" length wing shapes with sharp radius leading edge. Prototype ceramic composite fabrication shall demonstrate the approach by producing relevant shape subscale parts, and then comparing key performance data obtained from legacy and improved materials systems in severe thermal testing, such as arc-jet tests. Potential ITAR/classification restrictions for technology will likely need to be in place when putting together materials concepts into relevant shaped subcomponent tests.

PHASE III: Build upon the knowledge gained in Phase II to integrate the sharp leading edge capable fiber architectures with Ultra High Temperature Ceramic Composite matrix precursors. The resulting ultra-high temperature sharp wing leading edge prototypes will be built and demonstrated. Following certification testing, design documentation will be provided to the missile prime contractors funded under the DARPA Hypersonic flight demonstration programs. Full scale wing leading edges design disclosures will be provided leading to full scale leading edge fabrication for the demonstration flight program. Potential ITAR/classification restrictions for technology will need to be in place when putting together materials concepts into relevant shaped subcomponent tests.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Future military high speed and hypersonic propulsion components have a great potential to transition to the civilian rocket and related aeroengine and aerostructure applications such as low cost access to space and high speed jet engines. The materials resulting from these studies also have the potential for significant cost saving if they outperform existing state of the art materials systems. Further, these new materials may utilize revised fabrication methods, which allow advanced component designs.

REFERENCES:

1. L. Hubbard, Hypersonic Materials Summary; Requirements and Properties, U.S. DoD Research and Engineering, July, 2008.

2. M. Opeka, Journal of Materials. Science, 39 (2004), 5887-5904.

KEYWORDS: Ceramics, Fiber Reinforced Composites, Fiber Architectures, Materials, Ceramic Composites, textile engineering

N142-120 TITLE: High Fidelity Prediction of Electromagnetic Wave Propagation

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: Air and Missile Defense Radar Program, ACAT 1, NAVSEA IWS 2.0

OBJECTIVE: The objective of this effort is to define and develop a concept by which high fidelity knowledge of the shipboard electromagnetic wave propagation environment can be predicted. Anomalous propagation that varies both spatially and temporally is common due to the trapping of energy caused by refractive gradients in the lower atmosphere causing an effect known as ducting. Microwave systems often have no direct knowledge of the current propagation conditions with which to optimize their performance.

DESCRIPTION: The Surface Navy has interest in high fidelity prediction of electromagnetic wave propagation from surface ships to support prediction of radar, electronic warfare, and communications system operation. Currently, the fidelity of programs such as the Advanced Refractive Effects Prediction System is limited by the fidelity of the refractive profile information fed to it. This project desires to investigate technologies that would enable high fidelity measurement or prediction of refractive profiles in the vicinity of a surface ship. Measurements out to a range of a minimum of 32 nautical miles, 360 degrees in azimuth, from an elevation starting at the horizon extending to 5 degrees, with 1 nautical mile range resolution, 1 degree azimuth resolution, and 15 feet altitude resolution are required with accuracies sufficient to enable construction of high fidelity refractive profiles. Technologies of potential interest include:

1. High fidelity numerical weather prediction techniques that would allow near real-time forecasting of refractive environments. Of primary interest are advanced computing technologies that would allow current numerical weather forecasting models, which are very computationally intensive, to be run in much smaller computing footprints that are much less expensive to procure and maintain. For example, the application of current high performance Graphics Processor Units such as those available from NVIDIA and AMD to accelerate numerical weather prediction is of potential interest. Any computational system proposed must be air cooled and designed to fit in a space not to exceed a standard full height 19 inch rack footprint.

2. Also of interest are systems that allow for prediction of the environment based on the path loss measurement of microwave signals emanating from shore based commercial infrastructure for use in propagation modeling or in validation of existing models (specific near term interest is in predicting operation of S-band radar systems, and so wireless signals close to that frequency band are preferred).

PHASE I: Define, develop and if possible validate a concept for the prediction of high fidelity electromagnetic wave propagation that can meet the resolution requirements previously listed.
Required Phase I deliverables include a report which defines the concept and provides relevant details that shall include benchmark code and results, hardware designs, and relevant measurements validating the feasibility of the final design.

PHASE II: Refine, develop, demonstrate and validate the hardware and software designs produced in the Phase I effort into a prototype system. Deliverables from the Phase II effort shall include the prototype hardware and software, and a report that documents the performance of the prototype.

PHASE III: Refine the prototype system into a product that can be used on a surface Navy combatant, with appropriate user interfaces, and documentation. At the end of the Phase III effort the system should be at a Technology Readiness Level of 7.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Marine weather forecasting, commercial shipping and navigation, severe weather forecasting

REFERENCES:
1. S. Chen, J. Cummings, J. Doyle, R.H. Hodur, T. Holt, C. Liou, M. Liu, A. Mirin, J. Ridout, J.M. Schmidt, G. Sugiyama, and W.T. Thompson, 2003, COAMPS™ Version 3 Model Description--General Theory and Equations, NRL Publication, May, 2003, 145. Available from the Naval Research Laboratory, Monterey, CA, 93943-5502. Approved for public release; distribution unlimited. [NRL/PU/7500--03-448.]

2. Michalakes, J. and M. Vachharajani: GPU Acceleration of Numerical Weather Prediction. Parallel Processing Letters, Vol. 18, No. 4, World Scientific. Dec. 2008. pp. 531-548, http://wwww.worldscinet.com/ppl.

3. O. Fuhrer, T. Gysi, X. Lapillonne, V. Osuna, T. Dimanti, T. Schultess, et al., "Adapting Numerical Weather Prediction codes to heterogeneous architectures: porting the COSMO model to GPUs," ECMWF 15th Workshop on the Use of High Performance Computing in Meteorology, 2012.

4. J. D. Doyle, F. Giraldo, S. Gabersek, "A Multiscale Non-hydrostatic Atmospheric Model for Regional and Global Applications," ECMWF 15th Workshop on the Use of High Performance Computing in Meteorology, 2012.

5. T. Rogers, Q. Wang, and C. Yardim, "Discrimination Data Sources for Estimating Electromagnetic Propagation," National Radio Science Meeting, 2014.

KEYWORDS: Numerical weather prediction, radio frequency propagation, environmental sensing, high performance computing

N142-121 TITLE: Extended Range Forecasting and Advanced Climate Applications Decision Support System

TECHNOLOGY AREAS: Information Systems, Battlespace

ACQUISITION PROGRAM: PMW-120, Future MetOc Capabilities (FMC), non-ACAT

OBJECTIVE: Develop a software suite which would allow DoD mission planners to access, manipulate, display, and save extended range (intra-seasonal to inter-annual) probabilistic environmental prediction graphical products from a distributed Federal data service through a fast, flexible, and IA-compliant web service.

DESCRIPTION: Almost all mission analysis and planning tools in the DoD rely heavily on short range (0-7 days) explicit deterministic forecasts of environmental conditions and/or long term statistical climate products (for example, weekly, monthly, or seasonal averages of multi-decadal observations for a region or city/airfield/port based on data from observations or re-analyses, such as the Climate Forecast System Reanalysis (CFSR)). Dynamical and statistical extended range predictions, at leads of a week to several seasons, are now routinely available from a number of organizations and are used operationally by NOAA, as well as several foreign weather offices, such as the European Union and the United Kingdom. US federal agencies, including DoD, have access to many of these extended range forecasts, as well as related products (e.g., conditional probabilities, hindcast results, skill metrics and masks). But the forecast and related product datasets are massive and provided in diverse formats that are not well suited for DoD use, especially for use in decision support tools applicable to DoD mission planning.

The objective of this topic is to develop software tools that allow DoD climate and seasonal forecasters to develop decision support products from sub-seasonal to seasonal ensemble numerical forecast guidance in a timely (minutes to hours) and work flow efficient manner without requiring download and user-side manipulation of local copies of the source datasets. The staff for this project would work with operational planning staffs and their meteorological and

oceanographic (METOC) support centers to develop data processing, analysis, and visualization tools that can work in the Navy Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) system and across networks and suitably display large, Geographic Information System (GIS)-enabled datasets that include assessment of risk and probability. This software suite would provide new capability into the current Navy Advanced Climate Analysis and Forecast (ACAF) program at the Fleet Numerical Meteorology and Oceanography Center. ACAF is a web-enabled visualization tool that currently creates conditional probability and decision support products from interfacing with multiple static climate observational and reanalysis databases. These tools would be used to conduct server-side calculations on multiple gridded extended range prediction fields and pass the results (derived fields, visualizations, and decision support products) back to the user in a rapid, low-bandwidth, and computationally efficient manner. These results would need to be compatible with both image display formats (jpg, png, etc.), as well as Open Geospatial Consortium (OGC)-compliant GIS services (ARCview, shape files, KML, etc.). The tools would need to be capable of rapidly and efficiently processing server side data volumes on the order of tens of terabytes to 1 petabyte per month.

PHASE I: The offeror will:
- Define and develop a systematic and consistent software engineering approach for the data analysis/visualization, data processing, and product generation tools.
- Evaluate alternative approaches and explain the rationale for further development of a particular approach to include: data format compatibility with the available datasets, software and computing requirements on the client end, compatibility with Navy Information Assurance and computing environment policies and constraints, and compatibility with the Navy's planned Fleet Capability Releases between 2015 and 2020.
- Provide a detailed bandwidth, data storage, and user-side computational capacity budget estimate.
- Provide a detailed description of the server-side and client-side data and software interfaces.

PHASE II: The offeror will produce a prototype software suite that is compatible with the Navy's ACAF software environment at FNMOC or at the Naval Postgraduate School and has secure access to the Phase II National Multi-Model Ensemble (NMME) server at the National Center for Atmospheric Research (NCAR).
- This will be an all-up system that can use real data for initial products, such as extended range forecasts of environmental conditions and associated anomalies, extremes, percentile extremes, and conditional probabilities for mission critical thresholds for user specified environmental parameters (e.g., surface winds, significant wave height, precipitation, sea and land surface temperatures).
- The system will provide a range of product display types, such as horizontal maps, vertical cross sections, time series, time-longitude, and time latitude visualizations.
- A six month evaluation of the results will be completed in collaboration with Navy Climate Services forecasters at FNMOC during the option portion of the Phase II.

PHASE III: The software will be implemented as an enhancement to the Advanced Climate Analysis and Forecasting (ACAF) system at the Fleet Numerical Meteorology and Oceanography Center (FNMOC) under a Technology Transition Agreement between COMNAVMETOCCOM and either ONR or PMW-120. Collaboration with other potential users such as USAF 14th Weather Squadron and NOAA Climate Prediction Center will also be explored. Additional potential product types beyond the prototype will be identified.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology could be used by commercial organizations involved in environmental services, emergency management, and decision support for a wide range of commercial sectors (e.g., resource development and management (water, agriculture, energy), transportation, insurance/reinsurance, etc.), as well as long range planners in local, state, and federal government agencies, DoD, and the intelligence community.

REFERENCES:
1. ACAF, https://ams.confex.com/ams/93Annual/webprogram/Paper211375.html.

2. The North American Multi-Model Ensemble (NMME): Phase-1 Seasonal to Interannual Prediction, Phase-2 Toward Developing Intra-Seasonal Prediction; Kirtman, B P. et al., Bulletin of the American Meteorological Society 2013; http://dx.doi.org/10.1175/BAMS-D-12-00050.1.

3. NMME, http://www.cpc.ncep.noaa.gov/products/NMME/.

4. Earth System Grid Federation (ESGF), http://esg-pcmdi.llnl.gov/esgf.

KEYWORDS: Environmental data visualization, climate and weather services and planning

N142-122 TITLE: Opportunistic Real-Time Multimodal Sensor Content Exploitation

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics

ACQUISITION PROGRAM: FNT-FY12-02 Autonomous Persistent Tactical Surveillance DCGS-N ACAT IAM

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is "ITAR Restricted". The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop tools for real-time frame-level video and voice (acoustics) content search, tagging, and tracking using common representation schemes, feature annotation, and autonomous biometric recognition methods to isolate entities-of-interest. Develop an automatic sequencing application to discover anomalies behaviors and infer intent in context of the activity environment.

DESCRIPTION: The goal is to develop time-critical actionable intelligence and insight from an extensive array of multimedia data sources and organic and non-organic sensors. The problem is lack of capability to perform frame-level contextual query and content tagging of files in multimedia sources including real-time sensor feed or archived files. Specifically, we need the ability to annotate, tag, and fully search content in video and voice (acoustics) files at the frame-level matched to the desired attributes of entities of interest in the frame, i.e., biometric signatures, landmark settings, geolocations, etc., so that objects of interest can be precisely defined, discovered, and tracked with respect to time and space; thus revealing their emerging behaviors, activity patterns, and intent. For example, an analyst enters the characteristics and attributes of the object of interest and events related to certain time windows (hours, days, etc.) and geographical region (county, city, etc.), perhaps using descriptive metadata that consist of geographic, temporal, and other references overlaid onto the image in the software application; in turn, the application automatically discovers all instances of that object's detections over all space, time, and sensor modalities to support a rapidly evolving event.

We need a software application with an efficient multimedia (video, voice, acoustics) tagging scheme, content-based parsing and indexing, automatic tagged-content propagation, and query functionalities that enable extraction of relevant content of interest automatically from all available multimedia files for a distributed and decentralized operational environment. The software application is expected to rapidly search all available multimedia sources (video, voice, and acoustics files) for specific set of contents of interest and/or the results shared and stored on the cloud. The tagging scheme needs to be contextually informative, for example, it could be a text, a video frame, or a voice clip that captures relevant knowledge being queried on the entities of interest present in the multimedia files (archived and live feeds from opportunistic sensors). The application's knowledge manager enables the flexibility to organize and manage content; for example, the analyst will have control over the entire content of interest being searched (both temporally and spatially), medium for storage, and with whom the content will be shared. Key features may include user-defined format by category, sequence, link, and chronology to effectively capture evolving events of interest over time.

End-user requirements include: application of the tools for joint-problem solving; shared-awareness in a multi-level collaborative environment (i.e., varying levels of security and access) as each participant may offer unique insight; end-users connectivity through a variety of communication devices both mobile and stationary with varying processing capacity.

PHASE I: Determine technical feasibility by investigating, evaluating (modeling and simulation), and identifying the most promising candidate approaches for autonomous real-time video and voice (acoustics) activity search, content tagging, sequencing, and discovery of information contained in distributed networked sensor data files at the frame level. Perform trade off studies amongst those approaches. Propose candidate techniques and technology concepts for systematic search, discovery, tagging of events of interest available from distributed sensors and data sources by which the system tracks entities of interest, discovers behaviors, and infers intent. Recommend key technology design and development requirements and a plan for the Phase II.

Deliverables: technology concepts and final report.

PHASE II: Develop prototype software and hardware system incorporating the technology from Phase I. Develop a mission scenario that employs spatially distributed multimedia data sources by which the system exploits relevant captured data such as geo-location, landmarks, background acoustics, and entities' facial and voice signatures in cluttered dynamic environments to be used for a basic proof-of-concept prototype evaluation. Verify and validate the performance through implementation and demonstration of the basic proof-of-concept prototype. Develop schemes for retrieval and storage of the data on the cloud. Demonstrate the automatic selection and return of relevant video clips to a human analyst for further review, analysis, and annotation. Develop a detailed design and a plan for Phase III.

Deliverables: System architecture, system interface requirements for mobile and stationary platforms, detailed description of techniques, prototype software, technology demonstration, and final report and test results.

Note: Though Phase II work may become classified, the proposal for Phase II work will be UNCLASSIFIED. If the selected Phase II contractor does not have the required certification for classified work, ONR or related DoN Program office will work with the contractor to facilitate certification of related personnel and facility.

PHASE III: Develop these capabilities to TRL 7 or 8 and integrate the new technology into the FNT-FY12-02 Autonomous Persistent Tactical Surveillance DCGS-N ACAT IAM. Once validated conceptually and technically, demonstrate dual use applications of this technology in civilian law enforcement, security services, and private security systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has broad applications for knowledge management, behavior modeling and inference, situational awareness, and security in both government and private sectors. In essence it enables rapid understanding of complex dynamic events and situations and facilitates quick response by connecting the dots in an environment that involves high volume of multimodal multimedia data types.

In government it has numerous applications in military, intelligence communities, law-enforcement, homeland security, and state and local governments to deal with asymmetric threats, deploying first responders, crisis management planning, and humanitarian aid response.

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2. Ulges A., Schulze C., Keysers D., Breuel T.M., Content-Based Video Tagging for Online Video Portals.

3. Wang S., Liu Z., Zhu Y., He M., Chen X., Ji Q., 2014, Implicit Video Emotion Tagging from Audiences' Facial Expression, Multimedia Tools and Applications.

4. Moxley, E., Tao Mei, Manjunath, B.S., Video Annotation Through Search and Graph Reinforcement Mining, 2010, IEEE Transactions on Multimedia, Vol. 12, Issue 3.

KEYWORDS: Video; Voice; Content Tagging; Search; Frame-level; Sequencing

N142-123 TITLE: High Speed and High Voltage Capacitors for Naval HPRF Directed Energy Applications

TECHNOLOGY AREAS: Materials/Processes, Electronics, Weapons

ACQUISITION PROGRAM: NAVAIR PMA-242 (Direct and Time Sensitive Strike)

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OBJECTIVE: To develop compact high precision high voltage capacitors for use in Naval directed energy weapons systems.

DESCRIPTION: Capacitors currently available have a breakdown voltage more than an order of magnitude too low for applications that require small size, weight and power (SWaP), temperature stable dielectrics, low equivalent series resistance and the ability to repetitively charge and discharge in less than 400ns. With lower voltage capacitors, very large banks with the devices connected in series and parallel must be assembled frequently requiring hundreds of capacitors. Capacitors that can store high energies are an integral part of pulse power systems used for high power radio frequency (HPRF) applications. This innovation is seeking to develop compact capacitors with breakdown voltages of at least 80kV with a 5nF capacitance, a volume less than 100 cm3 (which corresponds to an energy density of .16 J/cm3 or better), an equivalent series resistance less than .5 ohm at 1MHz, a type C0G (NPO) dielectric, a rated voltage reversal of at least 80%, and be able to handle the mechanical and thermal stress of repetitively charging and discharging in less than 400ns. It is completely acceptable that this could be realized by stacking several smaller capacitors, with lower individual voltages, such as ceramic chips for greater flexibility as long as the overall specifications including the overall volume of the entire stack are still met.

PHASE I: Define and develop a concept for a capacitor that can meet the performance constraints listed in the description through the use of novel materials and/or manufacturing methods. Perform a technology review of existing capacitor technologies to determine the design feasibility and potential implementations as necessary. Research efforts should also be made to determine the current limitations of capacitor technology with these electrical specifications for the volume specified. The completion of Phase I will include the development of novel capacitor designs to meet the outlined requirements. The conceptual designs, along with the design implementation and capacitor performance models should be included as well as a cost analysis and material development.

PHASE II: Phase II will involve the design refinement, procurement, integration, assembly, and testing of a proof of concept prototype(s) leveraging the Phase I effort. The Phase II prototype will meet all specifications as described in the description except for voltage and volume which must be at least 40KV and less than 0.5 m^3. Noting of course that individual capacitance, voltage and volume may be less if a stacked approached is being pursued. In this case scalability would have to be demonstrated. The prototype(s) must demonstrate a clear path forward to a full scale prototype based on the selected technology. Prototypes will be made available to the government for independent testing in their own facilities at their option. 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 and will include expected lifecycle data.

PHASE III: The capability of future Directed Energy (DE) systems will be affected significantly by the emergence of new technologies. Future DE systems will benefit from advances in power generation, power conversion, energy storage, microwave and laser source development, advanced IED detection/location/tracking systems, and by more sophisticated and capable robotic platforms. Knowledge of these new technologies will be important because advanced threat systems will employ different topologies, materials, and miniaturization. The performer will apply the knowledge gained during Phase I and II to build and demonstrate a full scale final demonstration capacitor device capable of meeting the full electrical specifications, and compact size less than 100cm^3 to include all related

packaging requirements. Data packages will be submitted throughout the development cycle and test results will be submitted for regular review of progress. The final demonstration capacitor will represent a complete solution and should be ruggedized for, at a minimum, testing in a shipboard or airborne environment across a temperature range of -20 °C to > 70 °C, MIL-STD shock and vibration, and be environmentally enclosed. The small business will support the Navy with certifying and qualifying the capacitors for Navy use. When appropriate the small business will focus on scaling up manufacturing capabilities and commercialization plans.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Potential commercial applications include a variety of communications, sensor and medical applications using high power RF systems requiring compact, high speed and high voltage capacitors. Capacitors are common across a variety of electronic applications from current blocking, signal filtering, voltage stabilization, frequency tuning, to active power control. As systems get smaller, higher voltage and faster acting capacitors would be an enabler for commercial RF generation related systems. The commercial potential for new and more dynamic system applications would be enabled by lower cost, more reliable, better protected compact high voltage capacitors.

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1. M. Prevallet, S. Bagdy, J. Prymak, and M. Randall, “High Voltage Considerations with MLCs,” IEEE International Power Modulator Symposium and High Voltage Workshop, San Francisco, 2004.

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6. Korovin, S.D., Rostov, V.V., Polevin, S.D., PEGEL, I.V., Schamiloglu, E., Fuks, M.I., Barker, R.J., "Pulsed Power-Driven High-Power Microwave Sources," Proceedings of the IEEE , vol. 92, no. 7, pp. 1082, 1095, July 2004.

KEYWORDS: Capacitors; High Voltage Capacitors; Precision Capacitors, Dielectrics, Multi-Layer Ceramic

N142-124 TITLE: Next-Generation of Maintenance Skills Training System

TECHNOLOGY AREAS: Human Systems

ACQUISITION PROGRAM: PMS-339 - Schoolhouse Training Systems

OBJECTIVE: Provide Navy maintenance trainers with initial and refresher training protocols, assessment tools, and a model of skill acquisition and decay that can be used to predict and prevent deterioration of maintenance skills and knowledge.

DESCRIPTION: Maintaining the Navy’s mission critical equipment in a state of optimal readiness requires a well-trained technical staff. This is of critical importance as funding for new equipment/platforms is reduced. Currently, technicians are trained to maintain equipment by following specified sets of step-by-step procedures referred to as proceduralized training. However, the resultant skills acquired by this type of training are often brittle, are susceptible to decay through non-use, and ignore critical cognitive skills required for diagnosis, repair and/or replacement. The goal of this SBIR is to develop empirically-validated, next-generation training protocols informed by the science of learning, as well as tools for assessing training maintenance skills within an immersive virtual environment (VE) that

emulates the operational environment. This maintenance training capability will increase the durability and generalizability of both technical and non-technical skills. It will also support development of a model of skill acquisition and decay to predict and prevent skill decay throughout deployment cycles. This new model of skill acquisition could be used to guide the development of initial (e.g., schoolhouse) and refresher training (e.g., aboard ship) modules that could be implemented on a mobile platform (e.g., I-PAD or Smart Phone).

Over the past two decades, the method of choice for training high-volume maintenance skills and related technical knowledge has been to teach step-by-step procedures supported by technical manuals. However, such training produced skills that were not durable, were brittle, and ignored task relevant cognitive skills. Current research on skill decay notes that cognitive skills are essential for durability and generalizability of knowledge required to execute critical maintenance skills.

PHASE I: Define and develop a concept for an immersive game-based training environment that emulates the operational environment and has the capability to provide empirically-validated, next-generation protocols informed by the science of learning and tools for assessing and training maintenance skills within a VE. Phase I deliverables include a design concept that describes the components of the training environment and tools. If awarded, Phase I Option deliverables would include an acquisition and decay model that identifies the rate of acquisition and decay of cognitive (e.g., troubleshooting), perceptual (e.g., haptics), and psychomotor (e.g., replace and repair) maintenance skills.

PHASE II: Develop prototype training system based on the Phase I research effort that is ready for demonstration and validation within a Navy Technical school (e.g., Center for Naval Engineering). The prototype training environment should be delivered at the end of Phase II, ready to be implemented and evaluated in a Navy schoolhouse.

PHASE III: Transition a validated training system to military customers for production and acquisition. Provide military trainers and their interagency partners with a validated model of skill acquisition and decay that generalizes to additional domains (e.g., medical).

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This research and development effort has U.S. Government-wide and possibly multinational and international application (United Nations, NATO), as well as applicability to private sector training and education markets.

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KEYWORDS: Maintenance Training; Immersive Environments; Game-based Training; Skill Decay; Retention; Procedural skills

N142-125 TITLE: Affordable Manufacturing of Refractory Metal Components

TECHNOLOGY AREAS: Materials/Processes, Weapons

ACQUISITION PROGRAM: TRIDENT II (D5), ACAT I

RESTRICTION ON PERFORMANCE BY FOREIGN NATIONALS: This topic is “ITAR Restricted”. The information and materials provided pursuant to or resulting from this topic are restricted under the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130, which control the export of defense-related material and

services, including the export of sensitive technical data. Foreign nationals may perform work under an award resulting from this topic only if they hold the "Permanent Resident Card", or are designated as "Protected Individuals" as defined by 8 U.S.C. 1324b(a)(3). If a proposal for this topic contains participation by a foreign national who is not in one of the above two categories, the proposal may be rejected.

OBJECTIVE: Develop and demonstrate advanced additive manufacturing techniques for low-cost manufacturing of refractory metal components for Navy strategic missile post-boost propulsion systems.

DESCRIPTION: Current manufacturing techniques for refractory metal components are complex and labor intensive. SSP desires to reduce the cost and skill required to manufacture these components through more efficient use of raw materials along with a reduction of machining, multiple setups, and labor hours. One possible approach is use of Advanced Additive Manufacturing, which has demonstrated the ability to fabricate metallic parts with significant reductions in cost and lead-time compared to traditional manufacturing methods. To-date, the majority of additive manufacturing technology development has focused on conventional structural materials such as titanium. Application of this technology to refractory metal alloy components holds even greater potential to drive affordability given the high raw material costs and complex processing methods associated with these products.

The primary objective of this SBIR topic is to develop, demonstrate, and validate new manufacturing technologies in complex parts made of refractory metals (e.g., Ta-10W, C103, TZM, Mo41Re, W, and Re) for low-cost and rapid fabrication of post-boost control system hot-gas valve and manifold components while meeting performance requirements levied upon conventionally manufactured parts. Key performance requirements include surviving exposure to greater than 3,200 degree Fahrenheit gaseous environment for 10 minutes at 550 psi. Key challenges include tailoring advanced additive manufacturing processes and systems (e.g. electron beam, laser melting) to refractory metal alloys, understanding processing-structure-property relationships, evaluating the characteristics of engineered products fabricated using direct deposition or other methods, and addressing scale up for fabrication of full scale components with significant dimensional and geometric complexity.

PHASE I: Develop processes and demonstrate the fabrication of simplified, subscale article for C103 and develop and discuss approaches for fabrication of at least one more of the refractory metals/alloys listed above in the description. A suitable sub-scale demonstration article would be tubing with a 2 inch length, 1 inch OD, and 0.1 inch wall thickness. The process must also demonstrate scalability.

Measure physical and mechanical properties of refractory metal alloys fabricated using the advanced additive manufacturing technique and validate that they meet or exceed the properties derived from traditional processing methods.

Conduct mechanical property testing of fabricated specimens, microstructural evaluation, and verify adequate performance to advance to full scale representative components.

Identify technology and manufacturing development challenges and approach associated with insertion of manufactured parts to address in Phase II.

PHASE II: Conduct design and analysis of relevant hot gas valve and manifold components to be built with advanced additive manufacturing methods.

Develop, fabricate, demonstrate, and validate full-scale component prototypes using advanced additive manufacturing techniques.

Test manufactured prototypes in relevant environments and verify acceptably low degradation of mechanical properties or grain structure.

Quantify the cost and schedule benefits of fabricating hot gas valve and manifold refractory metal components using advanced additive manufacturing method.

PHASE III: Test manufactured prototypes in full-scale ground test. Navy Strategic Systems Programs will provide the assets and test support as Government Furnished Equipment and Services. SSP plans to transition the technology

into several aspects of the program for both further development of throttleable valves as well as currently produced items on the PBCS Gas Generator.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: There is the potential that this technology could be adapted for use on thrusters used on commercial spacecraft.

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KEYWORDS: Additive Direct Manufacturing; Direct Metal Deposition; Refractory Metals; Hot Gas Valves and Manifolds; Post Boost Control System; Strategic Missiles