NAVY
SBIR FY06.1 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, williajr@onr.navy.mil. For general inquiries or problems with electronic submission, contact the DoD Help Desk at 1-866-724-7457 (8AM to 5PM EST). 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 on the website before **13 December 2005.** Beginning 13 December, the SITIS system (http://www.dodsbir.net/Sitis/Default.asp) listed in section 1.5c of the program solicitation must be used for any technical inquiry.

TABLE 1: NAVY ACTIVITY SBIR PROGRAM MANAGERS POINTS OF CONTACT

Topic Numbers	Point of Contact	Activity	Email
N06-001 thru N06-047	Mrs. Carol Van Wyk	NAVAIR	carol.vanwyk@navy.mil
N06-048	Mr. Nick Olah	NAVFAC	nick.olah@navy.mil
N06-049 thru N06-067	Ms. Janet Jaensch	NAVSEA	Janet.L.Jaensch@navy.mil
N06-068 thru N06-069	Mr. Joseph Garcia	ONR	Joseph.P.Garcia@navy.mil
N06-070 thru N06-080	Mrs. Cathy Nodgaard	ONR	nodgaac@onr.navy.mil
N06-081 thru N06-084	Dr. Peter Majumdar	ONR	Peter_Majumdar@onr.navy.mil
N06-085 thru N06-099	Ms. Linda Whittington	SPAWAR	linda.whittington@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.onr.navy.mil/sbir**. 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. It is recommended that cost estimates include travel to the sponsoring activity's facility at the end of the phase I. The Navy encourages proposers to include, within the 25 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. For NAVAIR topics N06-001 thru N06-047 the base amount should not exceed $80,000 and 6 months; the option should not exceed $70,000 and 6 months. For all other Navy topics the base effort should not exceed $70,000 and 6 months; the option should not exceed $30,000 and 3 months. **PROPOSALS THAT HAVE A HIGHER DOLLAR AMOUNT THAN ALLOWED FOR THAT TOPIC WILL BE CONSIDERED NON-RESPONSIVE**.

The Navy will evaluate and select Phase I proposals using the evaluation criteria in section 4.2 of the DoD solicitation in descending order of importance with technical merit being most important, followed by the qualifications, and followed by commercialization potential. 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.

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

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

PHASE I SUMMARY REPORT

In addition to the final report required in the funding agreement, all awardees must electronically submit a non-proprietary summary of that report through the Navy SBIR website. Following the template provided on the site, submit the summary at: **http://www.onr.navy.mil/sbir**, click on "Submission", and then click on "Submit a Phase I or II Summary Report". This summary will be publicly accessible via the Navy's Search Database.

NAVY FAST TRACK DATES AND REQUIREMENTS

The Fast Track application must be received by the Navy 150 days from the Phase I award start date. Phase II Proposal must be submitted within 180 days of the Phase I award start date. Any Fast Track applications or proposals not meeting these dates may be declined. All Fast Track applications and required information must be sent to the Technical Point of Contact for the contract and to the appropriate Navy Activity SBIR Program Manager listed in Table 1 above. The information required by the Navy, is the same as the information required under the DoD Fast Track described in section 4.5 of this solicitation.

PHASE II GUIDELINES

Phase II proposal submission, other than Fast Track, is by invitation only. If you have been invited, follow the instructions in the invitation. **Each of the Navy Activities has different instructions for Phase II submission. Visit the website cited in the invitation to get specific guidance before submitting the Phase II proposal**.

The Navy will evaluate and select Phase II proposals using the evaluation criteria in section 4.3 of the DoD solicitation in descending order of importance with technical merit being most important, followed by the qualifications, and followed by commercialization potential. 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.

All awardees, during the second year of the Phase II, must attend a one-day Transition Assistance Program (TAP) meeting. 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.

As with the Phase I award, Phase II award winners must electronically submit a Phase II summary through the Navy SBIR website at the end of their Phase II.

A Navy Activity will not issue a Navy SBIR Phase II award to a company when the elapsed time between the completion of the Phase I award and the actual Phase II award date is eight (8) months or greater; unless the process and the award have been formally reviewed and approved by the Navy SBIR Program Office. Also, any SBIR Phase I contract that has been extended by a no cost extension beyond one year will be ineligible for a Navy SBIR Phase II award using SBIR funds.

The Navy typically awards a cost plus fixed fee contract or an Other Transaction Agreement for Phase II.

PHASE II ENHANCEMENT

The Navy has adopted a Phase II Enhancement Plan to encourage transition of Navy SBIR funded technology to the Fleet. Since the Law (PL102-564) permits Phase III awards during Phase II work, the Navy may match on a one-to-four ratio, SBIR funds to funds that the company obtains from an acquisition program, usually up to $250,000. The SBIR enhancement funds may only be provided to the existing Phase II contract. If you have questions, please contact the Navy Activity SBIR Program Manager.

PHASE III

Public Law 106-554 provided for protection of SBIR data rights under SBIR Phase III awards. A Phase III SBIR award is 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. 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. 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 rights of the SBIR company.

ADDITIONAL NOTES

The Small Business Administration (SBA) has determined that the Naval Academy, the Naval Post Graduate School and the other military academies may participate as subcontractors in the SBIR/STTR program, since they are institutions of higher learning.

Any contractor proposing research that requires human, animal and recombinant DNA use is advised to view requirements at website http://www.onr.navy.mil/sci_tech/ahd_usage.asp. This website provides guidance and notes approvals that may be required before contract/work may begin.

PHASE I PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria <u>must be met</u> or your proposal will be REJECTED.

____1. Make sure you have added a header with company name, proposal number and topic number to each page of your technical proposal.

____2. Your technical proposal has been uploaded and the DoD Proposal Cover Sheet, the DoD Company Commercialization Report, and the Cost Proposal have been submitted electronically through the DoD submission site by 6:00 a.m. EST 13 January 2006.

____3. After uploading your file and it is saved on the DoD submission site, review it to ensure that it appears correctly.

____4. For NAVAIR topics N06-001 thru N06-047, the base effort does not exceed $80,000 and 6 months and the option does not exceed $70,000 and 6 months. For all other proposals, the Phase I proposed cost for the base effort does not exceed $70,000 and 6 months and for the option $30,000 and 3 months. The costs for the base and option are clearly separate, and identified on the Proposal Cover Sheet, in the cost proposal, and in the work plan section of the proposal.

Navy SBIR 06.1 Topic Index

N06-046	Health Monitoring for Synthetic Material Arresting Cable
N06-047	Fatigue Life Improvement with Surface Treatments other than Shot Peening
N06-048	Development of HFPB Debris Throw Models for Ordnance Storage and Handling Facilities
N06-049	False Alarm Control for Advanced Radars
N06-050	USW Intelligent Controller
N06-051	Marine Mammal Mitigation (MMM) Mission Planning Tool
N06-052	Characterization and Modeling of PMC/CMCs Under Extreme, High Temperature, Short Term Thermal Exposure
N06-053	Adaptive Remote Sensor Communications
N06-054	Fish Net Penetration by UUVs
N06-055	Smart Coatings through the Application of Emergent Nano-Technologies
N06-056	Affordable, Advanced Lighting System
N06-057	Cargo Transfer from Offshore Supply Vessels to Large Deck Vessels
N06-058	Advanced Structural Development of an Interior, Elevated Decking System
N06-059	Replaceable Inserts for Ship's Line Handling Chocks
N06-060	Self-Repairing Coatings
N06-061	In-Situ Application of Powder Coating Technology
N06-062	New Approaches to Shipbuilding Finishing and Assembly Operations
N06-063	Application of a Uniform Coating Thickness for Complex or Irregular Surfaces
N06-064	On-Demand Curing of Surface Ship Coating Systems
N06-065	High Confidence Software and Automation in Submarine Systems
N06-066	Non-Scanning 360 Degree LPI Radar
N06-067	REAL-TIME OMNI-DIRECTIONAL HYPERSPECTRAL IMAGER
N06-068	Improved Aircraft Marker Lighting System
N06-069	Metrology for Ogive Infrared Dome
N06-070	Individually Adapted Web-based Training
N06-071	Compact, High Performance HF/VHF/UHF receivers
N06-072	Modular Software Architecture for Advanced Weather Radars
N06-073	Back Illuminated CMOS Detector Arrays
N06-074	Vertical Utility Unmanned Aerial Vehicle Design and Technologies
N06-075	Field Medical Sterilizer to be used in Austere Environments
N06-076	Use of Adaptive, Non-line of Sight Smart Sensors to Recognize and Locate Threats to Physical Assets and Field Forces
N06-077	Modeling and Prediction of Asymmetric Threat Learning Processes
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N06-079	Millimeter Wave Imagery for Maritime Domain Awareness and Force Protection
N06-080	Integrated real-time lidar/mission management package for airborne environmental reconnaissance
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N06-082	Flameless Oxidation/Combustion
N06-083	Processing Methods to Fabricate Reliable Device Elements of PMN-PT Piezoelectric Single Crystals
N06-084	Development of Materials for Load bearing Sonar Windows
N06-085	Understanding of Multi-Source Wireless RF Network Structures
N06-086	Tactical Secure Voice/Variable Data Rate Inter Working Function
N06-087	Service Oriented Architecture (SOA) Adaptation for Realtime Intelligence, Surveillance, Reconnaissance
N06-088	Biometric Identity Verification for Sailors in Battle Dress
N06-089	Cross-Domain RSS Processor and Router
N06-090	Dynamic Broadband RF Spectrometer
N06-091	Micro-Camera for oceanographic properties and shallow water hydrography
N06-092	Wi-Fi From the Sea
N06-093	Future Antennas
N06-094	Cross-Domain Collaboration Web Portal
N06-095	Optical Filter for Undersea Blue-Green Laser Communication
N06-096	Blue-Green Laser for Undersea Communication
N06-097	Placement of Sensing and Communications platforms for Enhanced C4ISR Operations

Navy SBIR 06.1 Topic Descriptions

N06-001 TITLE: Wideband Transmitter for Electronic Attack Aircraft

TECHNOLOGY AREAS: Electronics

OBJECTIVE: Develop new innovative technologies to increase the band coverage (500 – 4000 MHz) and effectiveness of the transmitter system to improve electronic attack tactical jamming capabilities.

DESCRIPTION: The current inventory of airborne tactical jamming systems consists of multiple transmitters covering several narrow frequency bands. These operating characteristics greatly reduces flexibility in mission planning and operational logistics.

The latest advances in high radio frequency (RF) power technologies may provide feasible and streamlined solutions to a high RF power generation approach by a relatively straightforward application of high-power RF combiner technologies. Combining several commercially available ultra-wide bandwidth solid-state basic power modules (BPM) can provide the desired levels of output power with reduced nonrecurring engineering (NRE) costs. For instance, instantaneous frequency range coverage from 800 MHz to 4,200 MHz at 1 kW RF output power levels with +/- 1dB gain flatness is possible and currently commercially available with convection cooling methods and in a rack form factor.

Innovative technologies are sought to combine existing high power RF technologies with the latest advances in cooling methods (e.g. Spray Cool, VIDA, etc.) to integrate and repackage the requisite hardware components to fit a standard RF transmitter form factor currently utilized by the EA-6B/EA-18G aircraft. The principal design efforts might include but are not limited to the following: (1) high-power broadband RF power combiner; (2) adaptation of efficient cooling technology; (3) efficient power supply; (4) modern expandable computer controller board for I/O, 1553 bus controller and transmitter control/status management; (5) modern OS/software design; (6) hardware bus for signal processing expansion electronics.

PHASE I: Determine the feasibility of developing a WBT and demonstrate proof-of-concept.

PHASE II: Develop a prototype WBT. Demonstrate and validate its capability to be utilized by the actual jamming system hardware setup and satisfy RF exciter signal handling capability. The prototype should include RF amplifier modules, RF combiners, integrated cooling, electronics and software. Perform vibration and environmental testing of the mechanical design.

PHASE III: Prepare the WBT for the ALQ-99 pod installation and flight test. The WBT must be packaged and qualified for the aircraft environment. Conduct and support flight tests to determine the WBT's potential for operational effectiveness and suitability and provide documentation.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS:
Successful design and implementation of the WBT transmitter provides a potential for a new generation of high- and medium-RF power amplifiers with smaller form factor, lower weight, and higher reliability.

REFERENCES:
1. Gonzales, Guillermo: "Microwave Transistors Amplifiers, Analysis and Design," Englewood Cliffs, NJ , Prentice-Hall, 1984
2. Cobbold, Richard: "Theory and Applications of Field-Effect Transistors," Wiley, New York, 1970
3. Maksimov et al.: "Radar Anti-Jamming Techniques," Artech House, Dedham, MA., 1980
4. Novel UWB antennas - theory and simulation
Smith, L.; Starkie, T.; Lang, J.; Ultra Wideband Systems, 2004. Joint Conference on Ultra Wideband Systems and Technologies. Joint UWBST & IWUWBS. 2004 International Workshop on, 18-21 May 2004, Pages: 299 – 303
5. Frequency notched UWB antennas
Schantz, H.G.; Wolenec, G.; Myszka, E.M., III; Ultra Wideband Systems and Technologies, 2003 IEEE Conference on, 16-19 Nov. 2003, Pages: 214 – 218

6. UWB antenna issues
Foster, P.; Ultra Wideband Communications Technologies and System Design, 2004. IEE Seminar on, 8 July 2004, Pages: 69 – 88

KEYWORDS: Airborne; Wideband Amplifier; Broadband; Wideband Transmitter; Multi-Band Transmitter; Radio Frequency

TPOC: (805)989-3461
2nd TPOC: (805)989-9034

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

N06-002 TITLE: Sea Surface Slope and Elevation Statistics To Support Radar Performance Modeling

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors, Electronics

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop a statistical model of the ocean surface in terms of probability distribution functions of surface wave slopes and elevations utilizing experimental measurements. The statistical descriptions of the ocean surface are to support the calculation of electromagnetic scattering from the ocean surface as part of an overall radar performance prediction model.

DESCRIPTION: The scattering of radio waves from the air-sea interface can be determined from a description of the slope and elevation of wind-driven waves. Cox and Munk obtained probability distribution functions for the slopes of the wind driven waves nearly fifty years ago. More recently, other investigators including Shaw and Churnside and Ebuchi and Kizu have added to these results. Our desire is to collect sufficient statistics to produce a high fidelity approximation of the ocean surface over a variety of conditions to include capturing rare events of interest such as waves exhibiting large slopes. A variety of collection methods are possible, but the collections must be extensive enough to capture a wide range of ocean conditions. The location(s) that the collections are made is an important factor. A means to store the data (to include wave slope, elevation, wind speed and direction, air temperature and water temperature) and process it in an automated fashion is required.

PHASE I: Determine the feasibility of developing a statistical model of the ocean surface by designing a data collection, storage and processing system; identifying suitable collection locations and collection techniques; and developing a detailed collection plan. The collection plan should include a detailed description of the collection methods, an analysis of collection locations, and approvals to make collections from those locations.

PHASE II: Develop a prototype data collection system. Conduct a long-term demonstration of the data collection system in a suitable operational environment. Analyze and process the data to provide the probability distribution function of slope and elevation for data sets with common environmental characteristics.

PHASE III: Produce a general collection system for sea surface slope and elevation measurements for commercial, academic, or government use. The system should be suitable for general environmental data collection as well as the collection of surface wave data from passing vessels.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The system is suitable for a variety of commercial, academic or government uses related to monitoring ocean dynamics. The general packaging should accommodate a variety of instruments.

REFERENCES:
1. Cox, C., and W. Munk, “Statistics of the sea surface derived from sun glitter”, J. Mar. Res., 13, pp. 198-227, 1954.
2. Shaw, J. A., and J. H. Churnside, “Scanning-laser glint measurements of sea-surface slope statistics,” Appl. Opt. 36, pp. 4202-4213, 1997 .

3. Ebuchi, N. and S. Kizu, “Probability distribution of surface wave slope derived using sun glitter images from geostationary meteorological satellite and surface vector winds from scatterometers,” J. Oceanogr., 59, pp. 477-486. 2002.

KEYWORDS: Electromagnetic Scattering; Oceanic Technology; Rough Surface Scattering; Sea Clutter Models; Radar; Maritime Surveillance

TPOC: (301)342-2637
2nd TPOC: (301)342-2043

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

N06-003 TITLE: Target Identification in Complex Sensor Environments

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: E-2 Advanced Hawkeye

OBJECTIVE: Develop innovative methods to determine the impulse response of sensors in their environment in order to implement an effective deconvolution process.

DESCRIPTION: Signal-processing arrays have a tendency to ignore the effects of one sensor on another as well as the interaction between sensors and the platform. Today's airborne platforms, however, tend to be complex, smaller, and densely populated with sensors. This can result in undesirable interaction effects that can have a negative impact on signal processing algorithms. We are seeking methods to mitigate this problem.

To carry out target identification from an airborne platform it is necessary to have an integrated, physics-based approach to analyze the data. To this end, the quantities of interest, which in this case are the radiated/scattered electromagnetic fields, must be characterized accurately in their appropriate environment. In addition, accurate physics-based methodology is required to analyze the data. For a real system to perform as planned, one needs to characterize not only the sensors accurately, but how their radiation/receiving characteristics are modified by the environment, an effect that can be significant. At present, even the largest supercomputers may not be capable of electrically characterizing the complete scenario.

Innovative methodologies are required to address these large, complex problems. In addition, traditional signal processing techniques cannot be directly applied to analyze data collected by these systems. The effect of the environment must be deconvolved out in order to analyze the collected target returns. To execute the deconvolution process, it is necessary to carry out an accurate characterization of the impulse response of the environment.

PHASE I: Demonstrate feasibility of the proposed methodologies for characterizing the impulse response of the environment in order to be able to apply the appropriate direction of arrival or adaptive processing algorithm to the system.

PHASE II: Demonstrate that the preferred characterization methodology can indeed accomplish the goal of accurate system characterization along with the sensors operating in their natural environment.

PHASE III: Generate a process and template for creation of a library of impulse responses from sensors in various configurations and environments. The library sensor response can be convolved with a simulated lone target response to yield a predicted target-in-scene response given a particular sensor configuration and environment.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Small and smart antenna arrays are moving into all phases of personal use. The ability of these systems to account for environmental effects will greatly enhance their performance.

REFERENCES:

1. Gupta, J.I. and A.A. Ksienski, "Effect of mutual coupling on the performance of adaptive arrays", IEEE Trans Antennas Propagat, Vol. 31, pp. 785-791, 1983.

2. Pasala, K.M. and E.M. Friel, "Mutual coupling effects and their reduction in wideband direction of arrival estimation", IEEE Trans Aerospace Electr Systems, Vol. 30, pp. 1116-1122, 1994.

KEYWORDS: Antennas; Antenna Arrays; Antenna-Element Coupling; Signal Processing; Target Identification; Environment Deconvolution

TPOC: (301) 342-2637
2nd TPOC: (631) 673-8176

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

N06-004 TITLE: Airborne Parasitic Bistatic Radar System

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA-290, EP-3

OBJECTIVE: Develop an airborne PC-based passive surveillance system that utilizes non-cooperative radar transmissions to generate a bistatic radar picture. The system design should balance detection performance with system cost, weight, and size and be capable of utilizing conventional mechanically scanned donor radars as well as frequency, pulse and beam agile donor radars.

DESCRIPTION: In a hostile environment, passive sensor systems that take advantage of radar transmissions to generate a radar picture are an attractive alternative to active radar systems for target imaging. The detection and tracking of both airborne and ground based targets are desired. The system should be able to exploit a variety of radar waveforms using carrier frequencies from very high frequency (VHF) through Ku band. The discrimination of target returns from radio frequency interference and clutter is critical. Consideration should be given to the fusion of radar cross-section (RCS) and flight kinematic calculations with other available target information to support identification. Typically, a direct line of sight will exist between the receiver and radiating antenna. However, it is desirable to also operate when a direct line of sight does not exist but terrain features are present that are mutually visible to both the emitter and receiver. Terrain databases can be used to facilitate localization and signal processing tasks. Array digital beam forming should be considered. Advanced approaches will be required to utilize frequency, pulse and beam agile donor radar systems.

PHASE I: Demonstrate the feasibility of a complete PC-based passive bistatic surveillance system. The design should be sufficiently detailed to allow an assessment of the system's performance potential. Innovative RF synchronization approaches are desired for both traditional as well as RF and beam agile and complex scan systems.

PHASE II: Fabricate a PC-based sensor test bed suitable for use on a manned aircraft. The system may be designed to operate within a subset of the carrier frequencies identified above. Demonstrate prototype system performance with an injected operationally representative simulated signal environment. The demonstration should be structured to provide strong evidence of the system's commercial potential.

PHASE III: Design and fabricate a complete robust wide band PC-based passive bistatic surveillance system suitable for used on military manned and unmanned aircraft.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This same technology can be used in civilian applications by piggybacking on available illumination systems such as air traffic control radars or nearby ship radars in coastal environments.

REFERENCES:

1. Hawkins, J.M., “An opportunistic bistatic radar,” Radar 97, IEE Conf. Publ. No. 449, 14-16, Oct. 1997, pp. 318-322.
2. Huss, R.E., “Passive situation awareness: a case study,” IEEE Digital Avionics Systems Conference, 1995, 14th DASC, 5-9 Nov. 1995, pp. 276 -280.
3. Griffiths, H.D., “From a different perspective: principles, practice and potential of bistatic radar,” IEEE Radar Conference, 2003., 3-5 Sept. 2003, pp. 1-7.

KEYWORDS: Bistatic Radar; Electromagnetic Support Measures; Passive Detection; PC-Based; Surveillance

TPOC: (301)342-2637
2nd TPOC: (301)342-9104

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

N06-005 TITLE: Rapid Repair Analysis Tool

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop and demonstrate a computational system that can be used to model and design structural repairs for advanced composite aircraft components. It should also be used to track, document, and manage the repair analysis and design process.

DESCRIPTION: Today’s modern aircraft are comprised largely of composite skins with metallic substructure. The composite skins can be monolithic, sandwich stiffened, or discretely stiffened. These aircraft are susceptible to various forms and levels of in-service damage. Because of the myriad of possible damage sizes, locations, surrounding structural arrangements and surface restoration requirements, it is extremely difficult to come up with a set of standard repairs that can be routinely applied without having to verify that the structural integrity has been restored. This verification usually involves some form of structural analysis. The complexities make traditional analysis techniques, such as the use of the computer code A4EI, unrepresentative and unsuitable to apply. Also, the construction of a detailed finite element model (FEM) requires modeling expertise and an unacceptable amount of labor.

A computational system is required that contains validated/certified tools and models that can be readily employed by non-FEM experts. Designers would be able to input parameters, such as panel bay spacing, boundary conditions, skin material and thickness, skin stiffness, flushness requirement, and scarf angles, while the system would automatically construct a valid finite element representation of the repair area. The system must also be capable of taking loads from larger global models and accurately applying these loads to the system-generated model. The system must be able to generate models for wing skins, fuselage skins, control surfaces, and doors. The system should also serve as a repository for completed repair projects that can be documented, referenced and shared. Finally, the system should provide the means to study, monitor, and manage the repair design process.

PHASE I: Determine the feasibility and then establish the essential requirements of the computational system. Identify the various structural arrangements and material combinations to be represented. Establish the basic operating shell and then demonstrate how the analysis system will be implemented using a solid laminate skin bay repair as an example.

PHASE II: Develop the procedures to analyze the repair of honeycomb construction and discrete stiffened skin construction, and incorporate these procedures into the computational system. Verify that the system can take loads/inputs from global FEMs and accurately translate these to the system-generated models. Verify that the system accurately analyzes repairs by conducting laboratory tests on representative structural elements. Provide copies of the computational system to the government and other end users for test and evaluation.

PHASE III: Complete the computational system and transition the system into aerospace acquisition platforms. Provide updates for new materials and structural forms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Many of the latest business jets such as the Raytheon Premier I, Hawker Horizon, and Augusta/Bell D609 utilize composite construction. In addition, the latest products from Airbus (A380) and Boeing (787) make extensive use of composite construction. This analysis toolset would be invaluable for both the Original Equipment Manufacturers (OEMs) and repair centers for designing and analyzing composite repairs.

REFERENCES:

1. Hart-Smith, L. J., "Analysis and Design of Advanced Composite Bonded Joints," NASA CR-2218, 1973.
2. Hart-Smith, L. J., "Adhesive-Bonded Scarf and Stepped-Lap Joints," NASA CR-112237, 1973.
3. Hoskin, B. C. and Baker, A. A., "Composite Materials for Aircraft Structures," AIAA Education Series, 1986.
4. Composite Repair, SAMPE Monograph Report, ISBN-0-938994-29-8, 1985.

KEYWORDS: Composite Bonded Repairs; Bonded Analysis; Computational System; Structural Repairs; Structural Analysis; Rapid Repair

TPOC: (301)342-9360
2nd TPOC: (301)342-8509

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

N06-006 TITLE: Prognostic for Process-Related Integrated Circuits (IC)

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop a self-test prognostic integrated circuit (IC) chip.

DESCRIPTION: This SBIR topic seeks to advance the state-of-the-art in prognostics and health management (PHM) of ICs by moving the PHM architecture from the circuit card level to the integrated circuit level, thus reducing or eliminating ancillary components dedicated to PHM functions on circuit cards. Integrated circuit devices have differing degradation characteristics depending on the conditions in which they are manufactured and operated. The basic failure mode is electro-migration (p-n junction degradation). This process occurs during the manufacturing process and during operation. Key environmental factors contributing to this phenomenon are high temperatures of semiconductor materials, electrical overstress (excess current or voltages applied across junctions), electro-static discharge, or a combination thereof. Degradation can be accelerated by extended periods of operation at high temperatures.

Inability to detect early symptoms of IC degradation can lead to poor performance and unforeseen IC failures. It is highly desirable to devise and develop a self-test prognostic IC chip capable of monitoring electrical degradation, assessing remaining useful life, and warning of impending failure of itself and/or other ICs resident on the same circuit card.

PHASE I: Determine the feasibility of developing a self-test prognostic IC chip. Provide a model of the system along with the necessary algorithms.   Demonstrate the model's ability to determine expended IC life and the system's capability to maximize PHM functionality while meeting the stated requirements.

PHASE II: Develop and demonstrate a final application for the model produced in Phase I. Provide the architecture and algorithms required to perform the life usage algorithm. Demonstrate the prognostic models for the JSF specific electronic design.

PHASE III: Demonstrate the system on-board an aircraft with flight qualified hardware and software. Incorporate the technology with JSF production aircraft and determine the system's compatibility with legacy and future applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: These advanced models would be applicable to any electronic system across the defense and commercial industries that aspire to apply diagnostic, prognostic, and health management capabilities. Any results and understanding gained from applying these failure progression rate models will provide a significant crossover benefit to a multitude of similar applications.

REFERENCES:

1. SAE E-32 Committee Documents
2. ISO TC/SG5 Draft Standards
3. IEEE Aerospace Conference Proceedings for 2003 and 2004 Track 11 PHM

KEYWORDS: Diagnostics; Prognostics; Integrated Circuits; Self Test; PHM; JSF

TPOC: (240)538-6223
2nd TPOC: (301)342-8861

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

N06-007 TITLE: Prognostic Capabilities for Field Effect Transistors (FET)

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop innovative statistical tools, models, and techniques that would define fault-to-failure progression models and provide accurate useful-life-remaining predictions for FETs.

DESCRIPTION: In order to fully enable the predictive component of a prognostic and health management (PHM) concept, the capability must exist to relate detected incipient fault conditions to accurate useful-life-remaining predictions for any point in time in a device's service life. An understanding of incipient fault-to-failure progression characteristics for the component and/or subsystem of interest, plus control of realistic and verifiable prognostic models, are essential to accomplishing this predictive task.

Airborne electronic systems containing FETs and their system components are the focus of this topic. The ability to diagnose faults accurately, and to predict failures and life remaining of these components, is paramount to the Joint Strike Fighter (JSF) user. This diagnostic and predictive process requires an understanding of the FET physics of failure, analytical and physical models, statistical techniques, and field failure data. Real-time sensor data and/or measurable state awareness are fundamental input to the prognostic models and techniques.

PHASE I: Define the techniques and processes needed to relate useful-life-remaining predictions to detectable fault conditions in airborne FET-based electronic systems and their components. Demonstrate the technical merit of the proposed solution. Develop an initial list of required inputs to the models and outline a method for acquiring these inputs from the aircraft. The models must execute on a standard PC platform, be optimized for minimal run-time environment, and possess a clearly defined user interface.

PHASE II: Develop and demonstrate a prototype of these advanced prognostic and useful-life-remaining models for several JSF FET-based systems and their components. Assess the application boundaries, accuracy, and limitations of these modeling techniques.

PHASE III: Finalize the models with a major aircraft and/or engine manufacturer. Apply these modeling capabilities to the JSF program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Advanced prognostic models will apply to any FET-based system across the electronics industry, in both the defense and commercial sectors, that require diagnostic, prognostic, and health management capabilities. Any knowledge gained from applying these failure-progression-rate models to particular electronic systems will provide significant crossover benefit to similar applications, commercial or military.

REFERENCES:

1. SAE E-32 Committee Documents
2. ISO TC/SG5 Draft Standards
3. IEEE Aerospace Conference Proceedings for 2003 and 2004 Track 11 PHM

KEYWORDS: Diagnostics; Prognostics Field Effect Transistors (FET); JSF; Useful Life Remaining; PHM

TPOC: (240)538-6223
2nd TPOC: (301)342-8861

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

N06-008 TITLE: Down Converter Hardware Development in a PXI (PCI (Peripheral Component Interconnect) Extensions for Instrumentation) Form Factor

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: PMA-260, Aviation Support Equipment

OBJECTIVE: Develop a down converter in a PXI form factor for use in a synthetic instrument measurement unit (SIMU) environment. The down-converter must be capable of operating over the target frequency range of 100 KHz to 26. 5 GHz.

DESCRIPTION: RF/microwave down-converters are available in a variety of formats: chassis mount assembly, rack mount assembly, or in fairly large modular formats such as VMEbus Extensions for Instrumentation (VXI). There is an interest by the Navy to investigate going to a more compact modular format called PXI, which is a modular instrumentation platform targeted specifically for test and measurement and automation applications. Currently there are no commercially available 100 KHz – 26.5 GHz down-converters available in a PXI format, there are however a large numbers of companion digitizers available in this format in support of SIMU implementations.

With PXI, the user can select the modules needed for a particular application and integrate them into a single PXI system from multiple vendors. Communication among the modules uses familiar PC-based technologies such as the 132 MB/s PCI bus, allowing high performance communication that leverages widely available software. PXI also integrates timing and synchronization into the system, so that the user can pass signals between instruments for high performance and accuracy, without additional cabling. From a module size perspective, PXI modules are governed by Eurocard specifications (NSI 310-C, IEC 297, and IEEE 1101.1), which have a long history of application in industrial environments. Both small (3U= 100mm by 160mm) and large (6U = 233.35 by 160 mm) compact form factors are an inherent part of the PXI commercial specification. This unit would be used in support of Automated Test Systems (ATS) and embedded applications.

PHASE I: Assess the feasibility of designing a down-converter in a PXI compliant, or other alternative small form factor if PXI is impractical, module format that meets targeted space allocation and performance specification goals. The proposed design should address power budget and electromagnetic interference (EMI)/radio frequency interference (RFI) shielding issues. An advanced module prototype is acceptable.

PHASE II: Develop, demonstrate, and validate a prototype PXI, down-converter solution in a synthetic instrumentation environment. Demonstrate both low frequency (i.e., frequency, counting, time based measurements, etc.) and RF (frequency, amplitude, phase, etc.) measurement capabilities that can be achieved using the prototype down-converter in unison with other synthetic instrument commercial-off-the-shelf (COTS) components.

PHASE III: Commercialize and transition the PXI based down-converter for use in military/aerospace programs such as Consolidated Automated Support System (CASS) modernization, embedded systems and/or the commercial marketplace.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology can be used by both commercial and military users (CASS) of PXI/modular microwave test instrumentation. Commercialization success is highly probable since this functionality is currently unavailable in the PXI marketplace and poses high risk for current suppliers to develop this RF/MW capability in a PXI format.

REFERENCES:
1. PXI Specification – PCI extensions for Instrumentation- www.pxisa.org/Spec/pxispec10.pdf

KEYWORDS: RF; Microwave; Down Converter; PXI; Test System; Synthetic Instrument

TPOC: (301)995-6408
2nd TPOC: (301)995-6364

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

N06-009 TITLE: Meteorological Ocean Dropsonde Technology

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors

ACQUISITION PROGRAM: P-8A, Multi-Mission Aircraft (MMA)

OBJECTIVE: Develop an innovative and affordable, air-launched expendable meteorological measurement system to support weapon and sensor deployment as well as the operational use of electromagnetic, infrared (IR), and visual sensors and weapons in the littoral land-sea interface environment.

DESCRIPTION: Knowledge of both the meteorological and oceanographic environment is crucial to naval operations. In support of anti-submarine warfare (ASW), knowledge of the meteorological environment is critical to mid- and high-altitude deployment of sonobuoy assets. Knowledge of the in-situ real-time wind field is crucial to understanding the appropriate air release point for expelling ballistic sonobuoy assets so that they will land in known positions on the ocean surface. This knowledge, coupled with the meteorological parameters of temperature, pressure and humidity, can support other Navy sensor systems. While a number of dropsondes are currently manufactured for research and scientific purposes, further development needs to occur to obtain the capability for carrying out such in-situ atmospheric measurements.

The service life of a meteorological dropsonde is typically over when it lands. The tactical and scientific communities are interested in the development of additional dropsonde capability to measure oceanographic and/or acoustic data and relay the data to an on-station maritime patrol aircraft (such as the P-3 or multi-mission aircraft (MMA)). Satellite communication (SATCOM) capability is also desirable but not a requirement.

A broad evaluation of the proposed approach against existing capabilities such as those provided by current dropsondes and sonobuoys and defined communication methodologies and the interface with existing Navy communication systems should be included in the proposal. Considerations for weight and cube should be maintained as A-size sonobuoy though smaller and lighter approaches are desirable. Meteorological dropsondes have been packaged in extremely small chaff dispensable units in the past. Emphasis should be placed on a compact, low cost, expendable air deployed measurement device, that may be deployed either through a pressurized A-size sonobuoy chute, a non-pressurized free-fall chute up to A-size in diameter, or a chaff/flare dispenser. It is desirable to have a system that is compatible with naval air platforms including remotely piloted vehicles (RPVs), unmanned air vehicles (UAVs), and autonomous underwater vehicle (AUVs) and the linkage with aircraft/ship/shore processors and displays. Concepts could include “piggy backing” on existing expendable sensors. It is also desirable that the system communicates via the sonobuoy channels 1-99, for compatibility with current and future radio receivers.

PHASE I: Demonstrate the feasibility of the proposed approach to meet the requirements above. Develop a communication and data integration approach with existing Navy assets.

PHASE II: Develop and demonstrate a prototype meteorological-ocean dropsonde; evaluate the development incrementally via the following parameters:
1. Characterization of the dropsonde deployment envelope it is desired that a dropsonde match the current sonobuoy deployment envelope -drop from up to 10000 meters, and from indicated airspeeds ranging from 45 knots to 370 knots.
2. Stable deployment within the dropsonde deployment envelope
3. Robustness of the telemetry uplink
4. Parameters included in the telemetry uplink, and data rates
5. Computation of the wind/speed/direction vs. altitude profile
6. Projected production cost of the dropsonde

Evaluation may be performed on individual components of the prototype as developed, in addition to field testing of prototypes.

PHASE III: Transition to operational Fleet air anti-submarine warfare (ASW) platform(s) and/or to commercial applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Meteorological-ocean dropsonde technology would have broad applications to research institutions and ocean weather groups.

KEYWORDS: Sonobuoy; Meteorological; Oceanographic; Sensor; Dropsonde; Multi-Mission Aircraft

TPOC:
2nd TPOC: (301)342-2051

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

N06-010 TITLE: <u>Sonobuoy – Electronic Function Selector (EFS) Replacement</u>

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: PMA-290, Maritime Surveillance Aircraft

OBJECTIVE: Design and develop an alternative concept to replace the Electronic Function Selector (EFS).

DESCRIPTION: Currently, sonobuoy functions, such as radio transmitter frequency, sensor depth, and operating life, are preset by an operator using the sonobuoy EFS. The EFS is accessed manually using a series of buttons located on the side of the sonobuoy. The settings are visible and readable on a light emitting diode (LED) display through a window on the side of the sonobuoy.

Advances in technology have made it possible to develop an alternate, innovative concept to allow users to select and confirm sonobuoy functions prior to loading via a wireless link. Modification to the sonobuoy should make it less expensive, require less volume, consume comparable or less power, and have more data/file transfer capacity than the button/LED device. The developed user interface device should be a small handheld, battery-powered device, usable in very low light conditions and cost less than $200. The interface device should comply with DOD requirements for electromagnetic frequency interference (EFI) as they apply to Navy aircraft. The ability to interface with a standard personal computer (PC) through a universal serial bus (USB) connection for-programming and record keeping should be incorporated. Maximum use of commercial-off-the-shelf (COTS) technology is encouraged. The system must operate while the sonobuoy is in the shipping launch container (SLC). In addition to a hand-held user interface, the proposed concept should be adaptable to the multi-mission maritime aircraft (MMA) so that function selection and confirmation can be accomplished via direct interface with the mission computer while the sonobuoy is in the launcher.

PHASE I: Determine the feasibility of using wireless link technologies as the sonobuoy EFS system. Select optimum system design concept(s) for development in Phase II. Identify the MMA launcher interface.

PHASE II: Produce a prototype sonobuoy and user interface device from identified technologies, perform testing and conduct a demonstration of the capability. Finalize the concept design and make recommendations for Phase III production-oriented designs.

PHASE III: Conduct integrated testing of the final concept and transition the technology to the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Various household products/appliances have programmable functions, e.g., washing machines, dishwashers, thermostats, etc. This concept could be directly applicable to simplify the programming of those devices.

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2. Approved Navy Training System Plan for the Navy Consolodated Sonobuoys (1998). N88-NTSP-A-50-8910B/A. http://www.fas.org/man/dod-101/sys/ship/weaps/docs/ntsp-Sonobuoy.pdf

KEYWORDS: Antisubmarine Warfare; Sonobuoy; Electronic Function Selection; Multi-mission Maritime Aircraft (MMA); Wireless Link

TPOC: (301)342-2163
2nd TPOC: (301)342-2051

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

N06-011 TITLE: Multi-Sensor Data Fusion for Littoral Undersea Warfare

TECHNOLOGY AREAS: Information Systems, Sensors

OBJECTIVE: Develop new data fusion processing technology to improve subsurface target detection, classification, and localization performance for a system of multiple in situ passive and active underwater acoustic sensors operating in a littoral high-density acoustic battlespace.

DESCRIPTION: One of the significant challenges in operating a system of multiple acoustic sensors is timely development of a single composite acoustic scene or tactical situation awareness display from the multitude of active and passive detection and information products generated for each sensor. Active and passive sonar processing systems generate detection images, acoustic feature measurements to support contact classification, and spatial measurements to support localization. Single-sensor automated sonar processing can help by alerting the operator to potential threat detections, highlighting threat-like contact signature features, and providing classification estimates. However, to control false alarm rate, single-sensor automated processing systems are susceptible to missed detections – even when signals are above minimum discernible level.

Developing a composite acoustic scene across the field of in situ passive and active sensors requires the system to reliably associate simultaneous multi-sensor detections and sequential non-simultaneous detections. Currently, sonar operators must analyze contact classification evidence and spatial measurements to determine if multiple single-sensor detections are produced by the same target. Measurements to be analyzed include passive narrowband and transient features, single-ping coherent and non-coherent active features, multi-ping active features, estimated location, and kinematics. In a littoral undersea warfare environment, this manual fusion process is often inconclusive or too time-consuming to be tactically relevant. Current automated field processing systems are prone to false associations or extended time latency, especially when operating in high-clutter acoustic environments typical of the littoral battlespace.

The goal of this research is to advance the capability of automated multi-sensor fusion processing to improve tactical subsurface target detection, classification, and localization performance. A number of technical issues must be addressed to develop a robust multi-sensor fusion capability. Accurate data registration is essential for automated data fusion. Automated fusion processing must associate multiple single-sensor contacts with dissimilar active and passive detection and classification features. Algorithms must spatially resolve targets in a high-density acoustic battlespace containing friendly, hostile, and neutral underwater acoustic sources. It is also desirable to improve overall system probability of detection by exploiting multi-sensor fusion (fusion before detect). One of the key technical areas of interest is automated detection from DICASS sensors, deployed in a multi-static scenario. This may include using DICASS earlier in the fusion process as a search sensor. Another key technical area is the development of better fusion algorithms to get higher-quality data at a higher frequency. This means, for example, obtaining a high probability of detection (Pd) combined with a low false alarm rate (FAR). In multistatic scenarios, there is often good Pd, but very high FAR. Previous work in this arena has focused on fusion algorithms that can tolerate high FAR, and detection algorithms that lower the FAR while maintaining large Pd values. Both approaches have met with very limited success. New and innovative technology is sought that addresses one or more of these issues. Performance metrics to be addressed by this research include probability of detection, false alarm rate, time latency, and sonar operator productivity.

PHASE I: Develop an operational concept and define candidate sensor fusion algorithms that will improve subsurface target detection, classification and localization performance on multiple passive and active sensors. Provide a feasibility assessment of the operational benefit of the proposed concept and algorithms.

PHASE II: Complete the design and development of a completely functioning prototype fusion system. The prototype system should be constructed to run on commodity computing hardware, in a networked environment. This system should be capable of operating from processed sensor data, which will be provided by NAVAIR.Demonstrate system operations with previously collected at-sea data and evaluate performance relative to operationally relevant metrics:

1. Probability of detection
2. False Alarm Rate
3. Effective Acoustic Gain from fusion
4. Time To Detect / Fuse

PHASE III: Transition the multi-sensor fusion processing capability into the acoustic processing segment of a major platform combat system.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has application to any multi-sensor acoustic and non-acoustic surveillance or security system where a large quantity of data must be monitored by a minimum number of operators.

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2. M. Hatch, E. Jahn, J. Kaina, “Fusion of Multi-Sensor Information from an Autonomous Undersea Distributed Field of Sensors”, Proceedings of the International Fusion Symposium, July 1999.
3. David L. Hall, “Handbook of Multisensor Data Fusion”, CRC Press, 2001

KEYWORDS: Acoustic Sensors; Automation; Sensor Fusion; Information Processing; Sonobuoy; Antisubmarine Warfare (ASW)

TPOC: (301)342-2163
2nd TPOC: (301)342-2051

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

N06-012 TITLE: Speech Recognition Technology for Air Traffic Control

TECHNOLOGY AREAS: Electronics, Human Systems

OBJECTIVE: Develop innovative speech recognition technologies for integration into existing and Future Air Traffic Control (FATC) Communications Systems.

DESCRIPTION: Voice-to-data conversion is essential in reducing future manned aircraft workload as well as enabling FATC concepts for the Joint Unmanned Combat Air System (J-UCAS) program. Speech recognition allows a seamless transition where manned users can receive full voice commands, while other manned and unmanned systems can still operate from data. In a speech recognition approach, the controller's verbal command is recognized as a valid command and sent to the intended aircraft as a data message over a data link. Some messages may be broadcast and used for situational awareness, while other messages are directed to specific aircraft and require a digital acknowledgment in return. Hidden Markov Models (HMM's) would potentially be a technology of interest for this effort. HMM's constitute a family of versatile statistical models that have proven useful in many applications, most notably, in automatic recognition of speech signals. Using HMM's for speech recognition would accurately identify speech patterns so as to successfully translate acoustic voice signal into digital representation of words or phrases that could then be recognized by manned and unmanned aircrafts. These messages and commands may be heard by other aircraft and used to improve overall situational awareness.

The key challenge for ATC is to make the recognition task reliable so that it can support safety of life applications. Current speech recognition systems are not developed to support safety of flight requirements, and thus do not have the Probability of Success (PoS) requirements and design constraints that are crucial for ATC operations. This application is unique not only in the elevated PoS requirement, but in the use of ATC vernacular/phraseology in a data link intensive environment. Proposed technology should be compatible with the Airborne Networking Waveform (ANW) data link system and the message formats and data should comply with requirements for J-UCAS Air Traffic Control.

PHASE I: Determine the feasibility, capability, and costs for developing speech recognition technology for use in FATC and demonstrate initial design concept.

PHASE II: Develop and build a prototype of the designed language model and run initial tests to determine the basic performance of the model.

PHASE III: Transition speech recognition technology and integrate with the J-UCAS FATC architecture, including ATC console, SATCC and the Ship Integration Processor (SIP) interface to the ANW link. Support demonstration with the system in the FATC and J-UCAS laboratories with operator in the loop simulations. Support testing at Patuxent River and aboard ship during J-UCAS surrogate and vehicle trials to make sure it meets the requirements for FATC Communications Systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Speech recognition technology developed in this SBIR could be of use in private sector ATC for the FAA .

REFERENCES:

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KEYWORDS: Speech Recognition; J-UCAS; Carrier Air Traffic Control Center; Sea-Based Joint Precision Approach and Landing System; Digital Data; Data Link

TPOC: (301)995-8272
2nd TPOC: (301)995-8946

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

N06-013 TITLE: Technology Development for a Multi-Mission Passive Anti-Submarine Warfare (ASW) Turret Capability

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

ACQUISITION PROGRAM: PMA-264, PMA-290

OBJECTIVE: Develop polarization and surface sea foam mitigation techniques and camera components to improve the performance and reduce the form factor of turreted passive multi-spectral imaging systems.

DESCRIPTION: The electro-optic passive ASW system (EPAS) is a research and development, packaged, passive electro-optic camera system in a 16-inch turret. The core of EPAS consists of four different nonacoustic detection technologies integrated into a single system. EPAS is a twelve- channel visible multi-spectral imager, a three-channel low-light-level spectral detector, a three-channel low-light zoomed camera, and a mid-wave (3-5 micron) infrared (IR) detector. EPAS also includes a next-generation digital magnetic anomaly detector (MAD) and a laser rangefinder/laser designator.

Currently, the EPAS multi-spectral imager does not take advantage of polarization or handle the negative effects of sea surface foam on system imaging performance. Significant reduction of false alarms and enhancement of the probability of detection are expected if these effects are understood. Twelve individual cameras are used to collect the visible multi-spectral data. Understanding these effects could result in a new, smaller system with optimized beam splitting.

PHASE I: Determine the value and feasibility of integrating polarization into a multi-spectral system. Include design approaches and algorithms for mitigating sea foam effects to improve the signal-to-noise (S/N) ratio and the image quality of passive multi-spectral EO images. The final report should consider the types of data required/available, the timeframe and method of data collection, and any hardware required to test the approach.

PHASE II: Acquire and analyze data (e.g. polarization matrix), and develop algorithms to demonstrate the S/N enhancement expected using polarization and sea foam mitigation. Develop laboratory prototype or system component(s) to provide polarization results for the EPAS high-performance multi-spectral cameras and optimize channel beam splitting, as appropriate.

PHASE III: Transition the developed product directly to the EPAS program during its acquisition cycle. Transition to other air platforms, such as multi-mission aircraft (MMA) (P-8A) and the H-60, and consider miniaturization for smaller unmanned air vehicles (UAVs).

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The use of airborne multi-spectral sensing has many commercial applications including fish population tracking, effluent detection and tracking, search and rescue, etc.

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KEYWORDS: Polarization; Imaging; Multi-Spectral; Sea Foam; Optical Splitters; Passive ASW

TPOC: (301)342-2022
2nd TPOC: (301)342-2025

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

N06-014 TITLE: High-Power Non-Cryogenic Semiconductor Lasers for Infrared Countermeasure (IRCM) Applications

TECHNOLOGY AREAS: Sensors, Electronics, Weapons

ACQUISITION PROGRAM: PMA-272 TADIRCM

OBJECTIVE: Develop mid-infrared (IR) semiconductor sources for use in a variety of IRCM jamming systems for fixed-wing and rotary-wing aircraft.

DESCRIPTION: The Naval Aviation Systems Team is developing a number of IRCM systems that use lasers to protect aircraft from IR guided threats. Current jamming systems employ mid-IR laser sources based on frequency conversion. These jamming systems tend to be heavy, expensive, and inefficient. Far preferable would be an electrically pumped semiconductor mid-IR source that emits high powers at ambient temperature or is thermo-electrically cooled, in a much more compact and inexpensive package. 3-5 mm semiconductor lasers are required that emit multi-watt quasi-continuous wave (CW) powers with beam qualities within a few times the diffraction limit, without requiring optical pumping or cryogenic cooling. Both inter-band diode and inter-sub-band quantum cascade designs are acceptable if the performance requirements can be met. High wall-plug efficiency, high modal-stability, and the ability to cover a variety of wavelengths throughout the mid-IR atmospheric transmission window are favorable attributes. Optimization of the thermal management approach and heat-sinking package are likely to be key to achieving the performance levels required for this application. Minimizing the cost of the proposed laser systems is an important factor. Costs should be less than $100K per system.

PHASE I: Demonstrate a baseline electrically pumped mid-IR semiconductor laser that emits at least 500 mW of CW power at a TE-cooler temperature or above at a wavelength in the 4.5-4.8 mm range. Wall-plug efficiency should be at least 4%. Develop a comprehensive plan for upgrading the power to the multi-Watt level, while meeting the other requirements for an IRCM source, including improved efficiency.

PHASE II: Develop and produce high-power mid-IR lasers that operate at a thermoelectric (TE) cooled temperature or above at a wavelength in the 4.5-4.8 mm range, with a wall-plug efficiency goal of 10 percent. Fabricate devices that are suitable for integrating into a prototype IRCM laser package. Generate multi-watt power levels in a high-quality beam, or provide quantum cascade (QC) wafer material for fabrication into high-power devices elsewhere. Test at long range to assess the status of mid-IR semiconductor sources for integration into existing and future IRCM systems.

PHASE III: Transition the semiconductor IRCM laser system to the Advanced Tactical Aircraft Protection System.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Besides the DoD need for countermeasures against IR threats, there is a growing awareness that commercial airliners need protection against the same threats. The Department of Homeland Security has initiated programs to address this threat. The availability of high-performance semiconductor IRCM sources may have even greater impact on the commercial sector, for which cost is an even greater driver. In addition to IRCM, there are a number of other potential applications for low-cost, high-power, non-cryogenic mid-IR laser sources. These include remote chemical sensing, biological detection, and free-space communications.

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KEYWORDS: Infrared Countermeasure; Laser; Uncooled; Tactical Aircraft; Jammer; Directed IR Countermeasures

TPOC: (202)767-5113
2nd TPOC: (202)767-3276

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

N06-015 TITLE: <u>High-Performance Passively Q-Switched Microchip Laser</u>

TECHNOLOGY AREAS: Electronics, Weapons

ACQUISITION PROGRAM: AIM-9X

OBJECTIVE: Develop an ultra-compact, high-performance, passively Q-switched short-pulse microchip laser that is appropriate for use in a military system environment.

DESCRIPTION: Recent advances in microchip laser technology provide the opportunity for significant performance gains from active optical sensors. A cost-effective, ultra-compact, passively Q-switched short-pulse microchip laser that can operate in a rugged environment is required to take advantage of these performance gains. Environmental parameters include storage and operation over a very wide temperature range (-54°C to +71°C for storage and -40°C to +100°C for operation), long storage times, and operation in a harsh vibration environment. This ultra-compact laser should be capable of providing sub-nanosecond pulses with minimum pulse energy of 12 µJ at a repetition rate greater than 4 kHz. The device should consume less than 2.0 W electrical power, excluding thermal conditioning power. The laser's output wavelength should be in the near-infrared region, and it is desired that the technology be adaptable to operate at visible wavelengths. The laser package should occupy less than 0.26 cubic inches of volume. It is preferred that any laser diode used as a pump source be capable of operating above 50°C.

PHASE I: Develop a conceptual design for an ultra-compact, passively Q-switched short-pulse microchip laser that meets the environmental and performance requirements for operation in a military system. This design should include the laser, thermal conditioning devices, associated beam forming optics, and mechanical packaging.

PHASE II: Finalize the laser design developed in Phase I. Fabricate a limited number of prototype lasers, and conduct performance and environmental testing.

PHASE III: Transition the tested laser into a Navy program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology could be used in rugged high-definition surveying equipment, high-resolution rangefinders, scientific spectroscopy, telecommunications, and material etching devices.

REFERENCES:
1. Carts-Powell, Yvonne (2000); "Pump Scheme Yields Ultrastable Microchip Laser Performance;" http://www.photonicsonline.com/content/news/article.asp?DocID=EFDCE04B-1846-11D4-8C37-009027DE0829&Bucket=In+the+Spotlight&Featured=True

KEYWORDS: Microchip Laser; Passive Q-Switch; Ultra-Compact; High Performance; Near-Infrared Region; Sub-Nanosecond Pulses

TPOC: (301)757-7289
2nd TPOC: (760)939-8903

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

N06-016 TITLE: Adjustable Attachment Device for Aircraft Blankets

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: V-22

OBJECTIVE: Develop an attachable, adjustable, removable, low-cost, easily installed device to retain aircraft insulation blankets without alteration of aircraft structure or blankets.

DESCRIPTION: A removable, adjustable attachment device is needed for retention of a new cabin blanket system for application to various aircraft. Positional adjustability of the device is required to provide flexibility for the installation of the blankets. It should be readily attachable to any aircraft structural frame and/or rib assemblies and should not create any structural degradation or deformation. Drilling of the airframe structure is impermissible as it causes airframe stress concentrations.

Cabin blankets are fabricated in sections that are all interdependent. Periodically, they need to be removed for scheduled maintenance inspections as well as for access to various components. Each blanket section requires a large number of fasteners for installation.

Current methods to attach aircraft blankets in the V-22 include bonded studs, stand-off devices and Velcro. These devices attach studs to aircraft structure. The studs pass through the mounting holes of the insulation blanket, where fasteners are used to retain the blankets. Each of three attachment methods has proven to be unreliable in a V-22 operational environment. Bonded studs and stand-off devices are fixed to aircraft structure and do not allow for variations in blanket hole location. While these attachment devices support in-plane shear stress, they can be subjected the high bending stresses associated with stud and blanket hole misalignment. Bonded studs – the most abundant attachment device used on the V-22 - are particularly susceptible to damage/breakage. Bonded studs consist of a fastener with a widened head that acts as a base that is bonded to the aircraft structure using adhesives. When a force from a load is applied offset from the mounting surface, as with a fabric blanket, bonded fasteners are often pulled off the airframe. Because bonded studs require surface preparation and adhesives to permanently bond the studs in place, purposeful or unexpected/unintentional removal of these studs can cause surface delamination of the composite structure and is avoided in most cases. The bonding procedure is time consuming and labor intensive. Stand-offs require permanent structural installation. Holes must be drilled in the airframe, sacrificing its structural integrity. These types of fasteners are generally nonadjustable and/or have limited adjustability. Velcro, on the other hand, allows for adjustability and is an adequate attachment device for flat surfaces and low maintenance areas. However, high velocity airflow can pull the Velcro loose.

New innovative attachment devices are sought that will require no modification to aircraft blankets or alter the structural integrity of airframe members, but will advance beyond the current design that causes damage or repeatedly fails. Proposed technologies should allow for adjustability in device position and/or radial float. The device should be able to tolerate blanket installation flexibility and misalignment, better resist out-of-plane and dynamic loads than bonded devices, be more survivable to accidental abuse and shock loads, and be relatively easy and quick to install to existing structural elements such as airframe flanges. The proposed attachment device should be capable of being installed after the aircraft has been partially or fully assembled (post-assembly).

PHASE I: Determine the feasibility of developing a multi-location, adjustable attachment device concept applicable to rotary- and fixed-wing aircraft including the V-22, that will cause no damage and be reliable.

PHASE II: Develop and demonstrate a prototype of the attachment system and compare to strength and durability of existing "bonded'stud" properties.

PHASE III: Qualify and transition the device to the V-22 and other rotary- and fixed-wing aircraft and identify a suitable industrial partner to develop a cost-efficient manufacturing process.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: A rapid, easy to install, and survivable, post-assembly attachment device would have potential use in air-freight and ground-freight applications, where insulation blankets are used. The adjustable and easy-to-install nature of the device lends itself to use in industrial settings.

REFERENCES:
1. NAVAIR 01-1A-8. Technical Manual, Structural Hardware.

KEYWORDS: Aircraft Blankets; Adjustable Attachment Device; Fasteners; Positional Flexibility; Multi-Directional; Reliability, Maintainability, and Availability (RMA)

TPOC: (301)342-9398
2nd TPOC: (301)995-3191

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

N06-017 TITLE: Destructive Expendable Countermeasure

TECHNOLOGY AREAS: Weapons

ACQUISITION PROGRAM: PMA-272, Tactical Aicraft Electronic Warfare Systems

OBJECTIVE: Design and develop an innovative aircraft self-protection destructive countermeasure capable of being dispensed from the Integrated Defensive Electronic Countermeasures (IDECM) system.

DESCRIPTION: Aircraft are typically engaged by anti-aircraft threats, from either other aircraft or ground-to-air missiles, from the rear hemisphere of the target aircraft. Aircraft maneuvers, decoys, and jammers are the primary defenses currently used to counter these threats. Unfortunately, these technologies are too costly to apply to all types of aircraft. The current need is to identify and develop innovative technologies to support destructive countermeasures against aircraft threat systems at a significantly reduced cost than what is currently available. The destructive expendable will require innovative advances in guidance, control, and maneuver; autonomous sensors; and/or cueing from on-board threat warning systems.

Proposed design solutions should be less than 1.0 meter in length with a wingspan of less than 1.5 meters. It should weigh less than 10 kg and have an operating range of no less than 500 meters, with endurance of at least 2 minutes flight time. The proposed expendable should be able to be launched from the ALE 50/55 IDECM system, and be equipped with a booster sufficient to clear the expendable from the canister. The innovative design should include the ability to 'fold' to fit into the canister and 'unfold' when expelled from the canister. It should be capable of being propelled with sufficient closing speed to cause catastrophic damage to the threat or result in an observable kill. Proposed designs should employ onboard sensors, automatic flight control, and stabilization and navigation systems to execute a terminal homing threat but should not require external flight control. The proposed design should be able to execute terminal homing to the threat using multi-spectral integration across the EO, IR and RF spectra and highly uniform focal plane array technologies with complementary clutter rejection technologies. A variant to terminal homing to the threat programming, using clutter rejection technologies, could be the capability to process a set of complex schemes and tactics which would result in reducing the enemy to a disrupted and chaotic state, making them hesitate, second guess equipment, make mistakes and cause the threat command and control or guidance system to become relatively useless. Concepts that cause fatal damage to threat systems are sought. Successful outcome from this concept will reduce injury to, and loss of life of, our aircrews. Exoatmospheric Kill Vehicle, Theater High-Altitude Air Defense System (THAAD), and the Navy Upper Tier Interceptor would benefit from the development of this technology.

PHASE I: Determine the feasibility of proposed innovative technology for an expendable autonomous vehicle capable of locking onto and tracking an aircraft missile threat, and then maneuvering to intercept and destroy the threat at a distance to protect the aircraft and personnel on board. Determine the amount of explosive material needed to deflect the oncoming missile or destroy it in flight and recommend the proper launch mechanism. Perform an analysis of technical risk and a rough order of magnitude (ROM) cost for the development and production costs.

PHASE II: Optimize the Phase I design and develop a prototype destructive device using off-the-shelf technologies where possible (where no current technologies are available for the subcomponents, use representative surrogate modules to indicate the space and weight approximations for these sub-components). Verify, through laboratory testing, that the subcomponents will perform as needed in field tests and then conduct modeling and simulation of the device to demonstrate the flight envelope. Advanced intercept modeling and simulation (appropriate software program to be supplied by the government) should be completed to determine the device's potential to intercepts threat systems.

PHASE III: Continue and complete the engineering development of the concept, including integration with existing and new naval platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Technologies developed may have application in commercial aircraft protection from the Man-Portable Air Defense System (MANPADS).

REFERENCES:

1. Defending America, A Plan to Meet the Urgent Missile Threat by The Heritage Foundation's Commission on Missile Defense, March 1999
2. Ballistic Missile Defense Organization report Summary of Report to Congress on Utility of Sea-Based Assets to National Missile Defense; www.nti.org/e_research/official_docs/mda/mda060199.pdf
3. Raytheon, AN/ALE-50 Towed Decoy System, http://www.raytheon.com/products/ale50/2.
4. Department of Defense Report to the Congress on Navy Theater Wide Defense System (Formerly Navy Upper Tier); Office of the Secretary of Defense; 25 March 1996; http://www.globalsecurity.org/space/library/report/1996/ntwd_960325.htm
5. Navy Theater-Wide Missile Defense, http://www.boeing.com/defense-space/space/md/ntwmd/
6. Missile Defense Agency Kinetic Energy Interceptor program
Kinetic Energy Intercepter; http://www.globalsecurity.org/space/systems/kei.htm

KEYWORDS: Aircraft Countermeasures; Aircraft Self-Protection Systems; Countermeasures; Destructive Expendable; CM; Autonomous

TPOC: (301)757-7891
2nd TPOC: (301)757-7890

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

N06-018 TITLE: Scenario Definition Language for Modeling & Simulation (M&S)

TECHNOLOGY AREAS: Information Systems, Human Systems

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop innovative standard scenario definition language that could be used by M&S applications to exchange scenario data below the command and control (C2) level.

DESCRIPTION: Many different M&S applications are used to plan training scenarios. Most, if not all, of these applications store their scenario data in different formats. This has at least three drawbacks. First, formats must be translated in order for different applications to share scenario data, which requires extra effort. Second, this results in the definition of many similar scenario formats, which implies inefficiency and could also lead to important data being missed in some applications. Finally, common tools cannot be created to perform common scenario-related functions (e.g., importing, exporting), so those functions have to be redeveloped for each application. A scenario definition language is sought that can be extended over time and can be used by applications in different domains and service branches. Similar languages have been created at the C2 level, such as CCSIL and XBML; these can be used as a starting point, but they are not designed to represent a sufficient level of detail for many M&S applications to realize any cost savings.

PHASE I: Propose a new and creative scenario definition language for future applications of different domains and service branches. Demonstrate the feasibility of the proposed definition language to meet the stated objectives.

PHASE II: Develop, test, and validate the new scenario definition language using new and/or emerging prototype modeling and simulation management applications. Creatively demonstrate how users from different domains and service branches would create scenarios using the new common language, with higher levels of detail than currently available. Project the cost and time savings that would be realized by adoption of the new scenario definition language.

PHASE III: Transition effort to commercial developers and government research and development facilities responsible for design and building of future modeling and simulation devices. Provide new specification to use scenario definition language in future simulators used for distributed simulation exercises by organizations such as the Joint National Training Capability (JNTC).

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Innovative scenario definition language technology can be applied to any training environment that uses modeling and simulation to plan the training scenarios. There are both commercial and military applications. Potential applications may be with the Joint National Training Capability (JNTC) or the Navy Common Training Environment (NCTE).

REFERENCES:

1. Hieb, Dr. Michael. "Extensible Battle Management Language." http://netlab.gmu.edu/XMSF/pdfs/XBML3Oct03.pdf
2. Hieb, Dr. Michael. "Developing Extensible Battle Management Language to Enable Coalition Interoperability." http://www.msiac.dmso.mil/journal/archive/SP05/tolk_1_61.html
3. Hieb, Tok, Sudnikovich, Pullen. "Developing Extensible Battle Management Language to Enable Coalition Interoperability." http://www.vmasc.odu.edu/publications/Tolk/04E-SIW-064.pdf
4. Argo, Brennan, Collins, Gipson, Lindstrom, MacKinnon. "Level 1 Model for Battle Management Language (BML-1)." http://www.uxxi.org/docs/c4i-repository/BML.pdf
5. Pullen, Wilson, Hieb, Tolk. "Extensible Modeling and Simulation Framework (XMSF) C4I Testbed." http://64.233.179.104/search?q=cache:z6SfiOrKgbgJ:www.movesinstitute.org/xmsf/events/JfcomWorkshopMay2003/XMSF-C4I-Testbed15May03.ppt+BML%2Bbattle&hl=en
6. Carey, Kleiner, Hieb, Brown. "Standardizing Battle Management Language – Facilitating Coalition Interoperability" by http://www.alionscience.com/pdf/Battle_Management.pdf
7. "Command and Control Simulation Interface Language (CCSIL)" by MITRE; http://www.uxxi.org/docs/c4i-repository/newCCSILbrf.pdf
8. Various Military Scenario Definition Language (MSDL) documents at http://www.onesaf.net, which requires account request & approval

KEYWORDS: Distributed; Training; Modeling; Simulation; Language; Protocol

TPOC: (407)380-4749
2nd TPOC: (301)757-2804

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

N06-019 TITLE: Enabling Internet Protocol Communications

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: F/A-18E/F

OBJECTIVE: Develop and demonstrate an innovative transmission control protocol/internet protocol (TCP/IP) network architecture that can be integrated into the shared reconnaissance pod (SHARP) to support time sensitive operations.

DESCRIPTION: The SHARP is equipped with an electro-optical/infrared (EO/IR) sensor system providing the F/A-18 E/F with the latest digital tactical reconnaissance (TAC RECCE). New technology is sought to expand the communication range and options to meet time sensitive strike requirements (directional and omni-directional transmission operating in the Ku and X bands). The aim is to maximize the effective use of TAC RECCE imagery data for use in multi-sensor fusion and target cueing. Integrated TCP/IP network communication and web based architectures for data and control systems are needed to go to and from multiple SHARP sensors including an emitter identification and location (e.g., time/frequency difference-of-arrival (T/FDOA) sensors). The proposed data link and networking technologies, suitable for the rigorous tactical airborne environments, should bring FORCEnet real-time connectivity to SHARP (e.g., TCP/IP over the data link using Ethernet over generic frame protocol (GFP)). IP network communications should be demonstrated with usable data rates (e.g. < 45Mb/s). Innovative approaches to buffering data for network applications, minimizing network retransmissions should be considered.

PHASE I: Demonstrate the feasibility of IP network communication architecture to provide FORCEnet capability to the SHARP. Evaluate methods to buffer data to minimize retransmission due to erratic link performance.

PHASE II: Develop a prototype and demonstrate network capabilities. Develop and evaluate potential modification to SHARP's common data link (CDL) and other communication equipment to accommodate the best option for IP network communications. Demonstrate at least one option to buffer data to support the potential for retransmission.

PHASE III: Demonstrate IP network communications to SHARP in flight or in a simulated flight environment. Demonstrate a suitable data storage device for the purpose of buffering data for retransmission.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Military, civilian, and commercial users are demanding TCP/IP connectivity and web-based architectures suitable for even the most rigorous airborne environments to support operations, science, and business. This SBIR will provide an architecture that will meet the most demanding of these requirements providing essential network connectivity for many applications.

REFERENCES:
1. "FORCEnet Architecture and Standards Volume II Technical View", Office of the Chief Engineer (SPAWAR 05), 31 December 2004 Available at:
http://enterprise.spawar.navy.mil/body.cfm?Topic_ID=809&Type=R&category=23&subcat=45

2. "Hostile Force Integrated Targeting System TM-DCS Interface Control Document (draft)". Ticom Geomatics Inc. 12 August 2003

3. "Network Message (NMSG) Reference Manual for the interface Between Hostile forces Integrated Targeting System (HITS) and Ship's Signals Exploitation Equipment, Increment E (SSEE-E)", Ticom Geomatics Inc., 24 February 2004

4. "Sensor Network Language (SNL) Reference Manual for the Between Hostile forces Integrated Targeting System (HITS) and Ship's Signals Exploitation Equipment, Increment E (SSEE-E)", Ticom Geomatics Inc., 24 February 2004

5. "Airborne Overhead Cooperative Operations COMINT Joint Interfaced Control Document (AOCO JICD) Version 4.0 (draft)", Airborne Overhead Interoperability Office, 28 April 2004

KEYWORDS: FORCEnet; Internet Protocol; Network Communications; Architecture; T/FDOA; TCP/IP;

TPOC: (301)757-0729
2nd TPOC: (301)757-0728

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

N06-020 TITLE: Innovative Methodologies to Determine Remaining Fatigue Life of Aircraft Dynamic Components

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: H1 Upgrades (4BW/4BN)

OBJECTIVE: Develop an innovative, non-destructive approach to predict remaining fatigue life from pre-crack initiation data obtained on both static and dynamic Navy/Marine Corps aircraft components.

DESCRIPTION: The structural design process for fatigue life of Navy/Marine Corps aircraft is based largely on predictions as to how severely the aircraft are expected to be flown. Strains imposed on aircraft components are obtained by flight-testing with a fully instrumented (strain gauges/load cells/accelerometers) aircraft. Having been designed and tested to this predicted usage it is presumed that the aircraft will be operated exactly in this manner when it enters service. However, actual usage is often far different from that which was predicted. This places individual aircraft and components in the position of either being used more severely than designed for, posing a safety risk, or being used less severely, and being discarded well before the end of their safe life expenditure.

Technological advances in the realm of sensors and simulators have demonstrated the capability of measuring structural changes such as conductivity and local plastic deformations at the atomic, molecular, and granular levels. However, a sound methodology is lacking that can interrogate such data for the determination of a component's remaining fatigue life. The Navy is interested in developing analytical methods/tools that would identify a metric as a pre-cursor to crack initiation, then interrogate and analyze metric data gathered with current sensor and/or simulation technologies to provide an accrued damage calculation on an individual component basis. The developed methodology would then be used to assess the remaining fatigue life as a function of flight condition.

This methodology and/or technology should require little-to-no maintenance and zero-to-low power requirements (not drawing power from main aircraft power systems). It must also survive the shock, vibration, and temperature environments of fixed- and rotary-wing systems. Additionally, this methodology and/or technology must be non-destructive.

PHASE I: Demonstrate the feasibility of predicting remaining fatigue life on a dynamic structural component, using an identified precursor to crack-initiation that can be measured using currently available sensor or simulator technology, before cracks initiate. Demonstrate the feasibility for interrogating this data. Coupon level testing should be performed in a simulated Naval environment to show potential for data gathering, data interrogation, and quantification of the remaining fatigue life on a component at any instant in time.

PHASE II: Fully develop the Phase I methodology and provide validation that the developed tools can predict the remaining fatigue life of coupon level and structural sub-element test articles. Produce a prototype turn-key system that works well with other Navy approaches that perform life calculations and component management and that could be utilized by the government in a Phase III flight evaluation program.

PHASE III: Integrate the prototype system into a Navy rotary wing aircraft and verify functionality. Transition the technology to the Fleet aircraft (e.g. H-60, H-53, H-1, P-3, E-6, etc.), and integrate it with existing Fleet maintenance practices.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The developed technology will directly transition to the commercial rotary and fixed-wing aircraft industry, providing a life prediction tool for aircraft components.

REFERENCES:

1. MIL-STD-810F, Department of Defense Test Method Standard Considerations and Laboratory Tests, dated 1 Jan 2000
2. MIL-STD-461E, Requirements for the Control of Electromagnetic Interference Emissions and Susceptibility, dated 20 Aug 1999
3. MIL-HDBK-454A, General Guidelines for Electronic Equipment, dated 03 Nov 2000
4. MIL-STD-1472F, Human Engineering, dated 05 Dec 2003
5. AR-56, Structural Design Requirements for Helicopters, dated 17 Feb 1970
6. MIL-A-8866C, Airplane Strength, Rigidity, Reliability Reqs, Fatigue & Damage Tolerance, dated 20 May 1987
7. MIL-A-8870C, Airplane Strength & Rigidity Vibration, Flutter, & Divergence, dated 25 Mar 1993
8. Simmerman, C. and Moon, S., "The Art of Helicopter Usage Spectrum Development," 61st Annual National Forum of the A.H.S., Grapevine, TX, June 2005
9. Bannantine, J., Comer, J., and Handrock, J., "Fundamentals of Metal Fatigue Analysis," Prentice-Hall, Inc.: Upper Saddle River, NJ. 1990.

KEYWORDS: Structural Monitoring; Fatigue Life Prediction; Aircraft Components; Dynamic; Structural; PHM

TPOC: (301)342-9239
2nd TPOC: (301)757-5531

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

N06-021 TITLE: Innovative Approaches to Serialize Aircraft Dynamic Components

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: H1 Upgrades (4BW/4BN)

OBJECTIVE: Design innovative approaches to serialize Navy/Marine aircraft dynamic components that are capable of operating in the naval sand, rain, and sea-salt environment without degradation and are compatible with the Naval Aviation Logistics Command/Management Information System (NALCOMIS).

DESCRIPTION: The Navy faces difficulties in maintaining an appropriate spare parts inventory, in part due to inadequate systems for serializing components. Many spare parts in inventory are unneeded, obsolete, or unused. Delays in acquiring spare components often force mechanics to cannibalize parts (removing parts from one aircraft to make repairs on another), and component history information is severely compromised. Additionally, the Navy must prevent components manufactured by unauthorized vendors from being used on its aircraft. Risks associated with buying "equivalent," "duplicate,", or “reverse-engineered” parts are significant. Components may not meet specification, strength, and certification requirements, leading to a compromise in the system integrity of an aircraft system.

Existing three-dimensional methods of serialization for dynamic components, e.g. stamping, engraving, and mechanically fastened data plates, result in degradation of the component through the introduction of stress risers. Other existing approaches using two-dimensional methods like tagging exhibit limited durability as a direct result of the severe naval environment in which they operate, or lead to issues with moisture collection that results in corrosion.

The focus of this topic is to develop an innovative approach to serializing dynamic components that demonstrates high durability for the lifetime of the component without introducing undue stress or promoting degradation. The approach should take into consideration a backup serialization method in the event the primary method fails while components are in use. The approach must be able to withstand harsh Navy environments and be compatible with NALCOMIS.

PHASE I: Demonstrate the feasibility of serializing dynamic components as described. Address both primary and backup methods. Perform testing on aircraft subelements under dynamic loading conditions in a simulated naval environment.

PHASE II: Develop detailed designs and a prototype system suitable for system validation on a Navy/Marine aircraft. Demonstrate functionality and capability of the developed technology, along with its ability to interface with NALCOMIS and other Navy logistical systems.

PHASE III: Integrate the prototype system into a Navy rotary-wing aircraft and verify functionality. Transitioned to Fleet aircraft (e.g. H-60, H-53, H-1, P-3, E-6, etc.), and integrate with existing Fleet maintenance practices.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The developed technology will directly transition to the commercial rotary and fixed-wing aircraft industry, providing a serialization tool for aircraft components.

REFERENCES:

1. MIL-STD-810F, Department of Defense Test Method Standard Considerations and Laboratory Tests, dated 1 Jan 2000
2. MIL-STD-461E, Requirements for the Control of Electromagnetic Interference Emissions and Susceptibility, dated 20 Aug 1999
3. MIL-HDBK-454A, General Guidelines for Electronic Equipment, dated 03 Nov 2000
4. MIL-STD-1472F, Human Engineering, dated 05 Dec 2003
5. OPNAV INSTRUCTION 4790.2J, The Naval Aviation Maintenance Program (NAMP), dated 1 Feb 2005

6. Official Naval Aviation Logistics Command Management Information System (NALCOMIS) Home Page; http://logistics.navair.navy.mil/ooma/index.cfm
7. Work Unit Code (WUC) Guide for Aeronautical Equipment", dated 17 Sept 2002. This reference will be posted on SITIS upon the opening of the solicitation.

KEYWORDS: Health Monitoring; Aircraft Components; Serialization; Inventory Management; Dynamic Components, Navy Logistics

TPOC: (301)342-9239
2nd TPOC: (301)757-5531

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

N06-022 TITLE: <u>Non-Intrusive Stress Measurement System (NSMS) Sensors with Standoff Capability</u>

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop innovative turbine engine blade vibration sensors with the ability to sense blade time of arrival from longer working distances than currently employed sensors, and without the requirement for through holes in the engine case. Integrate the developed sensors into a NSMS and demonstrate the capability to measure blade vibration modes with similar accuracy to existing eddy current and laser based probes.

DESCRIPTION: Current NSMS systems require through holes in the engine case with bosses to incorporate the existing eddy current or light based blade time of arrival probes. NSMS technology is transitioning to additional engine operational and test applications as it becomes more mature and affordable. One of the major restrictions limiting the incorporation of NSMS capability onto engine operational and test applications remains the requirement for pre-drilled engine case through holes. Blade time of arrival sensors with the capability to measure blade vibration, flutter and stall precursors through the engine case and at the first stage fan via the inlet aperture are required. This capability will facilitate incorporation of NSMS at various stages on fielded operational engines based on service related issues as opposed to just pre-planned locations identified during the design phase, greatly enhancing the flexibility and value of the system. The capability will also facilitate retrofit to existing and research engines for such purposes as durability, depot level pass-off, and research related tests. Standoff capability would greatly enhance the value of NSMS to military aircraft turbine engine applications by removing the significant barriers to incorporating NSMS onto engine tests, as well as providing flexibility in locating sensors on fielded engines.

PHASE I: Demonstrate feasibility of proposed sensors to make blade time of arrival measurements through engine case material that is representative in composition and thickness to various stages of a modern military gas turbine engine. In addition to through-the-case sensors, develop and demonstrate proof-of-concept sensors that monitor vibrations of the first stage fan via the inlet aperture from a standoff distance. Demonstrate the ability to incorporate the sensor outputs into an NSMS.

PHASE II: Refine the sensor design to ensure robust, reliable operation in the required operational environments. Design a robust means of attaching the through-the-case sensor, with provision for sensor removal as required. Design a flexible sensor installation and removal procedure for the inlet aperture based sensor targeting the first stage fan on engine tests. Demonstrate full NSMS measurement capability by using the developed sensors on military gas turbine engine tests and correlate results with those from traditional NSMS sensor systems.

PHASE III: Finalize sensor integration with major DoD end users, airframe. and engine manufacturers and conduct necessary qualification testing.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This advanced sensing capability would significantly enhance the state of the art for commercial aviation engine tests requiring NSMS instrumentation. The technology is directly transferable to commercial gas turbine engine applications.

REFERENCES:
1. Vining, Charles R; Arnold, Steve A.; Hayes, Bryan W.; Howard, Robert P. "Comparison of Eddy Current Probes to Generation 4 Line Probes." http://www.hcf.utcdayton.com/HCF05_pdfs/14_0930_Hayes_paper.pdf
2. von Flotow, Andy. "NSMS in a High Pressure Turbine with Eddy Current and Fiber Optic Sensors." High Cycle Fatigue Conference. March 2005. http://www.hcf.utcdayton.com/HCF05_pdfs/11_0230_vonFlotow.pdf
3. von Flotow, Andreas; Drumm, Michael J. "High Temperature, Through the Case, Eddy Current Blade Tip Sensors." On-line Magazine 'Sensors & Transducers" (S&T e-Digest). Vol.44, Issue 6, June 2004, pp. 264-272. http://www.sensorsportal.com/HTML/DIGEST/P_34.htm

KEYWORDS: Turbine Engine; NSMS; Blade Vibration; Stress; Sensors; Flutter

TPOC: (301)757-0477
2nd TPOC: (301)757-0508

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

N06-023 TITLE: Automated Reasoner Technology for Managing Military Aircraft

TECHNOLOGY AREAS: Air Platform, Electronics

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop and demonstrate an automated reasoner technology to facilitate the efficient management of a fleet of military aircraft and the associated large volume of operational and maintenance data.

DESCRIPTION: Massive amounts of data must be analyzed and assimilated to accurately and effectively disposition a large fleet of military aircraft. Data of interest include operational data downloaded from the aircraft as well as maintenance and usage data related to the various aircraft subsystems. A great deal of valuable information is contained within these data sets. However, there does not exist a way to assimilate and analyze these data in a timely and meaningful manner. As a result, most of the data is not used. Innovative automated reasoner technology, capable of utilizing the vast amounts of data, is needed to determine the current capability and predict the future readiness of the asset, resulting in reduced operating costs and increased operating efficiencies.

Interactive data visualization technology has taken a step in the right direction by facilitating in the decision making process. However, due to the interactive nature of that technology, assimilation and interpretation of the high level data is still required. The goal of this topic is to develop and demonstrate automated reasoners that are more efficient and accurate, enabling the decision maker to leverage in an automated fashion the vast amounts of data that are currently under-utilized. Proposed solutions should extend beyond interactive data visualization and develop a reasoner that is capable of providing decision makers with the appropriate required actions, and not call for high-level interaction with data that still must be interpreted. Underlying and supporting technology of the automated reasoners should allow the analyst to easily drill down into the data via interactive data visualization for further offline study and to refine automated techniques. All developed data interfaces should conform to an open systems architecture approach. Such technology would provide the DoD with a greatly improved, reliable and repeatable process for the disposition of these aircraft.

PHASE I: Demonstrate the feasibility of designing automated reasoner technology for military aircraft application. Select the aircraft platform(s) and develop a case example for an aircraft propulsion subsystem.

PHASE II: Develop a prototype of the automated reasoner technology that will utilize operational as well as maintenance and usage data sets.

PHASE III: Finalize the automated reasoner technology implementation with DoD end users and airframe and engine manufacturers and conduct necessary qualification testing.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The methodology and technology have direct applicability to management of civil aircraft and commercial vehicles, and the techniques can be leveraged across industry as well as DoD.

REFERENCES:
1. The Joint Strike Fighter (JSF) Prognostics and Health Management.
http://www.dtic.mil/ndia/2001systems/hess.pdf
2. Data Visualization for Business Intelligence.
http://www.fyicorp.com/content/papers/Fleet_Management_Case_Study.pdf
3. Vandagriff, David (2004). "The Evolution of Data Visualization: From Dreary Digits to Dynamic Dashboards."
http://www.dmreview.com/editorial/newsletter_article.cfm?nl=bireport&articleId=1010516&issue=20075

KEYWORDS: Interactive; Visualization; Maintenance; Usage; Aircraft; Disposition

TPOC: (301)757-0508

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

N06-024 TITLE: Durable Conformal State Awareness Sensor Arrays for Extremely Harsh Environment Turbine Engine Components

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop and demonstrate the ability to fabricate durable, embedded, conformal sensors capable of measuring temperature, heat flux, and strain on turbine engine structures and rotating components, with operational capabilities up to 1,200°C. In addition, integrate energy harvesting and wireless communication capabilities with sensing capabilities to the maximum extent practicable.

DESCRIPTION: Modern aircraft turbine engines consist of an exceedingly complex array of engineering components, many of which are subjected to extremes in mechanical, thermal, and fatigue loads, as well as oxidizing and/or corrosive environments. The associated consequences on component life present a need for continuous monitoring of such loads on engine components. The goal of the proposed project is to demonstrate technologies that will enable low-cost, robust, reliable, embedded harsh environment sensors fabricated directly onto structural and rotating components without impact on structural integrity. This technology should incorporate thermocouple, heat flux, and strain sensor arrays and have the durability to withstand high temperatures, vibration, and thermo-mechanical loads associated with aircraft turbine engines. Accuracy of the technology and ability to be embedded within thermo-structural coatings and directly onto new and legacy components of complex geometry are essential to this project. This expanded sensor utilization in propulsion engines and structural components will allow a paradigm change from the current passive or reactive mode of operating and maintaining propulsion systems based on a pre-determined set of rules, to a proactive method based on ”state awareness” and knowledge of operating components in situ. This will not only improve the operating conditions and life management aspects of turbine engines, increasing reliability and safety, but also provide a unique new means of condition monitoring and machinery prognostics. The goal is to develop autonomous sensors capable of harvesting energy and communicating sensed parameters wirelessly. Teaming with an original equipment manufacturer (OEM) is strongly encouraged.

PHASE I: Determine feasibility of incorporating sensor arrays that are durable, accurate, and capable of being embedded into engine components. Testing should include realistic cyclic conditions for targeted components.

PHASE II: Develop a prototype technology and perform experiments, utilizing candidate turbine engine components, to demonstrate sensor functionality.

PHASE III: Finalize sensor integration with major DoD end users, airframe and engine manufacturers and conduct necessary qualification testing.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This advanced sensing capability would significantly enhance the state of the art in lifting methodology of gas turbine engine parts like blades, disks, and blisks.

REFERENCES:
1. S. Sampath, J. Longtin, R. J. Gambino, H. Herman, R. Greenlaw and E.Tormey; "Direct-Write Thermal Spraying of Multilayer Electronics and Sensor Structures", Direct-Write Technologies for Rapid Prototyping Applications, A. Pique and D. Chrisey (editors), Academic Press, 2002.
2. J. Longtin, S.Sampath, S. Tankiewzicz, R.Gambino, R.J. Greenlaw; "Sensors for Harsh Environments by Direct Write Thermal Spray", IEEE Sensors Journal, Vol. 4, No. 1 (2004).
3. R. DeAnna; “Wireless Telemetry for Gas-Turbine Applications, NASA/TM-2000-209815, March 2000.
4. K.H. Jung, J.W. Bredow, S.P. Joshi; "Electromagnetically Coupled Embedded Sensors, Proc. SPIE Vol. 3674, p. 148-156, Smart Structure and Materials 1999: Industrial and Commercial Applications of Smart Structure Technologies, Jack H. Jacobs: Ed.

KEYWORDS: Conformal Sensors; State Awareness; Harsh Environment; Embedded; Turbine; Engine

TPOC: (301)757-0508
2nd TPOC: (301)757-0477

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

N06-025 TITLE: Molding Technology for Low-Cost Infrared (IR) Chalcogenide Glass Optical Components

TECHNOLOGY AREAS: Materials/Processes, Sensors

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop innovative molding technology for low-cost infrared chalcogenide glass optical components that are consistently producible and meet cost parameters of existing and future government programs.

DESCRIPTION: Numerous military systems, such as infrared targeting pods and seekers, require infrared chalcogenide glass optical components. The unique optical properties of these materials often make their use necessary despite the challenging and costly fabrication steps required to meet engineering specifications. (These steps generally include grinding, polishing, and edging.) This extensive finishing operation does not support the cost goals of several military programs.

Numerous optical component manufacturers have demonstrated significant cost savings by implementing near net shape or net shape-type molding processes. By molding the optic into a shape very near the final specification (rather than producing a plano-type blank), fewer raw materials are required and a significant portion of the finishing process may be eliminated. To meet cost goals for IR chalcogenide glass optical components, the development of a molding process and associated technology is needed. Innovative tooling designs, equipment, and process parameters are desired to allow the production of low-cost IR chalcogenide glass components that meet dimensional and optical requirements for military systems.

Process improvements/modifications should not reduce the optical quality of the components. Seeker and targeting pod applications require excellent transmittance in the mid-wave infrared as well as excellent index of refraction homogeneity. Additionally, the index of refraction must change very little with any temperatures changes, i.e., the dN/dT for the components must be very near zero (<1e-6).

PHASE I: Determine the feasibility of developing processes, equipment, and tooling that would enable innovative net shape- or near net shape-type processing of IR chalcogenide glass optical components with the optical properties previously described. Determine the optical configuration that would enable the production of lower cost components. Estimate the cost savings associated with the improved processes based on a quantity of 2,000 IR chalcogenide glass optical components per year.

PHASE II: Demonstrate an innovative, lower cost production process by implementing the improved processes, tooling and equipment identified in Phase I. Based on this demonstration, estimate the cost savings associated with the improved processes based on a quantity of 2,000 IR chalcogenide glass optical components per year.

PHASE III: Insert the lower cost optical components into the Joint Strike Fighter and other military systems requiring IR chalcogenide optical components.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Technology improvements would benefit the manufacture of commercial sensor lenses for non-contact IR temperature measuring devices. As the technology for uncooled IR sensors improves and their cost decreases, the need for IR chalcogenide glass lenses in man-portable and process control applications will likely increase.

REFERENCES:
1. A.R. Hilton, et.al. in B.F. Andersen and M. Strojnik, ed., Infrared Technology and Applications XXIV, SPIE, Bellingham, WA, 1998, pp. 340-346.
2. A.R. Hilton, et.al in A.J. Marker, ed., Inorganic Optical Materials. SPIE, Bellingham, WA, 1998, pp. 47-59.
3. Y. Guimond, et.al. in R. Geyl, et.al., ed., Optical Fabrication, Testing, and Metrology, SPIE, Bellingham, WA, 2004, pp. 103-110.
4. Y. Guimond, et.al. in B.F. Andersen and G. Fulop, ed., Infrared Technology and Applications XXIX, SPIE, Bellingham, WA, 2003, pp. 807-813

KEYWORDS: Chalcogenide; Glass; Lenses; Infrared; Low-Cost; Molding

TPOC: (937) 904-4364
2nd TPOC: (301) 342-2398

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

N06-026 TITLE: Real-Time Maintenance Assessment Device and Post Data Analysis of Advanced Aircraft Coating and Composite Surface Integrity

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop the capability to remotely measure real-time emissivity, temperature, and radiance of aircraft coating/composite surfaces to support the rapid evaluation of aircraft coating surface integrity. Additionally, develop post-analysis software that would provide a comparative database of surface regions for each Navy aircraft that uses advanced coatings.

DESCRIPTION: The long-term operational degradation characteristics of advanced aircraft coatings are relatively unknown. Aircraft coatings designed to reduce thermal emissions are subject to degradation of their radiance properties as a consequence of exposure to different operational environments. Post analysis software is needed by aircraft to provide a means of rapidly measuring emissivity, temperature, and radiance distributions for various combat aircraft surfaces in order to determine possible needs for coating maintenance.   A robust, easy to use, hand held system with innovative analysis software would allow maintainers and engineers to analyze and compare each aircraft’s surface over time to determine and document coating degradation in the operational environment.

Currently, the Navy has devices capable of performing field infrared (IR) emissivity measurements at discrete points on aircraft surfaces, but performing an emissivity survey of an entire vehicle with such a point device would be excessively time-consuming in an operational maintenance environment. Innovative technology is needed that will provide the capability to accurately measure emissivity, temperature and radiances in real time while compensating for reflection(s) of the environment. Proposed solutions should be capable of providing real-time video output, weigh less than 10 lbs, be able to endure occasional rough handling, and survive the expected aircraft maintenance environment. It is recommended that the measurement/analysis device consist of commercial off the shelf (COTS) components when possible. It should also have the capability to determine which aircraft need surface coating maintenance and the environmental/operational conditions that cause degradation. Software developed to track advanced aircraft coating degradation characteristics over time should be comprehensive, user friendly and employ analysis tools that are compatible with current Navy databases.

PHASE I: Determine the feasibility of developing a device that can accurately measure emissivity, temperature, and radiance distribution measurements of actual combat aircraft surface areas in various background radiation environments within ±0.10 of calibrated values, using tabletop or functional prototype equipment. Demonstrate data analysis/comparison software capability and compatibility with current Navy database software.

PHASE II: Design, fabricate, and test a prototype of the needed aircraft surface emissivity, temperature, and radiance distribution measurement device that satisfies form, fit, function, and performance requirements. Design software analysis tools that will output data compatible with current Navy database software.

PHASE III: Accomplish initial measurement/analysis device production and analysis software for Fleet evaluation. Complete all support documentation for the device and analysis software, including user's manual, maintenance/repair manuals, and an operations/evaluation guide.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: A side benefit of knowing the emissivity distribution of surfaces is that the surface temperature distribution can also be determined radiometrically with unprecedented accuracy. Therefore, a device designed to measure emissivity can be used to measure temperatures very accurately for purposes of controlling commercial processes such as metal and plastics rolling, chemical reaction control, and food processing. Analysis software can be modified to provide real time monitoring of various products during manufacturing or in storage environments.

REFERENCES:
1. 'Measurement of thermal radiative properties of materials' by J C Richmond, in 'Compendium of thermophysical property measurement methods', vol. 1, by K Maglic, A Cezairliyan, V Peletsky (eds.), 1984, Plenum Press, New York

2. 'Thermal radiative properties of matter - the TPRC data series', vols. 7-9, by Y Touloukian & D DeWitt, 1970, IFI/Plenum, New York

KEYWORDS: Measurement; Infrared Camera; Emissivity; Infrared (IR); Paint; Coatings

TPOC: (732)323-2752
2nd TPOC: (732)323-1108

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

N06-027 TITLE: High Efficiency Radar Transmit Module

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-263 - UAVs

OBJECTIVE: Develop innovative technology with a high module (or building block) power output, that has the necessary characteristics to operate in a Class E or F radar transmit module.

DESCRIPTION: The efficiency of current radar transmitters for airborne surveillance systems is in the 20% to 30% range. The remaining 70% to 80% of the electrical energy that is generated to drive these devices must be removed as heat energy. The weight and fuel consumption associated with the generation of this unused electrical energy, and its removal as heat energy results in increased airborne system costs and/or reduced aircraft performance. These impacts are exacerbated by the reduced size and increased altitudes associated with high-altitude, long-endurance unmanned air vehicles (UAVs), where propulsion and power generation are principal cost drivers. Further, the increased demand for greater surveillance capability in the form of long-range detection of low observable air targets continues to drive power requirements to higher and higher levels.

The conventional approach to achieving kilowatts of peak power is to combine lower power devices, typically in a parallel corporate feed, to achieve the desired transmit power levels. There is a significant penalty associated with configurations of this nature, due to the RF losses inherent with the combining networks. The higher power requirements necessitate more combining networks with commensurately higher power losses. One approaches a point where the dissipation in the combining networks must be addressed as part of the overall system thermal design, impacting the capacity of the cooling system. Consequently, a comprehensive approach to both improving high power amplifier efficiency, and developing the highest module (or building block) power output is required to reduce the number of combining networks required to achieve the ultimate transmitter peak power. The focus of this development effort is on Class E or F High Power Amplifiers (HPAs) at the UHF frequency (405-450 MHz).

PHASE I: Demonstrate feasibility of proposed technology in a laboratory breadboard experiment and evaluate with respect to stated performance objectives.

PHASE II: Develop and demonstrate a prototype HPA circuit module that addresses the electrical objectives stated above and the thermal requirements that will satisfy reliable long-term operation within operational flight environments of next generation UAVs. Efficient packaging for multiple module integration should implement combiner networks to minimize RF losses, which will subsequently impact total efficiency of the HPA multi-module configuration.

PHASE III: Refine design as necessary and incorporate into a high power amplifier module design. Integrate and demonstrate modules to implement an operating UHF high power radar transmitter. Transition technology into an operational radar transmitter.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The high efficiency transmit modules should have application to all comercial avionics manufacturers, all commercial radar applications, and all marine radar applications.

REFERENCES:
[1] T.B. Mader and Z.B. Popovic, “The Transmission-Line High-Efficiency Class-E Amplifier”, 1999 IEEE M&GWL, Vol.5, N0.9, pp.290-292, Sept. 1995.
[2] R. Tayrani., “A Monolithic X-band Class-E Amplifier”, IEEE GaAs IC Symposium Digest 2001, pp.205-208
[3] T. Quach, et al., “Broadband Class-E Power Amplifier for Space Radar Application”, IEEE GaAs IC Symposium Digest 2001, pp.209-212
[4] Agilent Advanced Design Systems (ADS), V.1.7, & Agilent ICCAP, V.5.4.

KEYWORDS: Radar Trasmit Module; High Efficiency; Power Module

TPOC: (301)342-9094
2nd TPOC: (301)757-5881

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

N06-028 TITLE: Improved Electro-Optic Materials for High-Frequency Sensors and High-Speed Optical Switches

TECHNOLOGY AREAS: Sensors, Weapons

ACQUISITION PROGRAM: PMA-242, Direct & Time Sensitive Strike Program.

OBJECTIVE: Develop a new class of non-intrusive sensors that measure mid- to low-level temporal-electromagnetic fields (E-fields) for field tests for high power microwave (HPM) weapon development. This will create a new class of sensors that currently do not exist.

DESCRIPTION: The relatively new field of directed energy technology, and specifically HPM, has unique characteristics that make testing and understanding of this technology difficult. Non-intrusive E-field probes with better sensitivity and higher frequency responses need to be developed for measuring and characterizing HPM effects on test objects and targets. As new HPM devices are developed, new instrumentation to measure HPM effects for both development and protection are needed as well. Currently, electric-field (D-dot) probes are commonly used to measure the HPM wave front outside a target. However, these probes are insensitive to electric fields having strengths less than about 0.5 volt per meter (V/m) even at relatively low frequencies of less than about 10 gigahertz (GHz), and they are too large to install inside targets. Since the electromagnetic wave front changes as it propagates inside a target, new probes that can be installed inside a target must be developed. Additionally, new sensors must receive both horizontally and vertically polarized signals and be capable of processing large field strengths without arcing or distorting the HPM waveform. New probes that sense the horizontal and vertical components of the electric field inside a target over the full frequency range (100 MHz – 96 GHz) are required.

There are currently two classes of non-intrusive E-field probes: dipole-type and electro-optic (EO) effect-type sensors. None of the manufacturers of either type of probe have a standard product that can accurately measure E-field strengths that are necessary for testing HPM weapons and HPM protection programs (commercially available EO effect -type probes currently are limited to > 0.1 V/m at frequencies < 20 GHz). New materials need to be developed for high-frequency, high-sensitivity EO devices such as the E-field probes needed for HPM. Candidate materials include, but are not limited to, polymers with dendritic chromophores, ferroelectric relaxors such as lead magnesium niobate (PMN), lead zirconium niobate (PZN) and mixtures of these ferroelectric relaxors, and other electroceramics such as lead lanthanum zirconium titanate (PLZT).

PHASE I: Demonstrate the feasibility of candidate EO-active material(s) for new development of non-intrusive E-field probes.

PHASE II: Develop new probes. Build and demonstrate a prototype sensor module using the newly developed probes.

PHASE III: Transition new E-field probes throughout the directed energy community for integration into HPM instrumentation suites used for field-testing and analysis.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The area of HPM testing and development is continuing to grow and require new field probes in order to understand the test environment. This technology could also be used for lightweight microchip laser gimbal-less photonic radar (LADAR) for remote sensing and surveillance to support unmanned aviation and Homeland Security as well as high-speed secure optical communication devices.

Electro-magnetic compliance (EMC) and electro-magnetic-interference (EMI) shielding have become important safety issues for the telecommunication and broadcast industries. Recommended human-safety limits for exposure to electromagnetic radiation depend on frequency. For example, the recommended workplace exposure limit is about 1000V/m for a frequency of 100kHz and only 60V/m for a frequency of 400MHz. Most commercial microwave ovens operate at 2.45GHz, cellular phones operate in the frequency range from about 100MHz to 1GHz and satellite phones operate from about 1GHz to 18GHz. Manufacturers of microwave ovens, satellite and cellular phones would benefit from the development of non-intrusive E-field probes with better frequency discrimination, sensitivity and spatial resolution for measuring EMI and EMC during and after product development. Private-sector activities that would benefit from improved E-field probes include banks, insurance companies and hospitals that must protect computer data from accidental or deliberate exposure to high-strength E-fields. Commercial airports and airlines are concerned about monitoring and shielding aircraft avionics from the weak EMI generated by electronics and telecommunication devices. Sensitive, lightweight, remote sensors are needed for measuring E-fields near high-voltage towers to ensure human-safety limits are never exceeded.

There are many medical devices that would benefit from improved EO materials. Non-intrusive, EO-based sensors are being developed to measure small temperature changes during RF- and microwave-hyperthermia treatment of cancerous and non-cancerous tumors. Electrocardiography and electro-encephalography would benefit from the development of non-intrusive, miniaturized E-field probes that have better sensitivity and spatial resolution.

REFERENCES:
1. NAWCWD White Paper July 2005. Non-Intrusive E-Field Probes and New Inorganic-Thin-Film Electroceramics and IR-TCOs, Linda Johnson and Mark Moran
2. SYSTEM ENGINEERING DESIGN OF A HIGH POWER MICROWAVE TEST RECEIVER, 15 November 2004, D. Curtis Schleher, LCDR W. L. Rodgers, CAPT C. Krajacich
3. NAVAIR response to FY Defense Appropriations Bill Senate Report 108-284, 24 June 2004

KEYWORDS: High Power Microwave; Directed Energy; Electro-Optics; D-Dot; Probes; Sensors

TPOC: (760)939-2359
2nd TPOC: (760)939-8942

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

N06-029 TITLE: Restraint Factor-Compliant Installation/Retention of Cargo and Mission Equipment in USN/USMC Rotary and Fixed Wing Transport Category Aircraft Cargo Bays

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: V-22

OBJECTIVE: Design and develop an innovative system that offers cargo restraint load factor compliant installations of both palletized and wheeled cargo in cabin areas of medium- and heavy-lift helicopters/tilt rotors, as well as fixed-wing transport category aircraft.

DESCRIPTION: Installation of cargo in USN/USMC aircraft is required to meet load factor retention criteria for cargo and mission equipment. Cargo must be restrained to 4g's forward, 3g's aft, 3g's laterally, and 3g's vertical. Mission equipment must be restrained to 20g's forward, 20g's vertically, and 10g's laterally. Typical installations to date rely heavily on the use of traditional tie-down chains and straps. Due to the uniaxial load reaction capability of these elements, unmanageable numbers of chains or straps are often required to comply with the multi-axial load factor retention criteria. Large numbers of chains or straps increase times required to load and unload.

Innovative design advancements are sought in materials and devices to create a cargo and mission equipment restraint concept. This concept should allow for rapid loading and unloading of equipment and may interface with existing aircraft structure, such as tie down rings and rail locking systems, if desired. The restraint concept may transfer loads directly into existing aircraft structure, or utilize energy absorbing devices to reduce the load into the structure. The overall concept should be adaptable for differing g-level restraint capability (up to the mission equipment requirements) to account for future unpredicted equipment needs.

PHASE I: Demonstrate proof-of-concept of proposed design. Demonstrate feasibility to provide for load factor compliant retention of typical USN/USMC palletized and wheeled cargo in rotary-wing aircraft. Address both cargo-to-device and device-to-aircraft interfaces for all loads.

PHASE II: Develop a prototype and perform a stress analysis of all of the structural components for the load factors defined above.

PHASE III: Evaluate design enhancements and transition the system for both production and retrofit incorporation in all V-22 aircraft and H-53 aircraft. Additional static test certification may be required for unusual or complex structural components/joints prior to production incorporation.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: A proven, more efficient, user-friendly system could find application in commercial shipping companies and fleets. Such a system will be more crashworthy than current commercial equipment retention. Companies such as Fedex, UPS, DHL could greatly benefit from a more innovative solution.

REFERENCES:

1. MIL-STD-1366, Department of Defense Interface Standard for Transportability Criteria
2. MIL-STD-209, Department of Defense Interface Standard for Lifting and Tiedown Provisions
3. MIL-HDBK-774, Department of Defense Handbook Palletized Unit Loads
4. USAAVLABS Technical Report 66-50, Aircraft Cargo Restraint System, by A. Russo, of September 1966.

KEYWORDS: Cargo; Restraint; Tiedown; Mission Equipment; Retention; Load Factor

TPOC: (301)342-1009
2nd TPOC: (301)995-4983

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

N06-030 TITLE: Effects of Defects in Ceramic Composites

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop innovative technology that will provide the capability to evaluate the effects of defects in ceramic matrix composites (CMCs).

DESCRIPTION: The Joint Strike Fighter and other military platforms are considering (CMCs) for engine applications, where their low density and high temperature capability offer performance benefits. CMCs are relatively immature materials as a class, with a variety of development issues remaining. In order to efficiently fabricate, evaluate, predict life, and evaluate cost of these materials, improvements in material understanding are required, specifically in the area of effects of defects. Technology is required that can identify and evaluate the effects of various defects in CMCs. There are at least two significant aspects to this requirement. First is identifying and quantifying the position and extent of flaws using one or more nondestructive evaluation (NDE) techniques. Second is evaluating the effect of a given defect on the material/component properties; this will require material and defect modeling at some level. Ideally, both the identification and the quantification of defects should be accomplished rapidly, so that the methodology is applicable to in-process evaluation as well as evaluation of components that are in service. Teaming with a composite fabricator and/or engine manufacturer is recommended to ensure that issues are addressed adequately.

PHASE I: Demonstrate the feasibility of the proposed defect identification and evaluation approach. Ensure that both aspects of the problem are addressed. Limited correlation to actual test results should be accomplished. Identify a material and application/component for demonstration of the technology in Phase II.

PHASE II: Optimize the effects of the defects methodology developed in Phase I. Customize both the equipment and the software as required for the selected component. Validate both the flaw identification and flaw impact quantification through mechanical testing of significant numbers of samples/components. Develop a flaw-impact database as required to optimize the analysis. Perform a cost analysis of applying the methodology developed to the identified component.

PHASE III: Optimize and commercialize the evaluation system and methodology for the chosen component(s). Extend the analytical model to account for flaw orientation and position within a component. Undertake the demonstration necessary to qualify the NDE process. Modify the existing material process specifications to include the NDE process.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology and understanding developed (hardware and software) about the effects of defects will be applicable to virtually all CMC applications including military and commercial aircraft engine components and a variety of industrial applications where the high temperature capability of CMCs makes them desirable.

REFERENCES:
1. Sun, Erdman, Russel, Deemer, Ellingson, Miriyala, Kimmel, and Price. "Nondestructive Evaluation of Defects and Operating Damage in CFCC Combustor Liners." Ceramic Engineering and Science Proceedings, 23, 3, 2002, pp. 563-569.

KEYWORDS: Ceramic Matrix Composites; Nondestructive Evaluation; Defects; Modeling; Mechanical Properties; Cost Reduction

TPOC: (937)255-9800
2nd TPOC: (937)255-9818

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

N06-031 TITLE: <u>Process Automation for Ceramic Composite Fabrication Methods</u>

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop and demonstrate equipment and/or approaches for automation of ceramic matrix composite (CMC) fabrication processes.

DESCRIPTION: Various military systems are exploring CMCs for high-temperature structural applications such as in turbine engines, where their low density and high-temperature capability offer performance benefits relative to conventional materials. As an emerging class of materials, the processing methodologies for CMCs are relatively immature and have not been optimized for a production environment; numerous process steps need improvement. As a result, processing is expensive; touch labor is high, throughput is low, tooling requirements are extreme, and cycle time is excessive. Development of innovative manufacturing processes and/or equipment is required for increased automation to reduce the cost and time associated with processing and increase the throughput. A clear understanding of materials and processes of interest, targeted engine components, status of existing capability, and areas of particular need is critical; teaming with an engine company and/or material supplier is highly recommended.

PHASE I: Explore automation approaches and equipment for the selected process(s) to demonstrate increased throughput, reduced cycle time, simplified/reduced tooling, and cost savings on one or more CMCs. Iterate as necessary to demonstrate significant improvement without material degradation.

PHASE II: Continue to optimize the selected process(s). Design and build prototype automation equipment (if applicable), select a representative component that requires a range of representative processing operations, and demonstrate the capability of the improved process/equipment. Process no less than ten of the selected components as if in production to demonstrate throughput, cycle time, and other relevant parameters. Perform a cost analysis of the final automated process.

PHASE III: Based on the Phase II results and cost analysis, optimize the processing methodology and/or equipment for the chosen component(s). Undertake the demonstration necessary to qualify the improved manufacturing process. Modify the existing material process specifications as required.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The process automation technology developed here will be applicable to numerous CMCs with applications ranging from military and commercial aircraft engine components to industrial heat treatment, wear, and corrosion components where the low density, chemical inertness, and high-temperature capability of CMCs make them desirable.

REFERENCES:
1. Nageswaran and Bruce, "Low Pressure Injection Molding Process for Near-Net Shape, Hot Gas Filter Components," Ceramic Engineering and Science Proceedings, 23, 4, 2002, pp. 51-59.
2. Ventura, Narang, Twait, Lange, Khandelwal, and Cohen, "Solid Freeform Fabrication and Design," Ceramic Engineering and Science Proceedings, 21, 4, 2000, pp. 111-120.

KEYWORDS: Ceramic Matrix Composites; Process Automation; Manufacturing; Reduced Cycle Time; Tooling; Cost Reduction

TPOC: (937)255-9818
2nd TPOC: (301)342-9355

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

N06-032 TITLE: Thermal Barrier Coating Environmental Durability Enhancement (CMAS)

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop advanced thermal barrier coatings (TBC), enabling improved resistance to calcium magnesium aluminosilicate (CMAS), and methodologies to deposit them onto complex components.

DESCRIPTION: CMAS is a common material that is ingested into turbines and deposits onto airfoil surfaces. In the turbine section, CMAS can form a molten glass at temperatures above 1250C. The CMAS wets the outer insulating layer, or 7YSZ, of the current TBCs and infiltrates the inner porous layers. Below the coating surface, the CMAS solidifies resulting in a loss of strain tolerance of the top coat and a subsequent reduction in the lifetime of the TBC. As surface temperatures increase, the depth and severity of CMAS penetration into 7YSZ increases. CMAS induced TBC failures are anticipated to become more frequent as the operating temperatures of aircraft engines continue to rise. As a result, improved resistance to this type of attack is required.

Novel approaches are required to mitigate the effects of these deposits. Previous work has shown that alumina can raise the melting point of deposits and provide some mitigation, but may not be the only solution. Approaches for non-alumina materials for mitigating high-temperature deposits may also be promising.

PHASE I: Demonstrate the feasibility of using advanced TBCs to enhance protection against CMAS. Devise an innovative processing approach and demonstrate proof-of-concept for applying the coating to complex engine components.

PHASE II: Optimize the TBC and coating process. Develop a prototype that enables advanced CMAS resistant TBCs to be applied onto complex engine components. Demonstrate the performance of the optimized coating by applying it onto components suitable for engine testing.

PHASE III: Complete the development effort and transition technology to military propulsion original equipment manufacturers (OEMs).

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial jet engines are experiencing this degradation mechanism. All engines that employ TBCs will benefit from this technology.

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KEYWORDS: Thermal Barrier Coating; TBC; Calcium Magnesium Aluminosilicate; CMAS; JSF; Environmental Coating

TPOC: (301)342-8010
2nd TPOC: (301)342-8072

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

N06-033 TITLE: Innovative Ceramic Matrix Composite (CMC) Joining and Attachment Technology

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop innovative approaches for attaching and assembling CMC's to metallic engine components.

DESCRIPTION: The Joint Strike Fighter and other military platforms are considering ceramic matrix composites (CMCs) for engine applications due to their potential for higher temperature capability, weight reduction, and durability improvements. CMCs present design challenges due to their anisotropic properties, generally low interlaminar and bearing strength, low thermal expansion compared to metals (to which they are attached), low thermal conductivity, and limited strain tolerance. New and innovative attachments and restraint methodologies are required to minimize these limitations. In particular, it is often desirable to have the actual attachment device be made of CMC and possibly in part integral with the CMC component. Innovative attachment configurations, fiber reinforcement architectures, and processing are required as well as self-positioning, self-aligning restraint designs that minimize internally induced stresses and directionally restrain the component to direct and/or limit load transfer. Innovative CMC structures and/or fiber architectures may also be part of the solution, providing local stiffening (tailoring) and integral attachment features of components adjacent to areas being joined. The proposed efforts should ensure that realistic material and component types of interest are considered, reasonable analysis boundary conditions are employed, and feasible and practical attachment approaches are developed.

PHASE I: Develop an innovative attachment concept for an engine component that would benefit from a CMC application, but where a joining approach is required as a critical enabler. Determine feasibility through analysis, fabrication and testing of sub-element samples under thermal and vibratory environments.

PHASE II: Design, fabricate, and test prototype samples to a specific component to thoroughly validate the capability of the approach. Test a component employing the joining methodology in a representative rig or engine environment to validate the approach.

PHASE III: Optimize the attachment/restraint methodology. Productionize and qualify the improved component.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The attachment/restraint and design methodology developed will benefit a broad range of CMCs with applications that include military and commercial aircraft as well as various industrial applications such as ground transportation and power generation.

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7. S. Steven Lee, Larry p. Zawada, James M. Staehler and Craig A. Folsom "Mechanical Behavior and High-Temperature Performance of a Woven Nicalon/Si-N-C Ceramic Matrix Composite" J. Am. Cer. Soc. Vol. 81 No. 7, 1998.

KEYWORDS: Ceramic Matrix Composite (CMC); Joining; Fastening; Attachments; Modeling; Joint Strike Fighter (JSF)

TPOC: (301)342-9343
2nd TPOC: (301)342-9355

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

N06-034 TITLE: Fatigue Enhanced Weld Repair of Titanium (Ti) Alloy Integrally Bladed Rotors (IBR) /Blisks

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop enabling technology that delivers a practical weld repair solution that will meet or exceed fatigue requirements of airfoils in an integrally bladed rotor (IBR)/Blisk.

DESCRIPTION: State-of-the-art military turbine engines incorporate IBRs, which are one piece components consisting of blades and a disk (Blisks), in the compression system aimed at reducing weight through part count reduction, improved performance, and maintainability. However, to maintain affordability of these IBRs/Blisks resulting from foreign-object damage (FOD) to the airfoils, the need for weld repairs of either partial or full blades is warranted to avoid expensive IBR/Blisk replacements. No adequate technology exists today to repair fielded engines. For alloys commonly used in fans and compressors, current pre- and/or post-weld heat treatment practices, as part of the repair of airfoils, result in unacceptable micro-structural degradation in the highly stressed disk portion of the IBRs/Blisks. Exposing the undamaged airfoils to needless heat treatment at every repair leads to significant reduction in their structural capability. A novel and enabling weld repair technology that will permit independent repair and optimization of airfoil and disk material properties is needed to retain and restore the high cycle fatigue (HCF) characteristics of IBRs/Blisks. The technology should be able to meet these requirements in addition to addressing affordability and maintainability requirements of advanced military propulsion power plants.

PHASE I: Conceptualize, evaluate, and determine the feasibility of repair techniques that will restore the airfoils in an IBR/Blisk to their original material properties after a FOD event. Demonstrate cost-effectiveness of the proposed technique. Identify hardware and tools needed for the procedure. Evaluate improvements over current repair methodologies.

PHASE II: Enhance the process developed during Phase I. Demonstrate the technique and subsequent improvement in structural integrity and HCF performance in a rig and engine environment. Address potential adverse affordability issues and identify mitigating solutions.

PHASE III: Integrate the technology into a manufacturing environment at an original equipment manufacturer (OEM) or depot.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Modern turbine engines used in today's commercial aircraft utilize IBRs/Blisks both as a cost saving (fewer parts) and weight reduction effort. These aircraft would benefit from an innovative repair technique that would extend the life of the IBR/Blisk.

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3. D. W. Crall, P. J. Linko, C. English, and B. Busbey (GE Aircraft Engines, Cincinnati, OH); AIAA-1998-3416 "Laser twist weld repair of compressor blisk airfoils", AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 34th, Cleveland, OH, July 13-15, 1998.

KEYWORDS: Integrally Bladed Rotor; IBR; Blisk; Compressor; Weld Repair; Heat Treatment

TPOC: (301)757-0472
2nd TPOC: (301)757-0473

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

N06-035 TITLE: Lift Fan Gearbox Corrosion Monitoring System

TECHNOLOGY AREAS: Air Platform

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop a low-cost, lightweight corrosion (and/or corrosion exposure) monitoring system for the gearbox internal environment.

DESCRIPTION: State-of-the-art gas turbine engine bearing and gearbox steels are subject to significant rejection rates due to corrosion. Despite special handling, preservation, and packaging, and an oil lubricated operating environment, the low chromium content permitted in conventional high-strength steels renders the steel non-stainless. Newer alloys are being developed, such as Pyrowearâ 675, that offer corrosion resistance, but are limited by cost and material characteristics not suitable for all required applications.

Recent statistics from the engine overhaul depots indicate that greater than 50 percent of the bearings are rejected. Approximately 40 percent of these rejections are due to corrosion. For naval applications, the rejection rate is even higher. Such corrosion leads to premature surface crack initiation and spalling that cascades into accelerated surface damage, high vibration, and eventual catastrophic bearing failure. The JSF lift fan gearbox is particularly vulnerable as intermittent high- and low-temperature operation of the gearbox may allow moisture build-up in the lubrication system causing corrosion. There is currently no way to automatically detect a corrosive environment or monitor the corrosion of the bearings, gears, and other critical components.

A system that provides early detection of corrosion will significantly increase the operational capabilities, reduce the total ownership cost (TOC), and improve system readiness. Prognostic health monitoring (PHM) methodologies are required, providing Fleet maintenance personnel with early warning and corrective action procedures prior to significant component degradation.

PHASE I: Determine the feasibility of developing innovative methods and technologies to detect corrosion and monitor a corrosive environment in the gearbox compatible with current PHM philosophy. Design, fabricate, and test critical elements of a prototype system.

PHASE II: Refine the Phase I results. Develop a PHM methodology for monitoring corrosion. Design, fabricate, and test a prototype system compatible with the JSF lift fan.

PHASE III: Complete testing of a full-up corrosion monitoring system. Verify PHM methodology.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would benefit all commercial helicopter gearbox and turbine engine applications.

REFERENCES:
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2. http://www.dodcorrosionexchange.org/References/Files/GAO_Corrosion_Report_July03.pdf
3. http://www.gears-manufacturers.com/steel-gears.html
4. http://www.jsf.mil

KEYWORDS: Corrosion; Gearbox; Bearings; PHM; Lift Fan; Gas Turbine Engine

TPOC: (301) 342-0892
2nd TPOC: (301) 342-0873

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

N06-036 TITLE: Advanced Techniques for Digital Radio Frequency Memories (DRFM)

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop new state-of-the-art techniques and target generation capabilities utilizing an innovative DRFM architecture containing flexibility, programmability and other enhancements.

DESCRIPTION: The DRFM kernel capability employed in the current generation of threat simulation systems continues to provide an up-to-date set of capabilities in its essential performance parameters. However, the basic DRFM architecture is about 15 years old and only offers a rather simplistic set of deceptive jamming waveforms. The nature of threat radar systems has continued to increase in sophistication within recent years and now needs to be challenged by a more robust deceptive jamming capability. The new DRFM architecture concept should also be flexible and reprogrammable in its ability to generate the necessary target sets and provide for the inclusion of pathways for growth enhancements.

The current DRFM architecture implementation does not allow for a multi-threat environment. Due to wide proliferation of DRFM technology, the threat simulation community needs the ability to provide DRFM jamming in a multi-threat environment. In order to accomplish this goal, the proposed DRFM architecture concept must provide increased functionality such as the capability to define a threat library including, but not limited to, frequency, range of Pulse Width (PW) and Pulse-Repetition Frequency (PRF), and Effective Radiated Power (ERP).

The measured parameters of frequency, PW, Pulse-Repetition Interval's (PRI), and ERP (possibly others) would allow the user to replicate the required set of modern false target generation techniques simultaneously on all threats. The proposed DRFM kernel technology should be capable of tracking multiple threat PRI and distinguish them in such a manner that one deceptive countermeasure can be initiated on one threat PRI, while operating a different and completely independent deceptive countermeasure on another threat PRI. The DRFM will thus act like two DRFM's in operation against two separate threats, simultaneously.

The proposed DRFM kernel should have the capability of generating generic techniques that exist today, as well as advanced techniques. Generic techniques include Range Gate Stealer (RGS), Velocity Gate Stealer (VGS), linear, parabolic, and time-varied acceleration. The user must have the capability of specifying kinematically coordinated or uncoordinated range and Doppler waveform for any generic technique.

The DRFM kernel should provide the user with the ability to create an arbritrary range and Doppler walk waveform. From this, the user will be able to create complex and advanced false target generation techniques.

PHASE I: Demonstrate the feasibility of a DRFM based design capable of operating in deception jammers that provide the ability to replicate the required set of modern false target generation techniques.

PHASE II: Develop and test a prototype incorporating the new DRFM design architecture. Provide a description of the growth capability and develop a preliminary production design and cost estimate.

PHASE III: Transition the DRFM architecture to a Navy target and/or radar system.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The expansion of the capabilities of modern DRFM capabilities will have a direct application to the entire range of commercial products that will utilize this technology.

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1. Digital Radio Frequency Memory (DRFM) specification 13672-ATS676E
2. Watson, C.J., "A Comparison of DDS and DRFM Techniques in the Generation of 'Smart Noise' Jamming Waveforms,"
Naval Post Graduate School Masters Thesis, Monterey, CA. http://www.stormingmedia.us/81/8124/A812423.html
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http://www.stormingmedia.us/64/6480/A648003.html?searchTerms=goufu~

KEYWORDS: DRFM; False Target Generator; Electronic Warfare (EW); Radio Frequency (RF); Threat Systems; Jamming

TPOC: (805)989-5971
2nd TPOC: (805)989-4876

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

N06-037 TITLE: <u>Digital Voice Technology Development</u>

TECHNOLOGY AREAS: Electronics

OBJECTIVE: Develop innovative digital voice communications technologies for integration into existing and future air traffic control (FATC) systems.

DESCRIPTION: Digital voice and data messaging over the data link will be used for communications and control with Joint Precision Approach and Landing System (JPALS) equipped air platforms, such as the Joint Strike Fighter (JSF). In order to work seamlessly along with other military and commercial aircraft, digital voice technology must be integrated such that future air traffic controllers can use a single high-quality headset to communicate with all aircraft under their control. For JPALS aircraft, some of the controllers’ voice commands are converted to a digital signal and transmitted over the data link. For non-JPALS aircraft, an analog signal must be transmitted. In the JPALS aircraft, the digital signal is converted back to analog so that the pilot in the aircraft can hear the controllers’ voice commands or instructions.

Digital voice involves converting a voice analog signal to a digital format for transmission. The digital bit stream is transmitted to the destination via fiber, wire, data link, or other wireless method using a variety of protocols. After successful reception at the destination, the digital format is restored to an analog signal that approximates the original sound that may be heard over a loudspeaker or headset. This technology is frequently referred to as voice over IP (VoIP) for airborne networking waveform (ANW) applications or voice over data link (VODL) for link-dependent applications. Compression techniques and data packet transmission techniques are a concern for these systems. In addition, the digital voice must be capable of working over emission control (EMCON) data link systems. Digital voice will be one of the primary methods that air traffic controllers use to communicate with manned aircraft. Digital voice may also be used for intercom tasks.

Proposed digital voice technology should be compatible with the ANW and JPALS data link. The message formats and data sent over the ANW and JPALS data link should be compatible with other DoD and commercial messaging systems where applicable. The proposed technology should also be compatible with the DOD global information grid (GIG) and envisioned net-centric operations and warfare (NCOW) methods. It would be beneficial to use existing data transfer (i.e. messaging) systems when possible.

PHASE I: Demonstrate feasibility of proposed digital voice technology to meet requirements of future air traffic control (ATC) systems.

PHASE II: Develop, build, and test a prototype of the technology.

PHASE III: Install the prototype in the Navy FATC lab for demonstration and testing. Multilevel security issues should be investigated and resolved where classified and unclassified systems interface. If needed, firewalls should be designed, developed, and tested.

Subsequent installations should support flight test demonstrations through integration with the ANW/ JPALS data link, ATC console, landing safety officer (LSO) workstation, and primary flight control (PriFly) communication system.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Digital voice technology will have broad application to commercial ATC, the Internet and telephone industry.

REFERENCES:
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2. Hillenbrand, M.; Zhang, G.; “A Web services based framework for voice over IP”; Euromicro Conference, 2004. Proceedings. 30th 31 Aug.-3 Sept. 2004 Page(s):258 - 264.
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KEYWORDS: Digital Voice; Voice Over Data Link; Air Traffic Control; Global Information Grid; Net Centric Warfare; Communications

TPOC: (407)380-4699
2nd TPOC: (301)995-8272

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

N06-038 TITLE: Multi-Purpose Antenna

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: E-2 Advanced Hawkeye

OBJECTIVE: Develop a multi-function antenna that can condense the current very high frequency/ultra-high frequency (VHF/UHF) line-of-sight, UHF satellite communication, L-band and global positioning system (GPS) functions into a single airborne aperture that can be used on a Navy aircraft like the E-2C.

DESCRIPTION: Currently the E-2C is covered with antennas for VHF/UHF line of sight, UHF satellite communications, L-band and GPS functions. There is a need to condense some of these functions into a single aperture to free up real estate on the aircraft for future additions and cut down on interference between the antennas. Combining these functions into a single multi-function antenna is the design goal. The multi-function antenna should have the following features:

VHF/UHF line-of-Sight Communications

Vertical polarization, omni-directional, transmit and receive, 30 W CW power handling, 50 ohms impedance
30-88 MHz, -15 dBi (30 MHz), -5 dBi (88MHz), 2.5:1 VSWR
118-174 MHz, -5dBi average, 2.0:1 VSWR
225-400MHz, 0 dBi average, 2.0:1 VSWR

UHF Satellite Communications

Circular polarization, omni-directional, transmit and receive, 200 W continuous wave (CW) power handling, 50 ohms impedance
240-400 MHz, +5dBic, 2.0:1 vertical standing wave ratio (VSWR)

L-Band

Vertical polarization, omni-directional, transmit and receive, 50 W CW, 4 kW peak, 50 ohms impedance
960-1220 MHz, 0 dBi average, 960-1220 MHz 1.7:1, 1000-1100 1.4:1 VSWR

GPS

Right-hand circular polarization, omni-directional, receive only, 1.5:1 VSWR, 50 ohms impedance
L1- 1563-1588 MHz, 4 dBic peak gain, > -3.0 dBic @ 800 off boresight
L2- 1215-1240 MHz, 4 dBic peak gain, > -3.0 dBic @ 800 off boresight

The aperture design can be above aircraft mode line or below. Above mode line design goals would be no more than 10” high built with an aerodynamic form. Below mode line design goals would be a volume of no more than 15” X 15”X 6” cavity. The weight should not exceed 10 lbs for both designs. The radio function (RF) isolation between functions should be minimum of 40 dB. Each function should have a separate RF connector.

PHASE I: Demonstrate proof-of-concept of antenna design using either computer modeling and/or a fabrication of a laboratory model antenna system with limited measurement data.

PHASE II: Develop, fabricate, and demonstrate a prototype (laboratory model) antenna to design goals. If a laboratory model was developed during Phase I, demonstrate further maturity of the design.

PHASE III: Transition this antenna technology for airborne integration, operation evaluation, and production.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Technology developed under this effort will have applicability to unmanned air vehicles, multi-mission aircraft, and other military aircraft where multiple antennas are used and space is limited. This technology could be used in the private sector as well. It can be used with any vehicle that requires multiple antennas as a means to reduce the amount of individual antennas required.

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KEYWORDS: Antenna; Airborne; Communications; Satellite; VHF/UHF; GPS

TPOC: (301)757-2306
2nd TPOC: (301)342-9152

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

N06-039 TITLE: Innovative Smart Coating System for Detection of Impact and/or Thermal Damage on Aircraft Structural Composite Components

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35/Joint Strike Fighter

OBJECTIVE: Develop an innovative smart coating system capable of detecting and measuring impact and/or thermal damage on aircraft composite materials prior to scheduled inspection.

DESCRIPTION: Aircraft composite structural components are susceptible to impact and/or thermal damage. The structural integrity of the damaged composite component can be reduced drastically, even though it appears normal. Damage may occur in hard-to-inspect areas or prior to scheduled inspection. When damaged areas/components are identified, there is no capability to determine the extent of the failure and what, if any, repairs are necessary. Smart coating technology is sought capable of detecting impact and/or thermal damage as well as the ability to provide an indication as to the severity of the damage.

PHASE I: Provide proof-of-concept of the proposed smart coating system. Demonstrate feasibility to detect and indicate severity of the impact and/or thermal damage.

PHASE II: Develop and demonstrate prototype coating system on aircraft components in simulated environment where damage can be induced.

PHASE III: Further develop smart coating system for production. Prepare a complete package with a users manual, hardware and software for the system to be integrated onto Navy platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Smart Coating technology will have broad application in both the commercial and military aerospace industry where composite materials are used.

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http://howard.engr.siu.edu/staff2/abrate/yigit.htm

KEYWORDS: Coating; Nano Technology; Impact; Thermal; Chemically Emit; Smart Coating System

TPOC: (301)342-0296
2nd TPOC: (301)342-8002

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

N06-040 TITLE: Ultra-Wide band Antenna (UWBA) for Electronic Attack Aircraft

TECHNOLOGY AREAS: Sensors, Battlespace

ACQUISITION PROGRAM: EA-18G

OBJECTIVE: New innovative technologies are sought to increase the band coverage of the improved tactical jamming systems aboard the EA-6B/EA-18G aircraft.

DESCRIPTION: Current airborne tactical jamming systems must select jamming transmitters and antennas to cover the expected enemy system frequency ranges prior to a mission. Once airborne, they are unable to adapt to changes in an enemy environment. Advances in transmitter technology now allow multi-octave coverage from a single high-power amplifier. However the physics of conventional antennas limit the usable frequency range resulting in the need to "missionize" or install antennas to cover the expected threat. During maneuvers between the jamming aircraft and the threat, the jamming antenna system must have the ability to steer, or direct the beam onto the threat. This allows the antenna system to dynamically adjust the polarization and support high-radiated power. The ability to dynamically adjust beam width (gain) to match the threat environment would provide improved jamming capability. Advances in antenna technology, including antennas used to support measurement of UWB systems, may now allow a single antenna to provide multiple-octave coverage while maintaining the polarization control, gain, side-lobe suppression, and directivity over the entire frequency band. The airborne jammer used on EA-6B/EA-18G aircraft is the ALQ-99. It has two amplifiers, which attach to separate antennas. These fit inside a hardback that is mounted on the underside of the aircraft. The radome is only a fairing and is attached to the hardback. The current antennas attached to the amplifier use standard and some specific radio frequency (RF) connectors.

PHASE I: Develop a UWBA concept and demonstrate proof-of-concept and antenna effectiveness.

PHASE II: Develop, demonstrate, and validate a prototype antenna. Demonstration should include prototype capability with the actual jamming systems.

PHASE III: Prepare an antenna for ALQ-99 pod installation and flight test. The antenna must be packaged and qualified for the aircraft environment. Conduct and support ground, chamber, and flight tests to determine the antenna potential for operational effectiveness and suitability and provide documentation.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: UWB systems provide the potential for sharing of the electromagnetic spectrum by spreading the energy over a wide frequency band. Potential users include secure cell phone networks and wireless large-area networks.

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Foster, P.; Ultra Wideband Communications Technologies and System Design, 2004. IEE Seminar on, 8 July 2004, Pages: 69 – 88

KEYWORDS: Airborne; UWB Antenna; Broadband; Multi-Frequency Antenna; Multi-Band Antenna; Radio Frequency

TPOC: (805)989-3443
2nd TPOC: (805)989-3728

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

N06-041 TITLE: Miniaturized Commandable Impulsive Acoustic Source Technology for Multi-Static Anti-Submarine Warfare (ASW)

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: MH-60R

OBJECTIVE: Develop innovative miniaturized sensors capable of outputting a single impulsive signal, or multiple smaller impulses, in sequential fashion for the purpose of conducting multi-static ASW missions.

DESCRIPTION: Most ASW aircraft utilize A-size (4.875"D x 36"L) sources. While these A-size sources are effective, the weight and volume constraints of the MH-60R helicopter, UAV platforms, along with the littoral ASW threat of quiet diesel-electric submarines in noisy environments, require an aggressive approach to miniaturizing sensors to allow for the deployment of denser fields. The requirement is to carry a greater number of sensors enabling adequate field performance in spite of inevitably short detection ranges for passive and active vulnerabilities.

Some preliminary work has been done to document the considerable weight and volume savings that would result from the miniaturization and repackaging of certain present day sonobuoy sensors. The following potential areas of technology development have been identified:
· Miniaturization of the decelerator and floatation functionality
· Miniaturization of payload chemistry, deployment and initiation methodology for a single charge, or sequential multiple series of smaller charges (M of N).
· Miniaturization of the transmitter/receiver to fit in the limited volume of a MJU-10 form factor.
· Miniaturization of the power source technology that provides power for all source functions for the life of the source.

PHASE I: Determine design feasibility, developmental testing, or analogy computation and modeling of proposed innovative solution. Optimize the package configuration to minimize logistic issues. Establish volume budget for the technology developments with tolerances.

PHASE II: Develop, fabricate, demonstrate, and validate the prototype hardware capable of being packaged. Conduct performance testing such as:
· Air retardation and in-water floatation subsystem
· RF communication/command subsystem
· Power source subsystem
· Initiator/payload subsystem

PHASE III: In conjunction with sonobuoy vendors, integrate and transition the technologies into a logistically supportable miniature package that is compatible for air carriage and air drop with existing and future Navy launch platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The small size, low cost, and standardized form factor will enable use of these sensors for marine mammal surveys, commercial harbor defense, and drug interdiction of high speed drug smuggling vessels.

REFERENCES:

1. Program Executive Officer (PMA-299) Air ASW, Assault, and Special Missions Programs, “Technology Issues,” 25 Feb 02.
2. Littoral Anti-Submarine Warfare Concept, Naval Doctrine Command, 1 May 1998, http://www.fas.org/man/dod-101/sys/ship/docs/aswcncpt.htm
3. N88 “Air ASW Vision Statement”, at http://www.hq.navy.mil/airwarfare/Programs/N880E/Air%20ASW%20Vision%20Statement.htm
4. Mission Needs Statement for “Multi-Static Search System Compatible with Rotary Wing, UAV and other Weight and Volume Limited ASW Platforms, May 1999

KEYWORDS: Miniaturized Sensors; Multi-static Anti-Submarine Warfare (ASW); Chaff; Acoustics; Sonobuoys; Littoral

TPOC: (301)342-2044
2nd TPOC: (301)342-8796

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

N06-042 TITLE: Signal Processing For Dense Fields Of Miniature Impulsive Sources And Sonobuoy Receivers

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: MH-60R

OBJECTIVE: Develop a signal processing system for aircraft multi-static anti-submarine warfare (ASW) systems composed of dense fields of miniaturized sensors that can effectively detect and classify submarine echoes.

DESCRIPTION: The biggest challenge for impulsive active sonar systems is echo classification (i.e. something has been detected, but is it a submarine echo?). Unique signatures imprinted by a target on an echo have not been found, experimentally observed, or exploited. In fact, in shallow water much of the echo structure is caused by multiple bottom-interacting propagation paths from the source to the target, and then, from the target to the receiver. The longer the range, the more times the paths will hit the ocean bottom and the more severe the distortion of the target signal will become. In addition, different bottom compositions will lead to different looking and sounding echoes, further adding to the confusion. Most impulsive sonar systems are designed for maximum area coverage and must work at long ranges that extend over 40 km. As absorption (transmission loss) in the water increases quickly with range and frequency, the long-range requirement limits the bandwidth available to the system for target detection and classification. These long ranges also make passive detections of a target, where some classification clues are known, unlikely.

Systems composed of dense fields of miniature sources and receivers can count on short-range (15 km, or less) detections (active or passive) and active detections that will generally be made in reverberation. These conditions lead to several processing advantages not available in long-range systems. Some of the important processing advantages are:

- Improved ability to predict multi-path structure and estimate target characteristics.
- Greater chance of multiple detections of a target (on one or more receivers, on one or more pings).
- Increased usable bandwidth for acoustic replay and echo characterization.

- Reduced non-target detection rate in reverberation (the largest rate occurs in ambient-limited conditions).
- Improved chance of passive detections of the enemy submarine (due to closer ranges available in the dense field).

Along with these advantages come several processing requirements:

- Effective detection algorithms for echoes in reverberation.
- Effective and robust automatic (or nearly so) active classification algorithms to control the rate of non-target detections.
- Algorithms for passive processing.
- Field management software to control the multi-static processing and to alert the sonar operator only when "high confidence" detections are identified.

The overall goal of this topic is to develop a processing framework to meet the above requirements.

PHASE I: Develop and conceptualize a basic processing architecture string along with modular integration of algorithms such as de-noising, echo detection, and classification, as well as an algorithm for processing and displaying multiple detections in the field environment. The focus should be on the integration of the algorithm modules and not on the individual algorithm performance or design. The framework design should allow substitution of algorithms to determine actual performance. Demonstrate this initial concept with simulated data.

PHASE II: Using results from Phase I, compare various algorithms in the string architecture using both simulated and real data. Utilize both new data and previously collected data to make the comparison. A limited amount of real data will be provided for the testing of single receiver, single ping detection, and classification algorithms. Demonstrate the successes of the various algorithms.

PHASE III: Transition the technology to make direct performance comparisons of acoustic algorithms in various environments and conditions enabling the Navy to select the best algorithms that may lead to improved sensor system designs to further enhance the Navy ASW capability. The modular design of this system will allow the easy plug–in of new algorithms as they become available at any point in the overall architecture processing string created in Phase I and developed in Phase II.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: An ASW system composed of a dense field of miniature sources and receivers, and using the processing environment developed in this effort, could also be used for commercial harbor defense and for the detection of drug smuggling vessels.

REFERENCES:
1. Program Executive Officer (PMA-299) Air ASW, Assault, and Special Missions Programs, "Technology Issues," 25 Feb 02.
2. Littoral Anti-Submarine Warfare Concept, Naval Doctrine Command, 1 May 1998; http://www.fas.org/man/dod-101/sys/ship/docs/aswcncpt.htm
3. N88 "Air ASW Vision Statement", at
http://www.hq.navy.mil/airwarfare/Programs/N880E/Air%20ASW%20Vision%20 Statement.htm
4. Mission Needs Statement for "Multi-Static Search System Compatible with Rotary Wing, UAV and other Weight and Volume Limited ASW Platforms, May 1999

KEYWORDS: Miniaturized; Sensors; Multi-static Anti-Submarine Warfare (ASW); Signal Processing; Detection, Classification

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2nd TPOC: (301)342-8796

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

N06-043 TITLE: Innovative Aircraft Landing Aid Transmission Technology

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-213, Air Traffic Control and Landing Systems

OBJECTIVE: Develop innovative technologies that would increase bandwidth and efficiency and reduce power density and losses in the transmitting set of the aircraft electronic landing aid.

DESCRIPTION: The AN/SPN-41 transmitting set is an electronic landing aid that measures azimuth and elevation of approaching aircraft and relays the data to display within the aircraft. This data provides the pilot an indication of where the aircraft is in relation to the proper glide-slope required to land on the carrier. The AN/SPN-41 broadcasts a series of pair pulses by means of two encoded transmitters utilizing pulse mode in the Ku-band. There has been little change to the system since it was designed in the late 1960's creating concerns regarding supportability, reliability, maintainability and capability of the transmitting set.

This system will be used as an independent backup system for the new Joint Precision Approach Landing System (JPALS). The JPALS system is to be installed in the new centerpiece of tomorrow's aircraft carrier (CVN-21 - 2014) and the lead aircraft platform is the Joint Strike Fighter (JSF). Innovative hardware and algorithm technologies are sought that will reduce power density, increase bandwidth, decrease loss and increase efficiency and offer overall performance enhancements to the Ku band transmitters. Innovation may be achieved in component miniaturization, microchip controlling and monitoring hardware/software.

Proposed transmitter technology should be able to radiate accurately coded microwave signals into aircraft approach area which can be decodable for a range of up to 50 NMI Line-of-Sight (LOS) in clear weather and 16 NMI LOS with 2.54 Cm (1 inch) per hour rainfall. The frequency requirement of the Ku Band transmitter is 15.4 to 15.7 GHz (10 specific frequency channels) and the maximum peak power requirement is 2.2 kW and an average power 7.5 Watts. The pulse width is 0.3 µsec, pulse transmission - coding information is time shared between azimuth and elevation transmission. Intrapair spacing varies between 10 – 15 µsec and 60 – 100 µsec, respectively. The transmission rate needs to be 5Hz and the angle of resulution is 1/8°.

This topic is intended to enhance the development effort from the Advanced Antenna Development.

PHASE I: Demonstrate feasibility of proposed innovative approach to reduce power density, increase bandwidth, decrease losses and increase efficiency in the Ku band transmitters.

PHASE II: Develop and demonstrate prototype algorithms and hardware. Evaluate prototype in a Navy environment.

PHASE III: Demonstrate a mature system in fielded platforms

PRIVATE SECTOR COMMERCIAL POTENTIAL: This technology is applicable in high power circuit design, radar and communications.

REFERENCES:
1. AN/SPN - 41 Technical Manual for Transmitting Set
2. FAS Military Analysis Network AN/SPN-41;
http://www.fas.org/man/dod-101/sys/ship/weaps/an-spn-41.htm

KEYWORDS: Transmitter; Waveguide; Pulse Code Modulation; Amplifiers; Solid State Electronics; Ku Band

TPOC: (301) 995-8203
2nd TPOC: (301) 995-8956

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

N06-044 TITLE: Advanced Antenna Development

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: PMA-213, Air Traffic Control

OBJECTIVE: Develop advanced non-rotational antenna technology for use with the Instrument Carrier Landing System (ICLS).

DESCRIPTION: The AN/SPN-41 is an electronic landing aid that measures azimuth and elevation of approaching aircraft and relays the data to display within the aircraft. This data provides the pilot an indication of where the aircraft is in relation to the proper glide-slope required to land on the carrier. The AN/SPN-41 broadcasts a series of pair pulses by means of two encoded transmitters utilizing pulse mode in the Ku-band. There has been little change to the system since it was designed in the late 1960's creating concerns regarding supportability, reliability, maintainability and capability of the system. This system is going to be used as an independent backup system for the new Joint Precision Approach Landing System (JPALS). The JPALS system is to be installed in the new centerpiece of tomorrow's aircraft carrier (CVN-21 -2014) and the lead aircraft platform is the Joint Strike Fighter (JSF). One of the desired characteristics of the new carriers is to have non-rotational antennas for the radar/transmitter systems used. Innovative non-rotating Ku-band antenna technology is sought to support the ICLS. Innovative development in self-diagnostic software, improved user interface and minimized circuitry will help extend the life of the system beyond the year 2040.

Technical parameters to be addressed are: (1) in the elevation antenna, a scan rate of 2.5 Hz, a coverage from 0 ° to 10 ° above horizon, a beam width: 1.3 °, stabilized axis from gyros for Pitch and Roll, (2) in the azimuth antenna: a scan rate of 2.5 Hz, coverage of ±20 ° around centerline, a beam width: 2.0 °, a stabilized axis from gyros for Yaw and Roll, the frequency range is from 15.4 GHz to 15.7 GHz. Possible development of an integrated and compact non-rotating antenna could be achieved through the use of phase array technology or similar technology.

This topic is intended to enhance the development of the Innovative Aircraft Landing Aid Transmission Technology.

PHASE I: Provide a detailed concept feasibility analysis for technology development of Ku-band non-rotational antennas.

PHASE II: Prototype, model and demonstrate the proposed antenna technology. Prototype should include options to integrate with suitable hardware for evaluation.

PHASE III: Demonstrate a mature system in fielded platforms

PRIVATE SECTOR COMMERCIAL POTENTIAL: The technology is applicable in high power circuit design, radar and communications.

REFERENCES:
1. AN/SPN - 41 Technical Manual for Transmitting Set
2. JPALS System Requirements Documents
3. JPALS Analysis of Alternatives
4. FAS Military Analysis Network AN/SPN-41;
http://www.fas.org/man/dod-101/sys/ship/weaps/an-spn-41.htm

KEYWORDS: Radiation Pattern; Phase Array; Multipath; Integrated Sensor; Radar; Non Rotational Antenna

TPOC: (301) 995-8203
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Questions may also be submitted through DoD SBIR/STTR SITIS website.

N06-045 TITLE: Infrared (IR) Transparent, Millimeter-Wave (MMW) Band-Pass, Missile Dome Design

TECHNOLOGY AREAS: Materials/Processes, Weapons

ACQUISITION PROGRAM: Joint Common Missile

OBJECTIVE: Develop an innovative design for an IR-transparent, MMW band-pass coating for domes and windows that meets the technical challenges of multi-band transparency and electromagnetic shielding.

DESCRIPTION: The future of fire-and-forget missiles has been advanced by merging diverse sensor outputs (i.e., multi-mode seekers). [1] Multi-mode seekers that merge IR detection and MMW radar have been successfully demonstrated.[2] Building on these advances, innovative designs are needed for domes and windows of multi-mode seeker systems, in order to meet the technical challenges of multi-band transparency and electromagnetic shielding.[3] Pertinent material properties for common IR-transparent dome and window materials, and the fundamental physics that underlie such a design, are reported in the literature.[4] Research into electrically conductive, IR-transparent coatings is ongoing[5] but has not yet been integrated into any system. A successful design will be a lower-cost alternative to replace IR-transparent domes that employ an embedded metal mesh. An embedded coating may be used, although the simplicity and lower cost of surface coatings is desired. The coating should transmit mid-wave IR radiation and MMW radiation at a frequency in the Ka-band. The design should provide shielding at out-of-band microwave and radio frequencies. Reflection at Ka-band-pass frequency must be negligible. It must transmit >90 percent in the 3-5 micron IR region and MMW loss should be <0.5 dB at a specified frequency within the Ka-band. The design should provide the narrowest possible band pass around the designated frequency and the maximum possible (>20 dB) attenuation outside the band pass. Operation at a frequency in the W-band instead of the Ka-band is also desirable.

PHASE I: Determine the feasibility of designing a flat window material with an IR-transparent MMW band-pass coating. Provide a demonstration piece of a flat window material with an IR-transparent MMW band-pass coating and characterize its mid-wave IR and MMW transmission.

PHASE II: Develop an adequate number of flat window materials to determine if resistance to rain and sand erosion is sufficient for the operational environment of a missile to be carried by fixed- and rotary-wing aircraft. Determine the operational temperature range for the design. Based on these results, demonstrate a prototype of the coating on a hemispheric dome and optimize the optical and electromagnetic performance with regard to Navy standards.

PHASE III: Qualify the coating and design for insertion into a new or existing system (e.g. Joint Common Missile). Demonstrate production capability.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Both IR and MMW bandwidths are important in the communications industry. The advanced window design may be applicable to multi-mode communications.

REFERENCES:

1. M Cannon, PEO Tactical Missiles, Sensor to Shooter Timeline Equation, http://www.dtic.mil/ndia/2004precision_strike/CANNONTimelineEquation.pdf, last accessed 7 April 2005. J. C. Kirsch, W.R. Lindberg, D. C. Harris, M. J. Adcock, T. P. Li, E. A. Welsh and R. D. Adkins, “Tri-Mode Seeker Dome Considerations” Proc. SPIE Vol. 5786, Window and Dome Technologies and Materials; Randal W. Tustison; Ed., 2005.

2. (a) New Eagle Eyes Dual-Mode Seeker Successfully Demonstrated, http://www.spacedaily.com/news/missiles-04c.html , last accessed 7 April, 2005. (b) Raytheon successfully demonstrates Common Modular Missile tri-mode seeker, http://www.raytheon.com/newsroom/briefs/011303.html , last accessed 7 April, 2005. (c) Joint Common Missile Seeker Successfully Tracks Tactical Target Vessel in Littoral Testing http://www.missilesandfirecontrol.com/our_news/pressreleases/05pressrelease/011905-JCM.htm , last accessed 7 April, 2005.

3. J. C. Kirsch, W.R. Lindberg, D. C. Harris, M. J. Adcock, T. P. Li, E. A. Welsh and R. D. Adkins, "Tri-Mode Seeker Dome Considerations" Proc. SPIE Vol. 5786, Window and Dome Technologies and Materials; Randal W. Tustison; Ed., 2005.

4. (a) D. C. Harris, Materials for Infrared Windows and Domes, SPIE Press, Bellingham WA, 1999. (b) M. Stead and G. Simonis "Near millimeter wave characterization of dual mode materials" Applied Optics, 28(10) 1874-1875. (c) C. I. Bright "Electromagnetic Shielding for Electro-Optical Windows and Domes" Proc. SPIE Vol. 2286, Window and Dome Technologies and Materials IV; Paul Klocek; Ed., 1994, 388-395.

5. (a) Linda F. Johnson, Mark B. Moran "Infrared transparent conductive oxides" Proc. SPIE Vol. 4375, Window and Dome Technologies and Materials VII; Randal W. Tustison; Ed., 2001, 289-299. (b) D. H. Rapkine, G. A. Thomas, R. J. Cava, J. Kwo, S. A. Carter and J. M. Phillips, Band Gap Shift in a New Transparent Conductor http://flux.aps.org/meetings/BAPSMAR96/abs/S1730129.html , last accessed 7 April, 2005.

KEYWORDS: Infrared Dome; IR Window; Radome; Millimeter-Wave; Band-Pass Filter; Multi-Mode Seeker

TPOC: (760)939-1629
2nd TPOC: (760)939-1649

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

N06-046 TITLE: Health Monitoring for Synthetic Material Arresting Cable

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: PMA-251, Aircraft Launch and Recovery Equipment

OBJECTIVE: Develop technology for monitoring the health and service life of synthetic material arresting cables.

DESCRIPTION: Carrier aviation is dependent on the ability to recover aircraft expeditiously and safely aboard ship. The arresting gear system aboard aircraft carriers relies on a 1-7/16 inch diameter cable to transfer the energy from the landing aircraft to the arresting gear engines located below the deck. Current arresting gear cables are constructed from steel weaved around a polyester core. The Navy has recently funded research into a new all-synthetic material cable to replace the current steel cable. Synthetics have a higher strength-to-weight characteristic than steel, which will improve the performance index of the arresting gear engine in both the high and low energy levels. Improved arresting gear performance translates to reduced wind-over-deck requirements and higher aircraft bring back weight, reducing the necessity to dump fuel and/or release stores prior to landing.

While employing synthetic cables for our needs is a goal in the future, the unknown failure mode of synthetic cables remains a primary technical risk. Steel cable will begin to fail when the outer strands break, and this can be visually inspected. A synthetic cable may fail internally, without any warning. For example, heat could build up within the cable interior as strands rub together and melt or rupture, causing the cable to lose tensile strength and ultimately break.

This topic is seeking a sensor, indicator, and/or process for detecting the condition of a synthetic material arresting cable that would inform the operator when a particular cable is approaching the end of its service life and is near failure. This is considered crucial to the implementation and success of the synthetic arresting cable. The ability to predict the failure mode would be additionally desired, as would an estimate of service life remaining. The Navy will consider proposals for both in-situ sensors (i.e. part of the cable) and inspection tools that are not part of the cable. However, the inspection must be accomplished while the cable is in operation. Any proposed method that requires destroying the cable will not be considered.

The arresting gear cable is actually two separate cables, the cross-deck pendant and the purchase cable, which are connected via a terminal and pin. The cross-deck pendant is the portion of the cable that is stretched across the landing area and interfaces with the aircraft tail hook. It is approximately 100 feet long and is replaced after approximately 125 cycles. The purchase cable is the portion of the cable that is reeved through the fairlead system and the arresting engine below the flight deck. It is 2,200 feet long, is subject to bending stresses from the many sheaves that it is in contact with, and is replaced after approximately 1,500 cycles. The synthetic cable research effort is addressing only the purchase cable at this time. Cable construction and material for a new synthetic cable is yet to be determined. The nominal breaking strength of the cable should be 215,000 lbs.

PHASE I: Identify all failure modes associated with synthetic cables. Develop a conceptual design for a synthetic cable life indicator that can detect these failure modes and provide early indication and prove the feasibility of the concept to meet the requirements. Develop a concept of operations, and provide defendable estimates for cost and reliability and maintainability (if applicable).

PHASE II: Develop a prototype and demonstrate. Final demonstration will be on synthetic cable in a test environment representative of the arresting gear aboard ship.

PHASE III: Further develop a prototype for robustness and shock testing (if applicable). Test the prototype in conjunction with synthetic cable qualification testing. Produce units for delivery to carrier Fleet and shore sites, or incorporate into synthetic cable production.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Wire rope has a wide range of applications in industry, including bridges, construction equipment, ship moorings and offshore oil rigs. Because of its performance benefits and high strength-to-weight characteristics, synthetic rope has been gaining market share in these applications. By providing the means to monitor and predict life usage, synthetic cables could safely and realistically be transitioned into these applications.

REFERENCES:
1. Aircraft Carrier Reference Data Manual, NAEC-MISC-06900
2. Fiber Rope Inspection & Retirement Criteria; The Cordage Institute; International Guideline CI2001-04

KEYWORDS: Nondestructive Inspection; Health Monitoring; Synthetic Material; Carrier Arresting Gear; Cable; Wire Rope

TPOC: (732)323-4260
2nd TPOC: (732)323-2716

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

N06-047 TITLE: Fatigue Life Improvement with Surface Treatments other than Shot Peening

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: V-22

OBJECTIVE: Develop surface treatment technologies that will increase the fatigue performance of dynamic aircraft materials/components more quickly and cheaply than traditional shot peening methods.

DESCRIPTION: Fatigue life is one of the critical measurements of structural performance of rotorcraft. The general approach to enhancing fatigue life is to modify the microstructure and stress states in the surface region of the materials. Imparting residual compressive stress in a dynamic part, such as a gear, is a valuable and widely used technique for improving the fatigue life [1]. Presently, the most common form used for imposing residual stresses in a component surface for increased fatigue strength is shot peening. While imposing high levels of residual compressive stresses, shot peening is relatively inexpensive, measurable, and has acceptable process controls. However, the depth of residual stresses induced by such a method is less than the initial damage tolerance crack size [1]. Cavitation peening provides a deeper residual compressive stress zone and does not alter surface finish, yet the residual compressive stress is not as deep as laser shock peening [2]. Laser shock peening results in the best residual compressive stress effect in both depth and magnitude, which is particularly beneficial in restoring the fatigue life of a component with deeper surface flaws [1].

There is a need to develop innovative technologies that can provide an advantage in performance, cost, and/or speed over traditional shot peening methods for improvement of fatigue life, damage tolerance, and reliability. The proposed solution should demonstrate the best potential to improve the fatigue life, fatigue strength and resistance of components to stress corrosion cracking and effectively improve fatigue performance of dynamic components, such as transmission gearboxes, the main gearbox, etc.

PHASE I: Demonstrate feasibility by measuring residual compressive stresses and depths, repeatability, use on various geometries, and the effect on the fatigue life of damaged components (machined surface flaws) through coupon testing.

PHASE II: Develop a prototype surface treatment technology/technique and demonstrate repeatability and process controls on a variety of materials/geometries. Develop process controls for varying degrees of stresses, depths, and materials. Fabricate coupons of the materials used in the critical parts/components for demonstration.

PHASE III: Perform surface treatment technique at the sub-element level, such as gears, gear boxes, etc. Demonstrate the reliability, control, cost effectiveness, measurability, and use in various geometries.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Successful advancements in this technology and its transition will be a benefit to commercial applications by providing increased fatigue strength to components, allowing them to be lighter and smaller, as well as, provide increased damage tolerance for components to increase service life and save cost for the end user.

REFERENCES:
1. Everett, Jr., R. A.; The Effects of Shot and Laser Peening on Crack Growth and Fatigue Life in 2024 Aluminum Alloy and 4340 Steel, NASA/ TM-2001-210843, ARL-TR-2363.

2. Butler, Tom; Using Cavitation Peening to Obtain Deep Residual Compressive Stresses, 3.

KEYWORDS: Peen; Shot Peening; Cavitation Peening; Laser Shock Peening; Fatigue; Surface Treatments

TPOC: (301)342-9239
2nd TPOC: (301)757-9506

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

N06-048 TITLE: Development of HFPB Debris Throw Models for Ordnance Storage and Handling Facilities

TECHNOLOGY AREAS: Materials/Processes, Weapons

OBJECTIVE: Develop High-Fidelity Physics-Based (HFPB) Fast Running Models (FRMs) for simulating the explosive effects of stored munitions on magazine response, break-up and the characteristics of thrown debris that can result in collateral damage and lethality.

DESCRIPTION: The primary requirement is to determine if High-Fidelity Physics-Based (HFPB) models can be used to simulate the structural response and break-up of different types of explosive storage magazines (e.g., earth covered magazines, hardened aircraft shelters, above-ground shelters, etc.) to the blast and fragmentation loads resulting from an internal explosion. Currently, very little HFPB modeling in this area exists. The model must consider the magazine types and stored munitions typically used at DoD operated bases and weapons storage facilities located in the continental U.S. and abroad. The HFPB models must be capable of determining the shock, gas and fragment loading considering an internal explosion of cased and un-cased weapons. In addition, the HFPB models must be able to determine the response and break-up of the magazine walls (for a full range of charge densities) and predict the amount as well as the distributions of debris size, velocity, and takeoff location/angle. The validity of the HFPB models must be compared to available accident and controlled test data (full-scale and sub-scale). For use in weapons hazard and risk assessment codes, the HFPB models must be translated into Fast Running Models (FRMs) that can approximate the loading, response, break-up, and debris characteristics using key HFPB model parameters given a magazine/munitions configuration.

PHASE I: Provide proof of feasibility to determine if HFPB models can simulate the structural response, break-up and thrown debris characteristics of magazines of different construction storing conventional weapons, and demonstrate the ability of FRMs to adequately simulate the HFPB results.

PHASE II: Develop, demonstrate and validate the accuracy of HFPB and FRM models to simulate break-up and thrown debris characteristics of actual magazines of differing construction storing a variety of conventional weapons.

PHASE III: Prepare a software module of Fast-Running Debris models that can be easily accessed by weapons hazard and risk assessment codes that estimate the effects of internal explosions on adjacent buildings and their occupants. Such codes include the Navy's ESS explosives siting application and the DDESB's SAFER risk-based explosives siting program

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The HFPB FRMs can be used or extended to address the effects of an internal explosion resulting from a terrorist bomb on the interior of a building and the potential for collateral damage. Commercial applications include software that will predict the effects of accidental explosions on refinery workers, and how explosive charges can be optimally placed to remove soil overburden for mining applications.

REFERENCES:

1. Hasselman, T. K., M. C. Anderson and D. C. Zimmerman, "Fast Running Approximations of High Fidelity Physics Based Models," Proceedings of the 69th Shock & Vibration Symposium, Minneapolis/St. Paul, NM, October 12-16,1998.

2. Myers, R. H. and Montgomery, D. C., "Response Surface Methodology: Process and Product Optimization Using Designed Experiments," John Wiley & Sons, New York, NY, 1995.

3. "Methods and Algorithms used in the SAFER (Safety Assessment for Explosives Risk) Model," DoD Defense Explosives Safety Board (DDESB), Alexandria, VA, September 2003.

4. "Prediction of Building Debris for Quantity-Distance Siting," DoD Defense Explosives Safety Board (DDESB), Alexandria, VA, April 1991.

5. Defense Explosives Safety Management Suite, Explosives Safety Siting (ESS) Application, DoD Defense Explosives Safety Board (DDESB), Alexandria, VA.
www.denix.osd.mil/denix/Public/News/EITM/FactSheets/ESS.pdf

KEYWORDS: Explosive Storage, Conventional Weapons, Shock Loading, Gas Loading, Structural Response, Debris Throw, High-Fidelity Physics-Based (HFPB) models, Fast Running Models (FRM).

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N06-049 TITLE: False Alarm Control for Advanced Radars

TECHNOLOGY AREAS: Sensors

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: Develop advanced techniques to reject radar returns from birds, sea, land, and weather clutter during high sensitivity operating modes. These techniques will increase the sensitivity and performance of existing and future Navy radars, enhancing ship self defense modes against stealthy, sea skimming, anti-ship cruise missiles.

DESCRIPTION: Future radars will be required to operate near-shore in high clutter environments to detect a broad range of target classes. Too often, the characteristics of objects that are not of interest will be similar to those of threat objects. The conventional approach to false alarm control is to reduce sensitivity of the radar in areas of clutter, using Sensitivity Time Control (STC). However, this approach is not effective for small and slow objects. This topic is interested in investigating alternatives to STC to address the broad ranges of threats and environments that the future radars will encounter. Since future combat scenarios will require greater radar sensitivity, STC cannot be set at the customary high level and most likely have to be eliminated altogether. Therefore, new techniques to discriminate against undesired detections (eg. sea clutter, birds, etc.) are needed. Of particular interest are new waveforms and signal processing techniques to discriminate objects of interest from clutter. The new techniques shall not degrade target detection or parameter estimation performance in either the search or the track modes, and should not require significant additional time-energy resources.

PHASE I: Identify several alternative techniques. Analyze their theoretical performance relative to selected radar models to demonstrate their feasibility.

PHASE II: Develop the techniques for specific legacy and future radars and demonstrate their effectiveness in actual radars and compare to theoretical predictions.

PHASE III: Transition these new techniques into an existing or developmental Navy radar.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: These techniques will increase the sensitivity and performance of commercial navigation, air traffic control and weather radars. They also have utility for homeland defense applications.

REFERENCES:
1. Skolnik, M. I., Introduction to Radar Systems, 3rd ed, New York, McGraw Hill, 2001

2. Edde, B., Radar Principles, Technology, Applications, New York, Prentice Hall PTR, 1992

3. Barton, D.K., Radar System Analysis and Modeling, Norwood MA, Artech House, 2005

KEYWORDS: False Alarm Control, discrimination, waveforms, signal processing

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N06-050 TITLE: USW Intelligent Controller

TECHNOLOGY AREAS: Information Systems, Sensors

ACQUISITION PROGRAM: DDG 51

OBJECTIVE: Develop automated intelligent controller technology to optimize the employment of USW sensors and sensor processing resources

DESCRIPTION: The future undersea warfare (USW) combat system will include a network of multiple sensor and target engagement modules deployed on airborne, surface, and sub-surface manned and unmanned vehicles. New sensor capabilities will include extended bandwidth acoustic sensors, multi-static active sonar, acoustic intercept processing, and multi-sensor ship self-defense. The effectiveness of this collaborative sensor force requires advanced management and control systems to ensure that all assets are properly aligned to perform detection, classification, and localization (DCL) functions. A data fusion capability provides the operator with an integrated workstation to analyze detection images and automated DCL products. A sensor performance prediction capability provides the operator with recommendations for sonar system set-up based on threat acoustic intelligence and environmental acoustic modeling. However, current operating concepts require the operator-analyst to manually interpret in-situ sonar system performance and adjust sonar processing parameters to optimize system operation.

This topic seeks development of an operating concept and technology to automate the management of USW sensors and processing resources. Intelligent controller technology components are needed to support improved search, contact classification evaluation, threat assessment, and tracking functions. USW combat system performance metrics to be improved by intelligent controller technology transition will include increased probability of detection, reduced time to evaluate/classify new contacts, increased contact handling capacity, and reduced operator workload.

PHASE I: Define and document a proposed concept for a USW intelligent controller capability. Define and demonstrate the feasibility of technology and tools required to implement the concept with models and laboratory analyses. Provide a technical approach and plan for Phase II development and technology demonstration.

PHASE II: Develop and demonstrate a prototype system of the technology and tools identified during the Phase I research. Evaluate prototype system performance through laboratory analysis of data obtained from at-sea experiments or conduct of at-sea testing. Develop a Phase III plan for transition of intelligent controller technology into an operational USW combat system.

PHASE III: Integrate the technology into the SQQ-89 Surface Ship USW Combat System and demonstrate performance at sea in an operational environment.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has direct application to commercial surveillance and security systems comprised of multiple controllable sensors to improve performance and reduce manpower cost. The intelligent controller technology could be used to implement security sensor systems to provide optimum surveillance coverage with fewest sensors.

REFERENCES:
1. Feedback Control of Dynamic Systems, Gene F. Franklin, 2002

2. Multivariable Feedback Control: Analysis and Design, Sigund Skogestad, 1996

KEYWORDS: Sensors, Automation, Modeling, Simulation, Control Systems

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N06-051 TITLE: Marine Mammal Mitigation (MMM) Mission Planning Tool

TECHNOLOGY AREAS: Information Systems, Sensors

ACQUISITION PROGRAM: DDG 51

OBJECTIVE: Develop mission planning software together with necessary data types and sources that can be used by mission planners to identify operational areas for active operations that are void of marine mammals and provide for real-time reporting of marine mammal activity.

DESCRIPTION: In an effort to identify areas where ASW exercises can be conducted with minimal impact on various marine mammal species, a mission-planning tool is required.

Mission planning tools should identify marine mammal hazard warning areas based on historical migration data and real-time observations while displaying hazard areas around applicable active sonar systems. Technology to obtain observations of nearby marine mammal activity could employ passive acoustic or non-acoustic sensors. The research must also address the challenge of the lack of standardized data sets for marine mammal distributions and migration patterns.

This tool will eliminate excessive costs incurred while conducting ASW exercises, which have been restricted from using the full spectrum of sensors due to marine mammal activity. The need for reasonable risk/hazardous analysis tools for MMM is vital to the Navy’s continued success in conducting ASW training and RDT&E.

PHASE I: Document and demonstrate the feasibility of the proposed concept through a Risk Hazard Reduction analysis as it pertains to mitigating risk to marine mammals. Define the proposed concept and provide a Phase II development approach and schedule that contains discrete milestones for the product development.

PHASE II: Based on Phase I results fabricate and demonstrate a prototype mission planning tool with required sensors and data links. Integrate the techniques and prototypes in current Mission Planning software and demonstrate the viability through laboratory testing, at-sea testing and/or analysis of previous exercises conducted.

PHASE III: Based upon the results of the Phase II effort, transition the Marine Mammal Mitigation Mission Planning Software for operational use onboard current and future naval platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has a direct application to numerous commercial ship industries that practice environmental safety while navigating oceans and/or conducting underwater surveys.

REFERENCES:
1. Letter “Environmental Protection” Judge Advocate General 11 February 1997 RADM Harold E. Grant (http://meso.spawar.navy.mil/Newsltr/Fy97/No_2/jag.html)

2. Letter “Marine Environmental Update Special Edition” April 7, 1997: A Message from the Judge Advocate General, Part II RADM Harold E. Grant

3. “Ocean Variability and Acoustic Propagation: Proceedings of the workshop held in LaSpezia Italy June 4-8 1990” John F. Potter Editor

4. “Meeting Summary Marine Mammal/Vessel Strike (MMVS) Working Group 3 May 2004 Meeting 5

KEYWORDS: ASW; passive sonar; multi-static active; environmental planning; MMDM

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N06-052 TITLE: Characterization and Modeling of PMC/CMCs Under Extreme, High Temperature, Short Term Thermal Exposure

TECHNOLOGY AREAS: Materials/Processes, Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: This research proposal is to develop an experimentally validated analytical model that describes the thermal degradation of engineering material properties of polymer/ceramic matrix composites under extreme, high temperature, short duration thermal exposures. The primary structures of interest are tactical missile nosetips and radomes as well as missile fins. The validation technique should be able to reproduce supersonic convection heating distributions in a transient flight regime.

DESCRIPTION: Material models of polymer and ceramic matrix composites under extreme, high temperature, short duration exposures are not well understood. In both commercial and military air vehicle applications, polymer matrix composites are traditionally used in applications where the peak thermal response of the material is at or below its service temperature. This thermal limit is driven by the material degradation seen under long term exposure, thermal cycling, and 20,000 hour service life requirements. For single use air vehicles with short or medium duration missions, the thermal response of exposed structures, such as dorsals, fins, and radomes, often exceed material service temperature thresholds by two or three fold with the exposure time frame to these extreme temperatures in the order of seconds to minutes. This proposed research is to develop a test capability and an experimentally validated analytical model that describes the thermal degradation of engineering material properties of polymer and ceramic matrix composites under these dynamic heating conditions.

PHASE I: Develop an analytical model that describes the thermal degradation of engineering material properties of polymer and ceramic matrix composites under extreme, high temperature, short duration thermal exposures. All common physical and mechanical properties should be addressed, including (as a minimum) density, thermal conductivity, heat capacity, thermal expansion, elastic modulus, and strength. Develop a validation test matrix, a preliminary test configuration able to reproduce supersonic convection heating distributions in a transient flight regime (Mach 2-7), and perform limited validation testing to demonstrate test methods and corroborate the analytical model. Testing shall be conducted on commercially available composite coupons agreed upon by the Government. Suggestions include cyanate ester, polyimide, or pthallonitrile matrix composites and alumina matrix composites. Possible sources include YLA for polymers and COI for ceramics. [Source suggestions are not intended to be taken as as endorsement by the Government.]

PHASE II: Fabricate a prototype test system and demonstrate on three government furnished material systems. Provide calorimetric test data showing system temporal and spatial performance. Correlate analytical model to test data; fully develop model.

PHASE III: Deliver an engineering material characterization system and analytical model capable of simulating high temperature, short duration, supersonic flight, thermal transient environments applicable to actual components.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Laboratory thermal shock test apparatus have commercial potential in automotive, machinery, and turbine development environments, as well as the intended application in the missile community.

REFERENCES:

1. High Temperature, Short Term Tensile Strength of C6000/PMR-15 Graphite Polyimide, P.R. DiGiovanni, D. Paterson, AIAA_82-0711, 1982

KEYWORDS: ceramic matrix composites; polymer matrix composites; radomes; thermal shock; supersonic; hypersonic; missile; fin; leading edge

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N06-053 TITLE: Adaptive Remote Sensor Communications

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO Littoral and Mine Warfare & PMS 420 LCS Mission Packages

OBJECTIVE: Provide technologies to improve communications reliability for a naval system of multiple remote unmanned vehicle sensor packages.

DESCRIPTION: The future naval tactical combat system will include a network of multiple acoustic and non-acoustic sensor modules deployed on airborne, surface, and sub-surface unmanned vehicles. Sensor data will be communicated from offboard vehicles to host platform(s) through a variety of communications paths that could include line-of-sight, satellite, and acoustic data paths. Although developments in naval communications technologies and data networking protocols have improved the bandwidth and range of remote sensor connections, the demands placed on the communications links continue to increase due to (1) higher bandwidth sensors, (2) increasing complexity of remote sensor packages with active sonar, passive sonar, video/infra-red, radar, and electronic surveillance components, (3) increasing number and types of remote vehicles. The performance of naval communications connections will also vary as a function of surface and subsurface environmental conditions and dynamic re-positioning of the host ship and remote vehicles during a tactical engagement.

With limited manpower available to manage the multi-vehicle sensor system, operators will not have sufficient time to continuously monitor and adjust communications assets in response to rapidly changing conditions. This topic seeks development of technology to monitor multiple communication links and automatically detect failures, degraded performance, or improved performance. In response to a change in conditions, the system should automatically reconfigure remote vehicle links or remote sensor operating modes. Operational benefits of this technology will include increased operational availability, reduced operator workload, and improved remote sensor performance.

PHASE I: Define and document a proposed concept for automated monitoring and reconfiguration of remote sensor communications. Define and demonstrate the feasibility of technology required to implement the concept with models and laboratory analyses. Provide a technical approach and plan for Phase II development and technology demonstration.

PHASE II: Develop and demonstrate a prototype system of the technology identified during the Phase I research. Evaluate prototype system performance through laboratory analysis of data obtained from at-sea experiments or conduct of at-sea testing. Develop a Phase III plan for transition of adaptive communications technology into navy ship tactical mission packages.

PHASE III: Work with Navy program managers and industry to integrate mature technology from Phase II into a Littoral Combat Ship mission package production baseline.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has direct application to commercial surveillance and security systems comprised of multiple remote high bandwidth sensors with wireless communications to a central analysis workstation.

REFERENCES:

1. Digital Communication over Fading Channels: A Unified Approach to Performance Analysis, Marvin K. Simon, Wiley-Interscience; 1st edition (July 27, 2000)
2. Simulation of Communication Systems: Modeling, Methodology and Techniques (Information Technology: Transmission, Processing and Storage), Michael C. Jeruchim, Plenum US; 2 edition (October 31, 2000)

KEYWORDS: Sensors, Communications, Adaptive Controls, Remote Vehicles

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N06-054 TITLE: Fish Net Penetration by UUVs

TECHNOLOGY AREAS: Ground/Sea Vehicles

OBJECTIVE: Enable unmanned undersea vehicles (UUVs) to free themselves from and pass through fishnets. This technology will advance and increase UUV capability in Sea Shield for MCM, ISR, and ASW.

DESCRIPTION: Fishing nets present a navigational hazard to UUVs, especially in the littoral areas.   Fishing Traffic in the littorals is extremely heavy with nets that cover large areas. Sometimes UUVs will be able to detect fishnets with a forward look sonar (FLS) and take avoidance actions, which can reduce the mission length of a UUV by over half. Due to limited energy or mission priority, it may be necessary for a UUV to penetrate a net instead of taking avoidance actions or in many situations to free itself from a net.

Current UUVs have limited space and volume available for equipment necessary to penetrate a net. A FLS, recovery equipment, and a homing sensor occupy the front section of the UUV. Innovative technology development is needed for net perpetration equipment (NPE) that uses limited space, weight, and power on the UUV. The design should be scalable for all classes of UUVs listed in the Navy's UUV Master Plan with the Light Weight and Heavy Weight Vehicles being the initial programs of interest. It is preferred that no expendable equipment or explosives be used for multiple net penetrations during one mission. The NPE should be stored conformal to the vehicle's hull to allow uninhibited launch and recovery.

Due to the wide variety of nets and tactics used in the fishing fleet, new innovative technologies are needed for success in the various conditions. This technology will be allow the UUV to pass through fishing net in enabling and increasing the capability to complete high priority missions in littoral areas support of Sea Shield and missions identified in the UUV Navy Master Plan.

PHASE I: Develop a concept design in which a UUV encounters a net and penetrates through. Design a system that reliably penetrates various nets, minimizes UUV integration, and will fit multiple sizes of UUV. Develop bench-level mockups to demonstrate a proof of concept as applicable. Identify notional space, weight, and power requirements of the system for vehicle integration.

PHASE II: Complete the system design and fabricate hardware for use on a 21" heavy weight vehicle. Test a prototype in the water against representative nets. Refine the prototype to increase reliability and chances of penetration and escape and meet applicable operational UUV requirements.

PHASE III: Integrate system into PMS 403 MRUUV program and test.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: UUVs and Remotely Operated Vehicles (ROVs) are increasingly capturing commercial applications such as ocean exploration, mapping, salvage, and oil and gas surveying markets. Old or lost nets litter the ocean floors and can cause entanglement and require diver assistance or loss of vehicle. NPE integrated onto these vehicles may reduce risk of loss of vehicle in an abandoned net or expensive cost of UUV retrieval.

REFERENCES:
Navy UUV Masterplan 2000
Navy UUV Master Plan Update 2004

KEYWORDS: fish net; UUVs; Mechanical;MRUUV; littoral

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N06-055 TITLE: Smart Coatings through the Application of Emergent Nano-Technologies

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: Develop and test a coating system that incorporates emerging nano-technology fillers and/or additives into a high-performance, epoxy-based, polymer coating system as a means of providing active corrosion control and passive corrosion sensing/indication characteristics.

DESCRIPTION: This topic seeks to explore the development and incorporation of emergent nano-powders into existing coatings systems as a method of enhancing the inherent properties of the coating system to provide on-demand (i.e., smart) active corrosion inhibiting performance improvements while incorporating passive condition-based corrosion sensing and indication (i.e., smart) methodologies. The technical risk associated with this topic is viewed to be high due to the anticipated challenges associated with the adaptation and incorporation of emergent nano-technologies into a product that does not exceed current cost and weight metrics while providing the ability to produce active corrosion inhibition and passive corrosion sensing to areas that require local electrochemical modification. For the purposes of this topic, initial developmental emphasis should be upon coating systems such as epoxies conforming to MIL-PRF-23236 and MIL-DTL-24441 which are currently in use in the naval shipbuilding industry. Solutions proposed should have a shelf-life of no less than one year and must be compatible with current application technology and equipment which is intended for shipyard use. The adverse environmental impact of the proposed technology should be negligible or no greater than that of currently used EPA compliant coatings.

PHASE I: Demonstrate the feasibility of the addition of nano-powders as a means of improving and tailoring coating system performance characteristics. Establish performance goals and metrics to analyze the feasibility of the proposed solution in various representative maritime coatings. Develop a Test and Evaluation Plan that contains discrete milestones for product development for verifying performance and suitability.

PHASE II: Develop and demonstrate coating system performance improvements based on the Phase I results. In a laboratory environment, demonstrate that the prototype product meets the performance goals established in Phase I and test it on various representative surface materials. Evaluate the processes for ease of application and the associated cost and weight benefits of the proposed concept(s). Provide a plan for obtaining Navy certification for shipboard installation.

PHASE III: Utilizing the concepts developed during Phase I and II, work with Navy and industry to certify and implement this technology to existing and future surface combatant maintenance, corrosion control, and manufacturing sector use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would have a broad range of applications in commercial industries such as manufacturing, automobile, construction (infrastructure applications, bridges, etc.) and commercial shipbuilding.

REFERENCES:

1. Cayton, R.H., “Nanoparticle Composites for Coating Applications,” Paint & Coatings Industry, Vol. 20, No. 5, pg. 48-54, May 2004.
2. Kivilevich, A., “A Paradigm Shift: The New Role of Heterogeneity and Interactions,” JCT Coatings Tech, Vol. 1, No. 4, pg. 38-48, April 2004.
3. MIL-PRF-23236C, “Coating Systems For Ship Structures” via http://assist.daps.dla.mil/quicksearch/
4. MIL-DTL-24441C, “General Specification for Paint, Epoxy-Polyamide” via http://assist.daps.dla.mil/quicksearch/

KEYWORDS: coating; nano-technologies; corrosion control; marine applications; shipyard environment

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N06-056 TITLE: Affordable, Advanced Lighting System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Electronics

ACQUISITION PROGRAM: DDG 51

OBJECTIVE: Develop a lighting system concept that provides variable chromaticity and intensities while utilizing the existing power structure of the ship by investigating new approaches to lighting system configurations.

DESCRIPTION: Historically naval shipboard lighting configurations have relied on the application of colored filter media over a white light source (either incandescent or fluorescent) and the use of variable voltage control for dimming of incandescent light sources. Typically, the colored lighting system is redundant to the white lighting system so that two separate systems (white & colored) are fielded and maintained to meet the ship’s mission. To add further complication, various color filters are applied to the fixtures dependent upon the ship’s operating location and mission profile. The incorporation of Night Vision Imaging Systems (NVIS) has driven the need additional filter media to address NVIS compatible lighting requirements.

This topic seeks to investigate the application of advanced lighting technologies to create an improved shipboard lighting system concept that will allow an operator to select the color/wavelength (white, amber, red or NVIS), and the intensity of a specific fixture as dictated by the ship's operating condition. It is envisioned that this advanced lighting system solution will allow for a more capable, flexible, efficient, reliable, and less maintenance intensive lighting system than is currently in use. The technical challenge will be in the cost-effective development of the necessary component technologies to provide the ability to control or select the color, wavelength and intensity as dictated by the ship's operating environment. The system proposed shall be capable of driving various light fixtures or sources in series and parallel configurations from the existing AC power feeds while meeting the requirements applicable to current naval lighting systems i.e. shock, vibration, EMI, etc,. Solutions should also address the development of form, fit and function packaging that will minimize ship impact, installation and/or integration.

PHASE I: Demonstrate the feasibility of an advanced lighting solution that will allow an operator to vary the chromaticities and intensities of series and parallel lighting fixture configurations. Establish performance goals and standards to analyze the proposed solution. Conduct a first-order Return-On-Investment (ROI) analysis and estimate potential Total Ownership Cost (TOC) reduction. Develop key component technological milestones.

PHASE II: Based on the results in phase I, design and develop a working prototype system. Perform laboratory testing to demonstrate the prototype's ability to control multiple fixtures in a representative shipboard configuration. Address the potential for shipboard replacement as well as the ability to meet shipboard environmental requirements and power quality specifications. Conduct limited testing as a means of demonstrating the viability of the prototype. Define all installation, maintenance, and repair practices and procedures.

PHASE III: Design and fabricate a full-scale system. Provisions will be made to facilitate shipboard lighting system testing and demonstration as deemed appropriate.

PRIVATE SECTOR COMMERCIAL POTENTIAL: The Navy's investment in this technology will be desirable initially in niche markets such as marine and commercial boating, mining and any application utilizing remote or limited power schemes.

REFERENCES:
Available at http://assist.daps.dla.mil/online/start/

1. MIL-STD-1399 sect 300A, "Interface Standard for Shipboard Systems, Electrical Power, Alternating Current"
2. MIL-STD-461E, "DOD Interface Standard; Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment"
3. MIL-DTL-16377H, "Fixtures, Lighting; and associated parts, Shipboard use, General Specification for"

KEYWORDS: Wavelength; Chromaticity; Intensity; Efficiency; Epitaxy; Solid State

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N06-057 TITLE: Cargo Transfer from Offshore Supply Vessels to Large Deck Vessels

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: LHD 1

OBJECTIVE: Develop an innovative, cargo transfer system capable of moving cargo between a dynamic positioned offshore supply vessel and an aircraft carrier or similar decked vessel.

DESCRIPTION: The Navy envisions that in the future, the use of non-military assets as a means of provisioning will be a more common scenario and will allow for greater flexibility within the naval and commercial industries. This topic seeks the development of an innovative cargo transfer system that will enable the movement of cargo between an offshore or intermediate supply vessel and a large-deck type ship, such as an aircraft carrier. An offshore supply vessel is equipped with the ability to position itself dynamically and maintain station within 50 ft. of the aircraft carrier without the use of mooring lines or fenders. Offshore supply vessels are not typically equipped with the heavy lift gear (i.e. kingposts, highline, etc.) or personnel levels necessary for more traditional methods or cargo transfer such as heavy Underway Replenishment (UNREP). The projected need of transferring cargo to large deck ships also precludes the use of skin-to-skin mooring for cargo transfer operations. For this reason, the navy seeks innovative approaches to mine, develop and address implementation of new solutions within the existing and future maritime environment.

The cargo transfer system proposed shall be capable of transferring loads ranging from individual pallets weighing up to 12,000 lbs, to 20-ft ISO containers weighing up to 52,900 lbs. Loads shall be lifted to/from the deck of the supply vessel and transferred to/from a cargo elevator platform on board the large decked vessel. Approaches shall address the ability to transfer cargo at a rate of 360,000 lbs of cargo per hour in a Sea State 5 environment. The system shall be able to be configured with minimal manpower and time to execute. The cargo handling system cannot interfere with normal large deck vessel operations when not in use.

PHASE I: Demonstrate the feasibility of a cargo transfer system. Perform modeling and simulation as needed as a means of demonstrating feasibility. Provide a preliminary concept design and validation plan.

PHASE II: Design, develop and fabricate a working prototype of the proposed system. In a laboratory environment, demonstrate the capabilities of the proposed system as a means of validation. Develop a detailed plan and method of implementation into a full-scale application.

PHASE III: Working with the Navy, demonstrate the transfer of cargo between a dynamically positioned OSV to a large decked ship at sea 25 nm from shore. Develop specifications for incorporation into aircraft carriers or similar large-deck ships.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology being developed under this would translate directly to commercial vessels that normally operate offshore and must, at times, be re-supplied via sea. Examples of commercial applications include offshore petroleum exploration, production vessels, platforms, as well as cable and pipe laying vessels.

REFERENCES:
1. "Offshore Supply Vessel Positioning" by Mathewson, 1999
2. NWP 38(C) Replenishment At Sea
3. Janes Fighting Ships
4. http://www.fas.org/man/dod-101/sys/ship/cvn-68.htm

KEYWORDS: Cargo Transfer, aircraft carrier

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N06-058 TITLE: Advanced Structural Development of an Interior, Elevated Decking System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: DDG 51

OBJECTIVE: To develop an affordable, interior, elevated, decking system that requires significantly less maintenance and associated life-cycle costs compared to current Navy false decking systems.

DESCRIPTION: "Honeycomb" decking systems currently in service are labor intensive to install and maintain and utilize materials that frequently chip or break under heavy foot traffic or loads. This topic seeks to develop a lightweight, elevated, interior decking system based upon the use of innovative advanced materials and structural concepts. A decking system refers to the deck surface, framework, attachment devices and necessary structural support components. The system must allow access and airflow for services such as, but not limited to, wiring, piping or hoses that might be run underneath. The solution proposed should also address installation and mounting schemes to metallic sub-structures. Structural concepts proposed should meet or exceed the weight and strength requirements for the currently approved system while providing improved wear and reduced total ownership costs (combined initial purchase, installation, operation and maintenance costs). Solution proposed shall be compatible with current ship construction materials and design configurations.

During Phase II technology development and Phase III fleet integration, validation testing will be conducted to ensure that the proposed design meets applicable military requirements for shock, fire, smoke and toxicity.

PHASE I: Demonstrate the feasibility of the proposed decking system concept to meet Navy needs. Provide a preliminary concept design and an associated component validation plan.

PHASE II: Finalize the design concept from Phase I and fabricate prototype panels. Validate prototype capabilities using laboratory testing and provide results. Demonstrate proposed installation and repair methodologies. Develop a cost benefit analysis and a Phase III testing and validation plan.

PHASE III: Construct a full-scale prototype based on the Phase II results for testing in a shipboard environment. Working with the Government and Industry, install onboard a selected DDG 51 class hull and conduct extended shipboard testing.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial applications include all computer rooms, laboratories, stages and applied to any room or space that requires an abundance of wiring, piping, or hoses to be run underneath a floor structure. Other US Navy platforms and commercial ships as well as the commercial airline industry will also benefit from the development of a robust, reduced maintenance decking system.

REFERENCES:
1. UL 1709, "Rapid Rise Fire Tests of Protection Materials for Structural Steel", available upon request
2. MIL-S-901D, "Requirements for Shock Tests", http://assist.daps.dla.mil/quicksearch
3. "Nomex Honeycomb False Deck Panel Requirements", available upon request

KEYWORDS: Deck; Elevated Deck; Flooring; Low Maintenance; Lightweight; Fire Resistant

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N06-059 TITLE: Replaceable Inserts for Ship's Line Handling Chocks

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: DDG 51

OBJECTIVE: Develop an affordable, easily installed and maintainable insert for deck chocks of a suitable material to prevent wear and chaffing of mooring lines.

DESCRIPTION: Presently, navy ships experience rapid wear and chaffing in ship's mooring lines due to the excessive rubbing of the line against the steel, 7 x 14 inch deck-edge chocks. This directly results not only in abrasive damage to the line, but also in localized heating such that the surface fibers of the line become structurally compromised, resulting in significant weakening. Once the line is chaffed it fouls blocks, sheaves, and capstans while rigging. Currently, the mooring lines need to be replaced every 18 to 24 months due in-part to the wear and strength reduction as a result of the chock abrasions. Consequently, there is an industry-wide need for reduced friction, durable, chock inserts that are easy to install and maintain. The inserts need to be corrosion resistant, compatible with the current material systems utilized onboard ship so as not to accelerate corrosion or pitting on the chocks. Proposed concepts must not contribute to the fouling of the mooring lines; either by chaffing or by accumulation of products from the insert itself. Concepts should be suitable for application in a harsh marine environment, shall have negligible impact on the radar cross-section of the ship, and shall be colored so as to blend with the surrounding environment. The concept proposed must be durable enough to be able to accommodate the breaking strength of the largest and strongest lines (300,000 lbs. including a factor of safety) onboard a DDG Class ship. In order to prevent excessive chaffing, the riding surface of the chocks should be maintained smooth with a roughness of 125 micro inches or less. The technical risk in this topic is the application of an advanced material or material system that can be installed in areas exposed to extreme weather and environmental conditions while handling the loads and stresses routinely seen in a ship's mooring chock. Technology advances as a result of this topic are projected to increase the line of the mooring lines to approximately 5 years per line.

PHASE I: Demonstrate the feasibility of an easily installed deck insert that will reduce the abrasive friction and subsequent chaffing to the ship's mooring lines. Establish performance goals and metrics to analyze the feasibility of the proposed solution. Develop a test and evaluation plan that contains discrete milestones for product development for verifying performance and suitability.

PHASE II: Develop and demonstrate a prototype insert based on the Phase I design. In a laboratory environment, demonstrate that the prototype meets the performance goals established in Phase I and test in representative ship handling scenarios and provide results. Demonstrate installation, maintenance and removal methodologies. Develop a cost benefit analysis and a Phase III testing and validation plan.

PHASE III: Working with the Navy, develop an Engineering Change Proposal (ECP) for new construction ships, and a Ship Alteration (ShipAlt) for back-fit installation during overhaul or ship repair availabilities for existing ships in the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology addresses the prevalent problem of excessive line wear due to chock abrasion. This technology is directly applciable to the commercial maritime industry (shipping, off-shore platforms, hoisting and rigging, etc.) and the commercial marine recreation industry as well as having broad across platform applicaiton across maritime platforms with the DoD. If development of this technology is successfully, the product will be placed on the Qualified Products List (QPL) and eventually assigned a National Stock Number (NSN).

REFERENCES:
1. Naval Ship's Technical Manual (NSTM) 613 Wire and Fiber Rope Rigging , http://www.fas.org/man/dod-101/sys/ship/nstm/

2. Naval Ship's Technical Manual (NSTM) 582 Mooring and Towing,
http://www.navygirl.com/downloads/NSTM%20582%20Mooring%20and%20Towing.pdf
3. MIL-S-901D, "Shock Testing", available at http://assist.daps.dla.mil/quicksearch/

KEYWORDS: Chocks; Ropes; Mooring; Synthetic; Rust; Chaff; Corrosion; Smooth

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N06-060 TITLE: Self-Repairing Coatings

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: Development of a self-repairing coating system to mitigate corrosion for the purposes of extending the service life of ship structures and sub-components.

DESCRIPTION: Corrosion continues to be a significant life-cycle cost driver for both military and commercial ships. Additionally, the movement toward reductions in crew size will limit the availability of personnel to perform corrective and preventative maintenance actions. Innovative and economical ways to reduce manpower workload requirements in the area of shipboard corrosion control are needed.

This topic seeks to develop and implement innovative technologies that will allow for the development and use of "self-repairing" coatings for marine applications. The interest is in the development and application of coating systems that have the capability to repeatedly and/or as needed, "self heal" or protect themselves by filling-in or correcting damage such as cracks, scratches, etc. before the physical or electrochemical properties of the coating and of the base structure are compromised. The anticipated risk is in the ability to incorporate affordable technologies that will be able to self-repair or self-correct in a harsh marine environment which could include cyclic immersion/non-immersion applications in fuel, oil, and seawater. For the purposes of this topic, initial developmental performance benchmarks should be based upon requirements contained in MIL-PRF-23236 and MIL-DTL-24441 which are currently in use in the naval shipbuilding and maintenance industry. Solutions proposed should have a shelf-life of no less than one year and must be compatible with current application technology and equipment which is intended for shipyard and in-service use. The adverse environmental impact of the proposed technology should be negligible or no greater than that of currently used EPA compliant coatings.

PHASE I: Demonstrate the feasibility of a self-repairing coating for use in a harsh marine environment. Establish performance goals and metrics to analyze the feasibility of the proposed solution in various representative maritime coatings. Develop a Test and Evaluation Plan that contains discrete milestones for product development for verifying performance and suitability.

PHASE II: Develop and demonstrate a prototype self-repairing coating(s) based on the Phase I results. In a laboratory environment, demonstrate that the prototype product meets the performance goals established in Phase I and test it on various representative surface materials using a variety of application equipment. Evaluate the processes for ease of application and the associated cost and weight benefits of the proposed concept(s). Provide a plan for obtaining Navy certification for shipboard installation.

PHASE III: Utilizing the concepts developed during Phase I and II, work with Navy and industry to conduct detailed testing and to certify and implement this technology to existing and future surface combatant maintenance, corrosion control, and manufacturing sector use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would have a broad range of applications in commercial industries such as manufacturing, automobile, construction (infrastructure applications, bridges, etc.) and commercial shipbuilding.

REFERENCES:

1. White, S.R., Sottos, N.R., Geubelle, P.H., Moore, J.S., Kessler, M.R., Sriram, S.R., Brown, E.N., and Viswanathan, S., "Autonomic Healing of Polymer Composites," Nature, 409, 794-797 (2001).
2. Brown, E.N., Sottos, N.R. and White, S.R., "Fracture Testing of a Self-Healing Polymer Composite," Experimental Mechanics, 42, 372-379 (2002).
3. MIL-PRF-23236C, "Coating Systems For Ship Structures" via http://assist.daps.dla.mil/quicksearch/
4. MIL-DTL-24441C, "General Specification for Paint, Epoxy-Polyamide". via http://assist.daps.dla.mil/quicksearch/

KEYWORDS: self-healing; coating; corrosion control; marine applications; shipyard;

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N06-061 TITLE: In-Situ Application of Powder Coating Technology

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: Develop and implement an innovative approach for the in-situ application of power coatings to confined and/or constrained spaces at a greater thickness than current application methods will allow.

DESCRIPTION: The Navy's Program Executive Office for Ships is leveraging the National Shipbuilding Research Program (NSRP) to effect change across the non-nuclear surface shipbuilding, modernization and repair enterprise by coordinating with U. S. shipbuilders to adapt and implement "World Class" commercial best practices in the area of surface preparation and coatings. The U. S. shipbuilding second and third-tiered shipyards lag behind the global shipbuilding market significantly in this area and the introduction of new technology is key to improving the existing domestic coating processes.

Current powder coating processes are limited to applying dry-film thicknesses of 4 to 8 mils in a single application and frequently require a post-application, thermal treatment to cure. The equipment is cumbersome and limited to shop applications where the shipyard resources (electrical, water, high-pressure air, etc.) are concentrated and heat-treating furnaces are available. This topic seeks innovative, cost-effective scientific and engineering solutions to enable the application of powder coatings for Navy-approved resin systems in-situ for field applications. The approach proposed must be portable and should be operable by no more than two individuals. The approach must be capable of applying thick deposits in a single application and must not rely on a post-application elevated temperature "baking" treatment to cure the coatings.

Incorporation of these innovative approaches will reduce the cost and time for coating shipboard surfaces and reduce associated monitoring and inspection steps. Ultimately, the introduction of the new technology will provide significant savings to the shipbuilders and as well as the U. S. Navy. Portability and use in confined shipboard spaces are critical attributes of any solution, as well as compatibility with current and pending environmental, safety and health regulations. Candidate technologies that require limited shipyard resources (electrical, water, high-pressure air, etc.) are most desirable.

Of particular interest are initiatives with a clear business case. Proposals should specifically describe the technology that will be applied to solve the problem, how it will be developed, what the estimated benefits will be and how it might be transitioned into the shipbuilding industry. While NSRP members are available to provide guidance, assistance in the preparation of proposals and in the execution of efforts awarded from this solicitation, teaming or consulting with the shipbuilder and repair industry (both public and private yards) is not required and will not be a factor in proposal selection. Shipbuilding and repair industry contacts are available at http://www.usashipbuilding.com (under the Panels button) and http://www.nsrp.org. US Naval Shipyard information is available at http://www.shipyards.navy.mil.

PHASE I: Demonstrate feasibility for improvements being developed and also identify impact upon shipbuilding affordability. Include a first order Return-On-Investment (ROI) analysis for industry implementation and estimate potential Total Ownership Cost (TOC) reduction. Establish Phase II performance goals and key devlepmental milestones.

PHASE II: Finalize the design, as appropriate, and demonstrate a working prototype of the proposed system(s). Perform laboratory tests to validate the performance characteristics established in phase I. Develop a detailed plan and method of implementation into a full-scale application.

PHASE III: Implement the Phase III plan developed in Phase II in coordination with the shipbuilding and repair industry.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic shall be applicable to both military and commercial shipbuilding and repair practices and marketable to the shipbuilding and repair industry. The products developed should find wide use in the manufacturing, automobile, and construction (infrastructure application, bridges, etc) as well.

REFERENCES:
1. NSRP ASE Strategic Investment Plan, available on line at http://www.nsrp.org
2. Shipbuilding and repair industry contacts are available at http://www.usashipbuilding.com
3. US Naval Shipyard information is available at http://www.shipyards.navy.mil
4. MIL-PRF-2323C, "Coating Systems for Ship Structures" via http://assist.daps.dla.mil/quicksearch

KEYWORDS: shipbuilding; affordability; coatings; resin; application; automation;

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N06-062 TITLE: New Approaches to Shipbuilding Finishing and Assembly Operations

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: The objective of the project is to develop and implement new, innovative in-situ field manufacturing and finishing technologies that can impact the cost and cycle time to construct, modernize and repair Navy ships.

DESCRIPTION: The Navy's Program Executive Office for Ships is leveraging the National Shipbuilding Research Program (NSRP) to effect change across the non-nuclear surface shipbuilding, modernization and repair enterprise by coordinating with U. S. shipbuilders to adapt and implement "World Class" commercial best manufacturing practices. The U.S. shipbuilding industry lags behind the global shipbuilding market significantly in adapting new technologies to long-standing inefficient manufacturing processed and improvement is this area is key to closing this gap.

This topic seeks innovative scientific and engineering solutions to inefficiencies in the long-standing industrial shipyard in-situ, field, metal removal (i.e. hole drilling, surface machining) and finishing technologies for ship components. Portability, adaptability, precision and automation will be important attributes to consider in developing solutions. Of particular interest are initiatives with a clear business case. Proposal should specifically describe the technology that will be applied to solve the problem, how it will be developed, what the specific benefit will be and how it might be transitioned into the shipbuilding industry. While NSRP members are available to provide guidance and assistance in the preparation of proposals and in the execution of efforts awarded from this solicitation, teaming or consulting with the shipbuilder and repair industry (both public and private yards) is not required and will not be a factor in proposal selection. Shipbuilding and repair industry contacts are available at http://www.nsrp.org. US Naval Shipyard information is available at http://www.shipyards.navy.mil.

Efforts cited within each research area are illustrative only and proposals dealing with other efforts within the describe area of interest are also solicited. The research areas include:- In-situ rapid material removal- Precision hole-making (vice conventional drilling) in metallic components- Rapid non-contact, field inspection and documentation- Field-applied, Computer-Aided Design/Computer-Aided Manufacturing Approaches

PHASE I: Demonstrate feasibility for the solution being developed and also identify impact upon shipbuilding affordability. Include a first order Return-On-Investment (ROI) analysis for industry implementation and estimate potential Total Ownership Cost (TOC) reduction. Establish Phase II performance goals and key developmental milestones.

PHASE II: Finalize the design, as appropriate, and demonstrate a working prototype of the proposed system(s). Perform laboratory tests to validate the performance characteristics established in phase I. Develop a detailed plan and method of implementation into a full-scale application.

PHASE III: Implement the Phase III plan developed in Phase II in coordination with the domestic shipbuilding and repair industry.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic shall be directly applicable to current military and commercial shipbuilding operation and repair practices. The products developed should find wide use in most heavy-industry, construction and assembly facilities including the oil/gas industry and power plants.

REFERENCES:
1. NSRP ASE Strategic Investment Plan, available on line at http://www.nsrp.org

2. Shipbuilding and Repair Industry Contacts are available at http://www.usashipbuilding.com

3. US Naval Shipyard information is available at http://www.shipyards.navy.mil

KEYWORDS: shipbuilding; affordability; production; manufacturing processes; maintainability; equipment portability

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N06-063 TITLE: Application of a Uniform Coating Thickness for Complex or Irregular Surfaces

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: Develop and demonstrate an approach and the associated technology(ies) usable with a range of surface coating systems that will allow for the application of a uniform coating thickness to irregular or complex surfaces.

DESCRIPTION: Coating failures tend to occur most rapidly in areas of geometrical irregularity, on corners and on edges. While the Navy has invested in edge retentive coating systems, application procedures still require the application of multiple coats (primer, stripe coat on edges and corners, and a topcoat) due the the challenges inherent in coating complex and irregular surfaces. The application of mutliple coats is to insure that there are no exposed areas that would be susceptible to corrosion. The use of multiple coating layers to ensure adequate coverage directly translates to increased labor and materials costs.

This topic seeks the development of an approach to reliably deposit a uniform coating at a controlled thickness that could be used on a variety of surfaces. The reliable application of a uniform coating could eliminate the need for a "stripe" coat which would directly translate to an appreicalbe savings in labor costs. Areas of particular challenge are in tanks and voids where stiffeners, piping, and supports create areas that are nearly inaccessible to conventional coating spray equipment. The method chosen must be compatible with the existing range of surface coating systems. For the purposes of demonstrating concept feasiblity, initial developmental emphasis should be upon coating systems, primarily epoxies, currently in use in the naval shipbuilding industry such as those qualified to MIL-PRF-23236.

The proposed process must be operable in an industrial shipyard environment and must be portable to allow for operation in remote ship spaces by no more than two people.

PHASE I: Demonstrate the feasibilty of an approach for the application of a uniform coating thickness to irregular or complex structures. Establish performance goals and metrics to analyze the feasibility of the proposed solution. Provide a Phase II development approach and schedule that contains discrete milestones for product/prototype development.

PHASE II: Develop a prototype of the proposed Phase I concept(s). Using laboratory characterization experiments, validate the performance goals identified in Phase I. Provide manpower, cost-saving and performance metrics. Prepare an implementation and test plan that contains discrete milestones for product development for the purposes of obtaining necessary ceritificaitons for shipyard and/or manufacturing sector implementaion.

PHASE III: Utilizing the concept(s) developed during Phase I and Phase II, work with Navy and industry to approve and certify the proposed concept for use in Navy applications and then transition this technology to existing and futre surface combatant systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would have a broad range of applications in commercial industries such as manufacturing, automobile, construction (infrastructure applications, bridges, etc.) and commercial shipbuilding.

REFERENCES:

1. Kaznoff, A.I. and Brinkerhoff, B., "The Future of Marine Tank Coatings-A U.S. Navy Perspsective", Journal of Protective Coatings & Linings, Vol. 22, No. 2, Feb 2005, pg 40-44.
2. MIL-PRF-23236C, Performance Specification, Coating Systems For Ship Structures, Aug 2003. http://assist.daps.dla.mil/online/start/

KEYWORDS: coating; structures; application; automation; corrosion control

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N06-064 TITLE: On-Demand Curing of Surface Ship Coating Systems

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: Develop and demonstrate an approach and the associated technology(ies) that will allow for an "on-demand" curing of surface coatings systems currently utilzied in the naval shipbuilding industry.

DESCRIPTION: One of the most labor intensive and costly maintenance tasks is the periodic recoating of ship surfaces to mitigate the effects of corrosion. A major cost driver is the cure time associated with currently approved coating systems and available cure mechanisms. Curing time is a function of the chemistry of the coating system. While, investments have been made in the area of "rapid cure" as shorter cure times are desirable so that the multiple coats can be applied in the shortest practicable time, the reduced time to cure also directly translates to a reduced coating window. If the maximum re-coat time is exceeded, as is frequently the case in shipyard availabilities due to conflicting priorities, the base coat must be abraded manually at great expense to achieve a satisfactory surface for bonding the next coat. Utilizing the current "rapid cure" technology, the time required for a coating layer to cure before recoat on a current technology 4 hours with a window of about 5 days.

This topic seeks an alternative curing methodology, applicable to a range of surface coating systems that will allow for a on-demand control of the curing process thereby controlling the coating window(s). The proposed curing mechanism would be initiated once the individual coating application was complete, allowing for a independently controlled cure time and therefore an adequate window of time for coating systems with multiple coating layers. Proposed concept shall be compatible with conventional coating application equipment. The technical risk associated with this topic is in the development of a methodology applicable to a range of surface coating systems that balances the abilitiy to control cure rates and subsequent coating windows while providing long-term coating performance.

The proposed process must be operable in an industrial shipyard environment and must be portable to allow for operation in remote ship spaces by no more than two people. For the purposes of this topic, initial developmental emphasis should be upon coating systems, primarily epoxies, currently in use in the naval shipbuilding industry which are qualified according to MIL-PRF-23236 and MIL-DTL-24441.

PHASE I: Demonstrate the feasibilty of an alternative curing methodology for surfaces coatings. Establish performance goals and metrics to analyze the feasibility of the proposed solution. Provide a Phase II development approach and schedule that contains discrete milestones for product/prototype development.

PHASE II: Develop a prototype of the proposed Phase I concept(s). Using laboratory characterization experiments, validate the performance goals identified in Phase I. Provide manpower, cost-saving and performance metrics.

Prepare an implementation and test plan that contains discrete milestones for product development for the purposes of obtaining necessary ceritificaitons for shipyard and/or manufacturing sector implementaion.

PHASE III: Utilizing the concept(s) developed during Phase I and Phase II, work with Navy and industry to approve and certify the proposed concept for use in Navy applications and then transition this technology to existing and futre surface combatant systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would have a broad range of applications in commercial industries such as manufacturing, automobile, construction (infrastructure applications, bridges, etc.) and commercial shipbuilding.

REFERENCES:

1. Pilcher, G.R., “Meeting the Challenge of Radical Change: Coatings R&D as We Enter the 21st Century,” Journal of Coatings Technology, Vol. 72, No. 921, pg. 135-149, Oct. 2001.

2. MIL-PRF-23236C, Performance Specification, Coating Systems For Ship Structures, Aug 2003. http://assist.daps.dla.mil/online/start/

3. MIL-DTL-24441C, “General Specification for Paint, Epoxy-Polyamide”. http://assist.daps.dla.mil/online/start/

KEYWORDS: coating; application; automation; corrosion control; surface coating

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N06-065 TITLE: High Confidence Software and Automation in Submarine Systems

TECHNOLOGY AREAS: Information Systems, Materials/Processes

ACQUISITION PROGRAM: SSN 774

OBJECTIVE: Develop integration tools, procedures, methods and technologies to support modernization of complex shipboard embedded control systems, including real-time fault tolerant fly-by-wire systems. This includes the development of open architecture applications and integration tools and techniques to support improved mission critical submarine systems performance. Emphasis shall be focused on achieving improved operator and system performance by incorporating cost-effective procedures and methods relative to High Confidence Software and Systems (HCSS) design. Additionally, it shall include Automated Information functionality such as operator functions, time reduction in pattern recognition, human factors, ergonomics, cognitive principles, information management, information access, data display, attention to alerts, warnings and alarms, and intuitive presentation of metrics on ship’s mission effectiveness. Further, it shall include such technologies as meaningful metrics for planning and managing workload, use of intelligent agents; data mining of onboard ship data repositories, and query and analysis tools.

DESCRIPTION: The migration to fault tolerant fly-by-wire technology in the Virginia Submarine Control System (SCS) has led to major advancements in ship maneuverability and control. However, this capability has stressed current technologies, resulting in significant CPU utilization and processor loading. System improvements are expected to result in significant development and life cycle cost savings associated with reducing safety certification efforts, improving performance certification efforts with applicability to legacy subsystems. Application of High Confidence Software and Systems (HCSS) has become an emerging standard in the creation of “mission critical and high consequence of failure” systems. The goal of using a HCSS approach would be to analyze the design of mission critical systems in order to evaluate the potential failure points and correct these points early in the development process. This would result in a higher confidence at a lower cost. Research is needed that applies cost-effective, high confidence attributes to new and existing systems.

PHASE I: Research current HCSS technology and develop a Concept of Operations that details how HCSS and high confidence software can be implemented within a critical submarine embedded control system, including complex fly-by-wire systems, in meeting the objectives stated above. This shall include analysis and recommendations for utilizing applicable current and theoretical modern processes and technologies; correlation of all hardware and software in support of system integration and operational requirements on submarines; meaningful metrics, to better plan and manage workload related to maintenance, personnel, learning/educational delivery, and tactical assessment.

PHASE II: Develop a demonstration using the concepts developed in phase 1, including HCSS and high confidence software, to verify and certify a mission critical element on a Government designated submarine system. Develop proof-of-concept integration tools and test methodology prototype(s) to support the modernization process. Map and identify new hardware, software, middleware, firmware applications and technology, which use integration tools and architecture applications that will eliminate costly obsolescence issues, and significant improvements in operational performance, maintainability and reliability, and training thereby, reducing life cycle support cost. Identify segregated middleware and architecture applications that will reduce safety re-certifications by partitioning safety critical software from common, frequently updated basic functional software.

PHASE III: Install and test on board a designated submarine the Government approved HCSS tools and improvements developed in Phase 2.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This research has applicability in security-critical and safety-critical systems in the domains of transportation, electric power generation, manufacturing, oil and gas production, chemical production, and financial services.

REFERENCES:
1. Timothy W. Kremann, William B. Martin, and Frank Seaton Taylor. An avenue for high confidence applications in the 21st century. Proceedings from the 22nd National Information Systems Security Conference, 1999.
2. National Coordination Office for Information Technology Research and Development. High Confidence Software and Systems Program Component Area. http://www.itrd.gov/iwg/hcss.html, 2005.

KEYWORDS: high confidence, information systems, high consequence

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N06-066 TITLE: Non-Scanning 360 Degree LPI Radar

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS 435

OBJECTIVE: Development of a compact low-probability of intercept (LPI) radar, capable of simultaneously detecting and classifying both small and large fast and slow moving sea-surface targets in 360 degrees of azimuth in all weather.

DESCRIPTION: The Navy has requirements for a small, compact, medium-range sensor that can be installed on a submarine mast, small boat, unmanned underwater vehicle (UUV), ocean buoys and other littoral sites to rapidly survey the local area in detail and provide data to evaluate potential threatening activities.

Innovative concepts and system architectures are sought to provide the necessary capabilities in an affordable and flexible manner. Concepts are solicited that utilize high range resolution (in the order of 1 foot or less) and advanced signal processing to achieve good performance in sea clutter (up to sea state 5) and that enable accurate tracking of over 100 moving targets simultaneously.

The sensor should detect small craft (e.g., RCS < one square meter) within line of sight and yet be undetectable by conventional ESM equipment. The sensor should also be able to detect hazards to navigation such as floating logs, barrels and drums, growlers, and buoys. The sensor speed of response is critical, with a goal of less than two seconds.

Technologies and concepts are desired that support high-throughput, adaptive signal processing and complex-Image analysis.

PHASE I: Develop and demonstrate the feasibility of the proposed concept to meet the needs identified in the topic. Demonstrations can be through hardware, models and/or simulations.

PHASE II: Develop an engineering model and demonstrate its performance in the laboratory and shore-based installation. Demonstrate detection, range and angle resolution, and target tracking and classification capabilities in all-weather environment. Evaluate speed of response.

PHASE III: Integrate with associated ship systems. Build, test and evaluate a production design (or designs) for installation on submarines, small craft, and at shore bases.

REFERENCES:
1. J.N. Briggs, Target Detection by Marine Radar, IEE, 2004, ISBN 0 86341 359 5
2. F.L. Posner, Spiky Sea Clutter at High Range Resolutions and Very Low Grazing Angles, IEEE Trans. AES, Vol. 38 No., January 2002, pp 58-73.
3. A.W. Rihaczek and S.J. Hershkowitz, Radar Resolution and Complex-Image Analysis, Artech House, 1996.

KEYWORDS: Complex-Image, High-resolution, real-time classification, detection radar, LPI, small cross-section, signal processing, zero false-alarm.

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N06-067 TITLE: REAL-TIME OMNI-DIRECTIONAL HYPERSPECTRAL IMAGER

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop a compact and highly reliable omni-directional, hyper-spectral camcorder capable of simultaneous operation in low-light ultraviolet, visible and near-mid infrared light bands, covering an instantaneous 360-degree field of view and transmitting images in real time.

DESCRIPTION: The Navy needs a single sensor that will enable continuous collection and real-time transmission of images in the spectral range of 380 nm through 5 microns. The new imaging system must have high spatial resolution (a minimum of 1 mega-pixel), zooming capability for high resolution imaging within a selected, narrower field of view. The entire imaging system can be housed in a vertical cylindrical container of 6.8 inches maximum in diameter, and 12 inches high maximum. All critical sensor components (including the cryocooler for IR imaging camera) must be highly reliable and must work for at least 20,000 hours without replacement or maintenance (equivalent to MTBF>20,000 hour performance with 5,000 cooldown cycles of a state-of-the art cryocooler).

PHASE I: Perform design and analysis of such a hyper-spectral imager, define its performance characteristics (including, but not limited to, spatial resolution, spectral resolution, operation level of light, spectral coverage, zooming capability, speed of operation and data storage capability, power consumption and heat management), develop the associated assembly-level electronic circuits, and select the major components (including a cryocooler, if needed) for proving feasibility of the proposed system. Analyze all possible failure mechanisms and estimate sensor reliability, based on performance of all the optical, mechanical and cooling subsystems.

PHASE II: Design and develop a full-scale prototype hyper-spectral imaging system ready for periscope installation and conduct a land-based demonstration simulating at-sea conditions to show that it will be able to perform at sea according to Phase I design specs. Document the design and test results in a final report.

PHASE III: Design and fabricate production prototypes for USN, merchant marine shipboard installation for surveillance and force protection.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The real-time omni-directional hyper-spectral imager has the potential of being used by the merchant marine for surveillance, perimeter protection, home and business security systems.

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KEYWORDS: Hyper-spectral Imaging, Spectrally-Matched Filter, Contrast Enhancement, Low-light level, Sensor, Real-time Image Fusion, Cryocooler.

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N06-068 TITLE: Improved Aircraft Marker Lighting System

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Develop a flexible, large-area, tunable-wavelength marker lighting system for Naval aircraft.

DESCRIPTION: Progress in meeting the goals of Sea Power 21 will be enabled by reducing the weight and cost of Naval aircraft and improving their survivability and operational safety. Current technology for marker lights or formation lights is bulky (compared to thin films); too bright for use with night vision devices; and shape and wavelength limited, i.e., it does not uniquely identify individual aircraft. The Navy and Marine Corps needs simple, durable, and cost-effective visible and infrared (IR) lighting for orientation, communication, and identification tasks such as formation flying or identification friend-or-foe (IFF, see references 1-4). In addition, night vision compatible lighting for training systems (to include simulators and targets) would be very useful for increasing the proficiency of operators.

Recent developments in electrically conductive polymers (ECPs) have enabled the fabrication of thin, wightweight materials having electrical and optical properties that can be modified by the application of an electric field. This behavior allows these materials to show promise in applications ranging from corrosion protection and charge dissipation to optical emission where the wavelength of emission could be controlled by the chemical structure of the ECP, its processing into a device, and the properties of the applied electric field.

Recent advances in flexible lighting technologies (such as organic light-emitting diodes -- OLEDS) show promise in meeting the needs above. However, the present technology needs to be enhanced to meet the spectral, environmental, and durability requirements of the Navy. The devices should be stable to UV light and marine environments. They should exhibit good resistance to common military chemicals such as aviation fuels. The devices must be compatible with storage and operational temperatures ranging from –60 to +80°C without compromising performance. These devices should be lightweight, flexible, durable, and cost-effective -- requiring minimal power to operate.

Additional system attributes desired by the Navy include variable brightness, tunable emission across the visible and IR spectrum, and modified angular emission. The devices must be compatible with aircraft handling and maintenance procedures, and they should be simple to install and maintain; e.g., pressure-sensitive (removable, repairable, replaceable) application of preformed light emitting geometries is preferable. The light emission system must be integrated with current aircraft electronics and airframe structures and must not interfere with the aerodynamic performance of the aircraft or its subsystems.

PHASE I: Conduct research into development of marker lighting systems that provide the desired attributes which include: temperature stability, UV stability, environment stability, chemical resistance, variable brightness, wavelength-tunable visible and IR emission, pressure sensitive application, modified angular light distribution, ease of installation and maintenance as well as preformed lighting emitting geometries. Develop a laboratory model of the proposed device(s) and demonstrate tunable emission and variable brightness.

PHASE II: Demonstrate compatibility with operating and storage temperatures. Demonstrate UV, marine environmental, and chemical stability. Develop pressure sensitive application methodology. Develop cost information and design specifications for production devices.

PHASE III: Initiate production efforts to build devices in commercial quantities. Prepare transition packages for specific platform users or organizational and depot military support units.

PRIVEAT SECTOR COMMERCIAL POTENTIAL: A flexible, large-area, tunable wavelength marker lighting system can be used for commercial aircraft, marine and land vehicles or in any solid-state lighting application.

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KEYWORDS: Flexible Lighting, Thin Film, Infrared, Aviation, Marine

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N06-069 TITLE: Metrology for Ogive Infrared Dome

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Develop hardware and a procedure to measure the optical figure of deep concave optics, including an ogive dome.

DESCRIPTION: Infrared transmitting domes with aerodynamic shapes, such as a tangent ogive, are being developed to decrease the drag of a missile and increase range, speed, or payload. In the past, infrared domes have always been hemispheres because this shape introduces minimal optical distortion. Conventional optics technology can measure the deviation of a hemispheric dome from its ideal geometric shape to within a fraction of the wavelength of visible light. No corresponding metrology is available for nonhemispheric shapes, such as a deep ogive. The geometric quality of the dome is called the optical figure.

Goal: By the end of Phase II, the contractor shall produce hardware and software capable of measuring the optical figure of deep concave shapes, including ogives. Ideally, transmitted wavefront error should be measured. If it is not possible to measure transmitted wavefront, then a measure of reflected wavefront error would be acceptable.

PHASE I: Demonstrate a procedure to measure the optical figure of a shallow nonhemispheric concave optic. The contractor can define the shape to be measured in Phase I. The procedure must, in principle, be capable of extension to an ogive shape. The procedure should be demonstrated on a hemispheric polycrystalline alumina dome to be provided by the Government. Results of the new procedure should be compared to conventional measurements of the same dome.

PHASE II: Develop hardware and software capable of measuring the optical figure of infrared-transmitting domes with an ogive shape with a base diameter of 60-150 mm and an aspect ratio(height/diameter) in the range 1-2. Polycrystalline alumina ogive domes will be provided by the Government. These domes will have good transmission at wavelengths of 3-5 microns, but poor visible transmission.

PHASE III: Develop a commercial version of the hardware and software capable of application to a wide range of deep concave shapes.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The ability to measure deep concave optics could enable new optical instrument designs that are presently difficult to make and impossible to measure.

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KEYWORDS: metrology, optics, optical metrology, optical finishing, dome, missile dome, infrared dome

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N06-070 TITLE: Individually Adapted Web-based Training

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: The objective is to develop software compatible with the SCORM (Shareable Content Objects Reference Model) and other restrictions in the Navy web-based learning environments that will provide for individual adaptation of the instruction provided to the needs and characteristics of the individual trainee.

DESCRIPTION: Ever since computer based instruction was first proposed and developed circa 1960, adaptation to the needs of the individual learner has been promised. However, that promise has seldom been realized. The limitations of current web-based instruction are particularly severe in this respect. Recent research has shown that highly sophisticated individual adaption in artificially intelligent tutoring systems can provide one standard deviation improvement in achievement (for comparison purposes, 100 points is one standard on the SAT). Furthermore, recent research with the REDEEM authoring tool developed at the University of Nottingham showed that overlaying a much cruder approximation of intelligent tutoring control on conventional pre-existing computer-based instruction provided, on the average, a one-half standard deviation improvement in instructional effectiveness. As the collection of "shareable content objects" for modern web-based instruction grows, the potential for improving instructional effectiveness, including savings of trainee time and associated costs, is also growing. The challenge here is to implement capabilities comparable to those of the obsolete, pre-web REDEEM system and/or student modeling based on instructional objectives in a way that can function in the web-based, SCORM dominated environment. This may require advancing the current state of SCORM, a matter of both software and social engineering.

PHASE I: The contractor must design the proposed system, indicating what capabilities for individual adaptation of instruction will be implemented, in what way. The contractor must research the state of the current web-based training environment, especially as implemented by the U.S. military, and present a detailed analysis of the problems that must be overcome in order to implement a system for individually adapting instruction that will be widely accepted. Among these obstacles is likely to be a need to bring about an advance in the current state of the de facto "SCORM" standard. A plan for overcoming these obstacles must be developed in Phase I.

PHASE II: In Phase II, the contractor must develop a beta-test level system for adapting instruction that implements at least several important features that can be reasonably expected to improve instructional effectiveness, based on the past research. A demonstration application to some instructional content of interest to the military must also be developed to demonstrate that the system functions as intended. The contractor must also implement any activities identified by the Phase I analysis and plan that are needed to overcome social and organizational obstacles to the practical implementation of this new system for adapting instruction.

PHASE III: Phase III sales or further development would be expected to the various training organizations providing military training over the web, or to their contractors who would acquire the tool to apply it to existing content in any of the many training topics of interest to the military. Of course, the company receiving the Phase II contract might also develop substantial business doing these specific applications for military customers.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Web-based training is also a very large business in the private sector. Comparable, but probably even larger, potential exists in the private sector as well as the military sector. The "SCORM standard" has been very widely adopted for web-based training and education, even internationally.

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KEYWORDS: web-based training; computer-based training; artificially intelligent training systems; instructional effectiveness; adaptive instruction;tutoring

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N06-071 TITLE: Compact, High Performance HF/VHF/UHF receivers

TECHNOLOGY AREAS: Sensors

OBJECTIVE: To improve the sensitivity and dynamic range of current HF/VHF/UHF receivers so that more signals can be simultaneously received and resolved without increasing the unit's volume.

DESCRIPTION: The military HF/VHF/UHF bands span 2-500 MHz, many octaves in frequency, and can be received at very long distances thanks to the earth hugging nature of the dominant propagation mode. This causes them to be favored for military communications. Unfortunately, even on a buoy in the middle of the ocean, the signal density is so high that cosite interference is a major issue. Moreover, the wavelengths are so long that conventional resonant antennas are prohibitively large for any mobile platform. Thus current receivers use extremely electrically small antennas, are often quite narrow band in character instantaneously, and often do not have sufficient dynamic range to resolve all the signals in real time. Innovative solutions which combine wide band and extreme dynamic range components without noticeably increasing the legacy unit's size are particularly desired. Solutions that provide a basis for digital beam forming from small arrays of omni-directional antenna elements are also desirable.

PHASE I: Identify innovative components starting from the antenna and ending with a digital representation of the information present in each signal. Use these to produce an integrated design of HF/VHF/UHF receiver front-end. Simulate its performance and determine what further component development is required to deliver >120 dB of useful dynamic range over the entire band instantaneously and be compatible with packaging in a grid with 15 inch spacing.

PHASE II: Iterate one or more of the critical components and produce and test a brass board demonstration unit of the improved receiver front end. Design the first iteration of a packaged front-end.

PHASE III: Transition the receiver design to a surveillance platform program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Electrically small antennas are needed whenever the size of the wavelength is inconveniently large. Such low frequencies provide over-the-horizon connectivity without an elevated/airborne relay station. This includes "push-to-talk" mobile networks associated with taxi coordination in urban environments. Moreover, designs that work well at low frequencies are likely to be adaptable to other frequencies as well.

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KEYWORDS: HF; VHF; UHF; electrically small antennas; extreme dynamic range; over-the-horizon comms; precision direction finding; digital beam forming

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N06-072 TITLE: Modular Software Architecture for Advanced Weather Radars

TECHNOLOGY AREAS: Battlespace

ACQUISITION PROGRAM: NPOESS

OBJECTIVE: Develop a software architecture for advanced weather radars with modular device drivers, processing algorithms, and display functions that can be easily reconfigured when applied to different radar and data acquisition hardware.

DESCRIPTION: Understanding the Marine Atmospheric Boundary Layer (MABL) is critical to Naval activities in open ocean and the littoral zone. Advanced weather radars, incorporating full spectrum processing, pulse-to-pulse beam scanning and pulse coding are being employed to sense the MABL. Due to advances in PC technology, data acquisition systems for these radars may be built around PC-based digital receivers, with all processing and display algorithms handled by the host PC. Early systems built using this architecture, relied on custom software, integrating device drivers, processing and display algorithms into a single program. Many of the processing algorithms required for these systems are of a general nature, such as algorithms for spectral estimation, clutter removal, range/velocity ambiguity mitigation, and pulse compression. Other algorithms are specific to a particular system, such polarimetric calibration algorithms or pulse-to-pulse beam steering for systems using phased array antennas.

A software architecture that incorporates device drivers, processing algorithms and display functions into reusable modules, will provide the Navy with high performance processing tools that are readily reconfigured for each application.

PHASE I: A feasibility study will be carried out to define protocols for the creation of device drivers, processing algorithms, and display functions. A small scale demonstration of the Modular Software Environment (MSA) concept will be carried out for an existing radar system.

PHASE II: A fully functional MSA toolset will be created, including but not limited to device drivers for two or more radar systems; processing algorithms for clutter filtering, creation of FIR filter weights for pulse compression; full-spectral processing with moment estimators, and a variety of 1D, 2D and 3D display modes. This toolset will be installed and tested on two Naval radar systems to demonstrate the MSA concept.

PHASE III: Transition the MSA toolset into operational use in Naval radar systems, through continued product support and development to include documentation, calibration and other tools and spare parts. Support MSA instruments integration for government customer-specified platforms. Finalize requirements for a MSA system that would allow its utilization by various research facilities on a variety of platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Hundreds of weather radars are now in service which employ custom processors based on dedicated DSP or FPGA processors. The MSA toolset, running on standard PCs, will provide a low cost path to upgrade existing weather radars.

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KEYWORDS: Radar; Weather; Meteorology; Tactical; Battlespace; Environment

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N06-073 TITLE: Back Illuminated CMOS Detector Arrays

TECHNOLOGY AREAS: Sensors, Electronics

OBJECTIVE: Develop and demonstrate silicon foundry capability to manufacture radiation-hard back-illuminated Complementary Metal Oxide Semiconductor (CMOS) detector arrays needed to improve DOD and commercial sensors.

DESCRIPTION: The low-cost high-yield CMOS technology developed for digital memory fabrication is finding application in making low cost image sensor (detector) arrays. The CMOS arrays also have superior radiation hardness compared to CCD image sensors due to the fundamental differences in readout. One major limitation of these CMOS arrays for military and scientific applications is the reduction in net quantum efficiency due to the fraction of the pixel taken up by the readout circuits within each pixel. In addition, the spectral response of the front side illuminated CMOS array is limited compared to backside illuminated CCDs whose spectral response extends into the ultraviolet and the near infrared and provide 100% optical fill factor. Developing the capability to manufacture back-illuminated versions of CMOS arrays can improve system performance and reduce production costs for a wide range of military and commercial sensors.

PHASE I: Provide preliminary design of a back-illuminated CMOS image sensor. Investigate manufacturing issues related to fabricating such thinned (back-illuminated) CMOS arrays, and identify silicon foundries that are amenable to modifying/expanding their manufacturing process to make back illuminated CMOS arrays.

PHASE II: Design, fabricate and evaluate back illuminated CMOS arrays as used in a representative military sensor.

PHASE III: The goal of this SBIR program is to develop the capability within industry to manufacture back-illuminated CMOS arrays. The role of the small business in Phase III is to have the silicon foundry fabricate one or more such arrays that would significantly improve the performance of the image sensor in important military applications such as low light level imaging, laser detection, and radiation hard imaging, etc. The small business would evaluate the performance and radiation hardness of these arrays for such applications, and build imaging systems, instruments around these improved image sensors for military applications.

The benefits to the small business in Phase III will be substantial. Because CMOS focal plane arrays (FPAs) are much less costly than industry standard CCD FPAs, the development and production costs of FPA-based sensors could drop by an order of magnitude or more. With substatially lowered hardware development costs, small businesses would become competitive with larger defense contractors in this very lucrative market. In addition, lowered costs would open up commercial markets to systems such as spectrometers and hyperspectral imagers that were formerly only affordable for the military. Indeed, it is not unreasonable to expect high resolution digital video imagers to become a disposable commodity, equivalent in price to current disposable film cameras, opening up a vast and untapped commercial market.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The private-sector application of these back illuminated CMOS arrays would parallel those military applications where low power, low cost, and compact size are of value. This would include inspection of nuclear reactors/power plants, endoscopy, satellite-based star trackers, and night vision.

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KEYWORDS: Electro-optical sensors, CMOS imagers, focal plane arrays

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N06-074 TITLE: Vertical Utility Unmanned Aerial Vehicle Design and Technologies

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: Develop high speed (> 230 knots) vertical utility unmanned aerial vehicle design concepts and supporting technologies

DESCRIPTION: Development of high speed (> 230 knots) vertical utility unmanned aerial vehicle design concepts and technology are needed to make significant contributions toward naval goals and missions. Design concepts for the development of compact high speed rotary wing aircraft technologies with autonomous control and shipboard compatibility are needed. These vehicles should be compact and storable in 8'x 8' x 40' containers, capable of carrying a payload of about 3000 lbs, range of about 250 to 300 nm and operate in a moderate sea with about 1.25 to 2.5 m waves (Sea State 4). Innovative ideas are sought in key technology areas including stability of rotor system at high speeds, aeromechanics of high speed (recognition and avoidance of vortex ring states), maximization of hover time, flight controls with electric actuators to reduce maintenance and assembly times, independent blade control, high strength folding airframe with fail safe joints and hinges, autonomous control algorithms for takeoff and auto-land recoveries, stable flight during landing and take off on ships at adverse flight conditions due to ship air-wake environment.

PHASE I: Exploratory and proof of concept studies are sought for the development of high speed (> 230 knots) vertical utility unmanned aerial vehicle in the areas of vehicle conceptual design and/or supporting technologies, including flight controls with electric actuators, flight controls with independent blade controls, autonomous control algorithms for take off and auto-land recoveries on ships with adverse flight conditions and vehicle foldability and compactness.

PHASE II: Development of high speed (> 230 knots) compact vertical utility unmanned aerial vehicle design and technology is sought through integrated/ component breadboard/laboratory validation testing in the key technology areas: design, flight controls with electric actuators and independent blade control, autonomous flight control algorithms for take off and auto-land recoveries on ships with adverse flight conditions and demonstrate scalability of the design.

PHASE III: Mature the phase II design and develop it for application on a future Vertical Utility Unmanned Air Vehicle platform

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Private industry will also benefit by the development of the compact scalable vertical utility unmanned aerial vehicle design and technologies. The unmanned rotorcraft can be used for dropping medical supplies in human crisis situations such as flood, hurricane and earth quake and it can also be used in border patrol and home land security applications.

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KEYWORDS: High speed rotorcraft technology, foldable and compact, autonomous landing and take off, ship board environment, scalable, independent blade control and electric actuators

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N06-075 TITLE: Field Medical Sterilizer to be used in Austere Environments

TECHNOLOGY AREAS: Biomedical

OBJECTIVE: Development of a portable, lightweight, ruggedized medical sterilizer which can be powered by a variety of fuels or variable voltage 120/220/24V DC electrical supplies to provide sterilization capability for surgical and dental instruments for medical units operating in austere environments.

DESCRIPTION: There is a current need for a replacement for the existing portable steam autoclave sterilization units currently in use by the Marine Corps. The existing system is large, heavy, obsolete, is no longer produced and spare parts are unavailable. The replacement appliance should be of similar capacity and throughput, but should be much lighter and safer to use. It should be capable of sterilizing unwrapped instruments, wrapped trays (2 per cycle), delicate fabrics, hollow tubes, and non metallic materials such as rubber and vinyl. Any approach that achieves full sterilization by standard tests will be considered, including, but not limited to, wet and dry steam, vacuum, ozone, chemical, ionizing or plasma radiation. Operator safety is a major concern, therefore the system must comply with all current standards for similar devices, and not require the handling or discharge of hazardous materials.

PHASE I: Develop an appliance design and development plan that provides the indicated capability

PHASE II: Develop and test a prototype appliance under field conditions. Tests would be to document sterilization of medical instruments/fluids/materials to acceptable standards

PHASE III: Conduct engineering and manufacturing design efforts that result in a production representative prototype device, to include all safety and performance features and certifications with instruction and training manuals.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This appliance could be used by medical, dental and veterinary personnel operating in wilderness/austere environments, or in urban areas in the event of disruption of power supplies due to natural or other disaster, or where portabble sterilization of medical instruments is required.

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KEYWORDS: Medical; sterilization; clinical; autoclave

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N06-076 TITLE: Use of Adaptive, Non-line of Sight Smart Sensors to Recognize and Locate Threats to Physical Assets and Field Forces

TECHNOLOGY AREAS: Sensors, Electronics, Human Systems

OBJECTIVE: Develop highly sensitive sensors that identify, recognize, and locate non-visual events such as perimeter breaches and the presence of personnel performing suspicious activity, especially when not visible due to darkness or obstructions.

DESCRIPTION: To date, the use of sensors for detection of threats have depended on trained human specialists to analyze an event to determine the level of severity and appropriate response. This consumes valuable manpower that is predominantly idle and without the tools necessary to highlight specific events and areas for them to focus attention and analysis. With pressure based and acoustic smart sensors these events can be identified especially amidst high noise and urban environments. The intent of this research is to isolate algorithms and approaches that can discriminate with a high degree of accuracy specific acoustic or pressure wave signatures, especially in highly volatile environments such as battle fields.

PHASE I: Demonstrate the feasibility, capability, and costs for manufacturing smart sensors that detect and recognize target sounds, recommend a design that improves upon current sensors, and provide a preliminary design for demonstration. Analytically show that the proposed concept provides the required acoustic performance.

PHASE II: Build a prototype of hardware consisting of a smart sensor processing unit, communications, and sensors. Additionally create a library of threatening sounds including RPG, AK 47, Mortars. In addition, adapt the technology so that it can work in tandem with a moving HUMVEE and provide complimentary support for convoy troops moving through danger zones by identifying the weapon and its location within one second.

PHASE III: Develop a full scale system for deployment in the field with key acoustic and pressure signatures adapted and ready to operate.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The resulting technology can be readily used in law enforcement, border protection, pipeline security, and as a non-invasive sensor for detecting bearing failure, power line aberrations, etc.

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KEYWORDS: Smart sensors; Acoustic Recognition; neural networks; temporal pattern recognition; gun shot detection/location; I.E.D.s; homeland security

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N06-077 TITLE: Modeling and Prediction of Asymmetric Threat Learning Processes

TECHNOLOGY AREAS: Information Systems, Sensors

OBJECTIVE: Develop an automated tool for enemy course of action prediction that accounts for enemy learning. The desired outcome is a system that not only gracefully adapts to changes in enemy patterns of behavior, but ideally is able to identify successful variations from established patterns even more quickly than the enemy can recognize these successes. This would allow U.S. forces to anticipate significant changes in enemy strategy even before such changes have been fully implemented.

DESCRIPTION: In current U.S. operations, terrorist and insurgent forces enjoy a significant advantage by being able to launch surprise attacks, whether by small arms, mortar, or improvised explosive devices (IEDs), against weakly defended or undefended targets and disappearing before U.S. forces can concentrate for a counterstrike. Better prediction of where and when such attacks are most likely to occur would therefore be of great benefit, allowing smart allocation of defensive resources as well as preparation for quick counteroffensive operations in response to terrorist and insurgent attacks. This task is significantly complicated by the fact that modern terrorist groups demonstrate an ability to learn and adapt quickly, making it difficult to predict future actions on the basis of past actions.

Recent work1 has applied and extended discrete choice models originally developed for use in econometrics2 to predicting the spatial probability of criminal activity. These point-pattern based density models have also been applied to the military domain for prediction of terrorist strikes3 and IEDs. The result is that the geographical patterns established by past events can be used to build threat maps showing where future strikes are most likely to take place, with accuracies notably better than hot-spotting techniques. The same basic strategy seems likely to be applicable to prediction of the timing of such activities as well as their location.

The technique utilizes as inputs a series of IED incidents or attacks in an area of interest and over a fixed time interval and geographic information system layers for the named areas of interest that provide the values of attributes or features that are known or believed to be relevant to the occurrence of the attacks or incidents. Attribute model parameters are derived from legacy data. The models typically contain large numbers of attributes, such as population density, proximity to a police station, distance to a mosque, etc. From case to case different attributes and different numbers of attributes are important. For example, when this technique was applied to bombings in greater Jerusalem, it was found that a single attribute, the distance to a controlled intersection, was an accurate predictor.4

A fundamental limitation of the techniques as they stand, however, is that they do not model changes in the subjects' decision-making processes; they must currently assume that the subjects' preferences are static. This limits the time horizon over which predictions are of use, and can cause periods of very poor prediction performance when a significant change in strategy occurs. An extension of discrete choice models that allows for learning-directed evolution in the subjects' decision-making processes would greatly improve their applicability to dynamic military situations.

PHASE I: Phase I should accomplish work related to the following:
* Develop and/or refine spatial-temporal choice models to predict both the time and location of terrorist and insurgent activity.
* Develop an understanding of the attribute space in terms an ontology for terrorist or insurgent behavior
* Connect the attributes semantically, so that observed changes in the importance of one attribute is understood in the context of the relative importance of all attributes
* Extend the techniques to dynamically identify and extrapolate trends in decision-making to improve prediction accuracy in the face of learning and adaptation (automatically recognize changes in the relative importance of attributes or when the attribute space no longer models the decision process)
* Develop techniques to mine local and remote data stores to detect changes in attribute value or attribute importance
* Develop techniques for identifying variations on existing patterns that are most successful, thereby anticipating what learning and adaptation is likely to take place

PHASE II:
* Develop automated tools to describe the terrorist decision process in terms of an ontology of measurable attributes
* Develop tools to counter the learning space available to the terrorist
* Build a prototype system able to interface with Marine Corps tactical intelligence sources
* Conduct a demonstration of the prototype on real-world data

PHASE III: The phase 2 product would become a service available to all source fusion engines (IAS, DCGS, MCISRE) and command and control engines (GCCS). Improved knowledge of where terrorists and insurgents are most likely to strike next will allow U.S. forces to effectively concentrate their efforts to defeat the asymmetric threat. This will not only contribute to defensive operations, saving lives of civilians and U.S. servicemen, but will also contribute to quick and effective counterstrikes to weaken and eliminate enemy forces. The same techniques can be applied to civilian law enforcement to counter gangs, organized crime, and other groups with the capacity to adapt their patterns of behavior through experience.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would have direct application to the development of business decision support and prediction tools as well as to law enforcement.

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KEYWORDS: Adaptive learning, enemy course of action, decision support tool

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N06-078 TITLE: Manufacture of Energetic Materials From Renewable Feedstocks Using Engineered Microbes

TECHNOLOGY AREAS: Materials/Processes, Weapons

OBJECTIVE: Commercially exploit developing academic strengths in genomics, biotechnology and bioprocessing to design, implement and scale-up processes for the economic and pollution-free biosynthesis of key precursors of Navy energetic materials from renewable biofeedstocks, and/or to demonstrate and scale-up the ability to nitrate the core structures of such precursors using microbial bionitration pathways.

DESCRIPTION: The dual-use biotechnology to be developed will replace increasingly unaffordable chemical syntheses from non-renewable petroleum feedstocks, and will substitute secure US renewables and domestic biotechnological infrastructure for expensive and potentially unreliable foreign sources. The dual-use features (e.g. chiral synthons that are usable in the pharmaceutical industry, or commodity chemicals such as coatings) are essential because the DoD market will be relatively small.

PHASE I: The first area of interest is the construction of a metabolic pathway in a suitable microbial host that produces a precursor to a Navy/DoD energetic material using a renewable biofeedstock. Examples of such precursors which have been biosynthesized are a) Butanetriol (ref. 1), which is chemically nitrated currently to generate butanetrioltrinitrate, a component of the Hellfire missile propellant. b) Phloroglucinol (trihydroxybenzene, ref. 2), which is chemically converted to triamino-trinitro-benzene (TATB). TATB is used as an insensitive high energy material in bomb fuses and other applications. Examples of new precursors to be biosynthesized are any one of a variety of high-nitrogen materials such as alicyclic hydrazines, triaminoguanidine, aminotetrazole, or dimethylpyrazole tetrazine. Proposers are encouraged to discuss target compounds with the topic writer. The second area of interest is the construction and demonstration of a bionitration pathway. The substrate to be nitrated is to be chosen after discussion with the topic writer.

PHASE II: The microbial pathway(s) constructed in Phase I is to be optimized at 1 liter scale under fermentor-controlled conditions to give yields of 15-50 g product per L. The process is to be scaled-up to 100 L and subjected to cost-analysis (including any required extractions of e.g. polyols from biofeedstocks). The biosynthetic product will be validated by the appropriate DoD facility. During this time planning should be initiated for partnering in the private sector with a company capable of manufacture at the ~50,000 L scale.

PHASE III: Partner with a manufacturing company to enable transition of the fermentor-controlled microbial synthesis of the targeted energetic material precursor to the private sector for acquisition by the appropriate DoD facility.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Depending on the energetic material that is targeted, there will be a variety of opportunities to exploit high-value intermediates in the bioprocessing stream. Such intermediates may be involved in the pharmaceutical production of important drugs for example, where chirality is essential. Alternatively, if aromatic rings are generated from biofeedstocks in the course of energetic precursor biosynthesis, coatings and adhesives in the commodity chemical sector are potential civilian products.

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KEYWORDS: Biosynthesis; energetics; propellants; microbial; green; affordable

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N06-079 TITLE: Millimeter Wave Imagery for Maritime Domain Awareness and Force Protection

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors

OBJECTIVE: Develop and implement a set of real-time image processing algorithms for interferomic passive millimeter wave imagery (pmmW). This will be done using hardware acceleration in a compact, lightweight, and low power system. The system will be able to implement different processing algorithms by reconfiguring the accelerator on a millisecond time scale. Real pmmW imagery will be gathered and processed with this system using motion tracking, super-resolution, distributed aperture synthesis, and feature extraction. More specifically, the system will be able to synthesize and process mmW imagery to provide enhanced sensitivity at sub-Kelvin noise equivalent temperature difference (NETD), it will provide super resolution on a wavelength/10 scale, and it will be able to extract features and identify objects of interest at video rates.

DESCRIPTION: The ability to perceive and image the immediate and nearby environments, regardless of weather, plays a significant role in Maritime Domain Awareness (MDA), navigation and anti-terrorism/force protection (AT/FP). The maritime environment typically has aerosol contents significantly higher than terrestrial environments (e.g. marine haze, fog). Additionally, the lines-of-sight (LOS) in maritime AT/FP or MDA are much longer than in urban environments. For these reasons, USN/USCG forces conducting maritime AT/FP or MDA missions need mmW sensors, where US Army/USMC forces may use terahertz (THz) sensors.

While imaging technologies have been developed in the visible and IR regions of the electromagnetic spectrum there is an emerging region that is becoming of increased importance, namely the millimeter wave region (mmW). This region of the spectrum remains relatively untapped from an imaging perspective, due primarily to technology limitations. However, recent progress has been made that promises to deliver key capabilities in this regard. Unfortunately, such systems are inherently limited by resolution due to the longer wavelengths in this region of the spectrum. For this reason, it is imperative to combine sophisticated image processing algorithms with key developments in sensor technology. With this being said, the implementation of such enabling algorithms must be done in a real-time nature in order to ensure the use of such systems in realistic scenarios. Accordingly, algorithms that afford motion compensations, super-resolution, distributed aperture synthesis, and feature identification and extraction are of particular interest. Therefore, the goal of this topic is to develop in tandem both mmW image sensors along with advanced image processing algorithms that can be implemented in real-time using hardware acceleration.

PHASE I: Develop a suite of image processing algorithms that can be implemented in hardware for real-time processing on millimeter wave imagery. Prototype implementation of candidate algorithms must be demonstrated and their acceleration targets must be clearly analyzed in the context of realistic scenarios. Candidate mmW imaging systems must be analyzed and initial hardware implementations demonstrated.

PHASE II: Building off the Phase I algorithms and prototypes, a combined system capable of running complex imaging processing algorithms for motion compensation, super-resolution, distributed aperture synthesis, and feature extraction will be implemented along with a suitable mmW imaging systems for real-time mmW imaging.

PHASE III: Design, build, test and demonstrate a prototype passive millimeter wave tactical imaging sensor system based on the the technologies proven in phases I and II. Demonstrate this sensor system in maritime environmental conditions which would prohibit the use of visible or infrared imagers. Perform anti-terrorism/force protection and situational awareness imaging for shipboard application. The sensor system would expected to integrate as a technology increment/upgrade for the Shipboard Protection System.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The resulting system will have a significant impact in the area of security and inspection for various commercial applications including: portal screening, border patrol, search and rescue, and navigation. Aircraft and ship pilots/watchstanders would have live imagery through marine haze, fog and light rain enabling greater situational awareness and improving safety of flight/navigation.

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KEYWORDS: pmmw; passive millimeter wave imaging; realtime; interferomic imaging;AT/FP; maritime

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N06-080 TITLE: Integrated real-time lidar/mission management package for airborne environmental reconnaissance

TECHNOLOGY AREAS: Air Platform, Battlespace

ACQUISITION PROGRAM: NPOESS

OBJECTIVE: Develop an in-flight software system that integrates outputs from lasers and in situ particle probes to provide real-time display of the aircraft's environment relative to atmospheric layering, velocity shear and visibility.

DESCRIPTION: The Navy is actively engaged in developing an understanding of the marine atmospheric boundary layer (MABL), its effects on Naval activity and its incorporation into weather forecasting models. Lower tropospheric winds and aerosols are two primary interests of the Naval research. Winds govern the wave states, the energy and momentum fluxes between the atmosphere and the water, the transport of aerosols and gases and impact the performance of aircraft and munitions. Aerosols have major impacts on radiative processes, visibility, multi-spectral mapping, and a variety of practical issues of importance to the Navy. One interesting aspect of atmospheric aerosols is that their distribution in the vertical is often characterized by layering. This layering posses both opportunities and obstacles for Navy operations.

Aerosol detection systems are used to measure airborne particles ranging from a few microns to several millimeters. These are in situ measuring devices mounted on the aircraft and thus only sense the aerosols along the flight path at flight level. Lidar's use a beam pointing system to obtain profiles of the winds and aerosols above and below an aircraft. This capability offers the potential for real time input to mission decisions regarding optimal flight levels and context for the in situ observations.

The system to be developed should integrate information from aerosol probes with information from a lidar and to display the results in a manner suitable for use in real time.

PHASE I: Feasibility study of the hardware and software requirements for developing an fully integrated system for the processing and display of Lidar and other atmospheric information. This study would be carried out using existing data and simulations where appropriate.

PHASE II: Build a prototype of the integrated data/display system and demonstrate its performance on board an aircraft. The tests should involve observations both of aerosol and lidar wind data. Develop a commercialization (Phase III) plan, including descriptions of potential customers, missions, demonstrations and transition efforts to be performed.

PHASE III: Transition the system into operational Lidar data/display system to include documentation, calibration and other tools and spare parts. Support Lidar data/display system integration for government customer-specified platforms. Finalize requirements for a Lidar data/display system that would allow its utilization by various research facilities on a variety of platforms, including aircraft, ships or ground based operations.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The lidar information offers a real potential for use on a number of military and commercial aircraft where winds and visibility (aerosols) above and below flight level are critical to mission decisions or the comfort/safety of passengers.

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KEYWORDS: Doppler wind lidar; aerosol backscatter; airborne Doppler wind lidar; atmospheric winds and aerosols; realtime data display; realtime data fusion

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N06-081 TITLE: Blast Resistant/ Fire Resistant Polymer Coating

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: Develop Explosion Resistant Coating [1] with superior fire resistance capability (or combined with durable intumescent coating or integral insulating layer(s)). The goal for fire-resistance is to pass the requirements of fire growth in ISO 9705 Room Corner fire test for a period of 20 minutes in accordance with the U.S. Navy criteria [2].

DESCRIPTION: Low-cost elastomeric polymer coatings have been shown to increase the blast and ballistic performance of steel plating by absorbing high energy. The objective of this SBIR is to formulate and synthesize lightweight cost-effective blast resistant polymer coatings with enhanced fire resistance, including additives, development of hybrids e. g. with silicons, intumescent coatings, and/or integral insulation layers. Fire resistant polymer, or combine the polymer with fire retardant or durable intumescent coatings to provide the required fire resistance.

PHASE I: Identify chemistry of polymer and agents to provide the mechanical properties for blast and ballistic mitigation. Identify the chemistry for fire resistant/fire retardants without deteriorating the mechanical properties required for blast and ballistic performance. Submit qualified samples to the Navy for small-scale flammability and blast mitigation testing flame spread and smoke indexes (ASTM E-84), and cone calorimetry (ASTM E 1354) [3].

PHASE II: Optimize blast /ballistic performance and move on to larger scale flammability and blast resistance testing. Submit optimized materials to the Navy to demonstrate ISO 9705 Room Corner fire test for a period of 20 minutes in accordance with the U.S. Navy criteria [2].

PHASE III: Optimize the properties, investigate durability and provide means for scale-up.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to Navy ships and MC vehicle applications, the proposed material applications have a a very wide spectrum of applications in Homeland Security, commercial aircraft and public transportation.

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KEYWORDS: Explosion Resistant Coating, Fire Protection, Polyurea, Fire resistant coating, intumescent coatings

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N06-082 TITLE: Flameless Oxidation/Combustion

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

ACQUISITION PROGRAM: F/A-18E/F

OBJECTIVE: Analyze the issues involved in applying high inlet air temperature oxidation/combustion (Flameless Oxidation/Combustion) process in high speed propulsion systems, and to optimize the relevant parameters to enable design and building of next generation propulsion engines for stable, quieter, and longer range operation, with multifuel capability.

DESCRIPTION: Flameless oxidation/combustion is the process of conversion of stored chemical energy in a fuel by burning it with air at higher temperatures (but below NOx formation temperature) over the entire region of the combustion chamber rather than with a propagating flame front from a flame holder as in conventional engines of today. The flame becomes invisible (flameless) with uniform temperature distribution resulting in stable operation, improved performance, reduced noise and emissions and excellent lean blow off capability. The high temperature of the incoming air (air-breathing engine) is obtained by mixing it with hot combustion products in atmospheric combustors. However, in aero engines, due to the high pressures and the high velocities of combustion reactants and products, innovations in preheating the air, as well as in producing sufficiently high temperature oxidant at initial start-up, will be required. At higher operating pressures, the higher chemical reaction rates make the flame distribution more difficult. Another major challenge is reducing the ignition delay, which becomes more crucial for fighter aircraft engines where the bypass ratio is smaller and the flow path is short. Distributed fuel injection and turbulent two-phase mixing in confined geometry is to be addressed for various pressure and velocity (altitude, Mach number) conditions and densities of ambient air in order to ensure a uniformly distributed mixture that when ignited releases heat uniformly at various flight conditions. The ideal location to extract combustion products, their distribution etc. and/or the locations and characteristics of fuel injection are to be determined. Conservative estimates from results of atmospheric combustion indicate that due to the increased energy release rates and improved pattern factors, reduction of 20% NOx emission and 10% increase in efficiency are possible. The influence of flameless combustion on improvement in the thrust generated, and other benefits obtained need to be quantified and the process optimized for maximum performance benefits. For Navy applications, high speed multiphase mixing phenomena with JP-10 fuel has to be investigated to determine approriate fuel injector design, identification of locations of fuel injection, particle size and distribution etc. Performance analysis should also include extension of life cycle of combustor components due to reduced pressure oscillations and thermal fatigue.

PHASE I: Design and fabricate and test (or perform numerical experimentation) a simple combustor at above atmospheric pressures to identify parametric conditions required to achieve distributed combustion in flameless or near flameless mode, and evaluate its operation (temperature distribution, flame characteristics, pressure oscillations, emissions and noise).

PHASE II: From the information obtained from Phase I, design and fabricate the components required for conversion of an existing (small) engine to flameless oxidation mode. Perform extensive tests to prepare performance maps at various ambient conditions (pressure, temperature, velocity) and possibly more than one fuel. Develop computational tools for performance evaluation, and optimization. Study the effects of catalysis on performance.

PHASE III: Design, fabricate and package the add on components in a government-provided full size engine. Evaluate static performance. Validate the computational model, and apply it for performance prediction, and optimization of geometrical parameters, fuel injection, air inlet and combustion products flow. Extend the computational predictions for forward flow conditions, and validate the model. Perform forward flight in a suitable wind tunnel facility. After optimization by numerical prediction, perform optimized test. Finally perform flight tests to evaluate the effectiveness of this concept in actual operation.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Application of flameless combustion to high speed aero-propulsion system represents the most difficult scenario. The technology developed in this program can be applied to commercial aircraft to minimize emission and noise, and to reduce the cost per passenger mile (by improving combustion and reducing fuel consumption). Due to the uniform temperature distribution and avoidance of hot spots, maintenance cost will be reduced, and engine operational life will be increased. The methodology can be utilized for commercial power plant and industrial power applications. This means that propulsion and power engine manufacturing companies, airframe integrators, the aero and power industry will benefit by this program

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KEYWORDS: flameless oxidation; didtributed combustion; pattern factor;NOx emission; high-speed propulsion; combustion instability; noise

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N06-083 TITLE: Processing Methods to Fabricate Reliable Device Elements of PMN-PT Piezoelectric Single Crystals

TECHNOLOGY AREAS: Materials/Processes, Sensors, Weapons

OBJECTIVE: Devise and demonstrate cost-effective methods to fabricate quality wafers and appropriate device elements from PMN-PT single crystal relaxor piezoelectrics, (having the extraordinary electromechanical properties of high coupling: 90-95 %, and high strain: ~ 1 %) for manufacturing practical devices for defense and civilian applications.

DESCRIPTION: Near the onset of 1997 came the discovery that single crystals of certain relaxor ferroelectric materials (lead magnesium niobate – lead titanate, and lead zinc niobate – lead titanate) exhibit extraordinary piezoelectric properties, namely, strains exceeding 1%, and electromechanical coupling exceeding 90% (compared to 0.1% and 70-75 %, respectively, in state-of-the-art piezoceramics). Concerted efforts to grow these materials in a variety of forms (bulk, multilayer, fibers, thin films, etc.) now yield materials in quantities, and at a price, suitable for device prototyping. Efforts to demonstrate prototype device performance are underway.

At this early stage of development, cutting, polishing and finishing is not fully developed, the machining can increase the final device cost by more than 50%. Technology is needed to control the surface perfection for reliable and reproducible manufacturing. This topic aims to devise processing methods that control surface machining defects to reduce the manufacturing cost and to increase reliability of the final products. While the materials technology being developed should target an application arena (for example, to define the form—bulk, fiber, film, multilayer—in which the piezocrystal is produced), that application is only incidental to the work performed. Nevertheless, clearly establishing a linkage between the proposed processing technology to a targeted application of importance to the Army, Navy, or Air Force would provide a big plus.

PHASE I: Design and demonstrate the feasibility of an innovative machining methodology that substantially lowers the cost of device production and increases in reliability and reproducibility. The final report must present an analysis of the manufacturing cost (capitalization, labor, materials) in a production, not development, mode.

PHASE II: Implement the innovative processing technology and demonstrate "zero batches" production for some candidate application. Validate cost projections in detail. Survey potential manufacturing markets and access capital investment needed for production at various annual rates.

PHASE III: Manufacture materials for applications in the defense sector ranging from Navy sonar, through Army rotor blade control, to Air Force airfoil shape control. In the civilian sector, applications target for this materials technology include medical ultrasonics, active machine tool control, and vibration suppression in HVAC systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In the civilian sector, applications target for this materials technology include active machine tool control, vibration suppression in HVAC systems, medical ultrasonic diagnostic imaging, piezo-hydraulic actuator for all-electric aircraft, actuators for active aircraft value control, electromechanical optical cross-bar switches, seismic acoustic accelerometers, and more.

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KEYWORDS: Materials Synthesis/Growth Technology, Electromechanical Sensors and Actuators, Smart Materials, Vibration Control, Shape Control, Acoustic Transducers, SONAR, Piezoelectrics, Single Crystals, Lead Magnesium Niobate –Lead Titanate, and Lead Zinc Niobate – Lead Titanate.

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N06-084 TITLE: Development of Materials for Load bearing Sonar Windows

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Sensors

ACQUISITION PROGRAM: DD(X)

OBJECTIVE: The purpose of this effort is to develop improved rigid acoustic windows for Navy applications.

DESCRIPTION: The Navy desires rigid acoustic window materials that are strong enough to function at the outer hull-seawater interface, admit sound without reflection, transmit sound without absorption, yet dampen unwanted ship noises and vibrations. Current approaches to such windows may involve polymer matrix composites in which additional components can be for reinforcement, density adjustment, or to dampen ship noises. One reason for this announcement is the development over the last few years of a number of commercially available liquid curable fluoropolymer resins, which may have favorable sound speed properties relative to epoxy and vinyl ester resins. Glassy fluoropolymers, however, may present challenges as composite matrix resins due to adhesion and toughness problems. Thus, this topic is not limited to fluoropolymer approaches.

PHASE I: The objective of Phase I is to develop a new approach (new matrix resin) to rigid acoustic windows. In phase I, a material should be developed that has: (1) the structural properties of a typical epoxy (4% strain at break, modulus greater than 3 GPa, tensile strength greater than 80 MPa); (2) a longitudinal sound speed that is close to water (1500 m/sec) to avoid lens effects at angles (1200 to 2000 m/sec); (3) a "specific acoustic impedance" (the density x sound speed product) that is close to water (water impedance is 1.5 E6 kg/(m^2 sec), target range is 1.0 to 3.0 E6 kg/(m^2 sec)). The performer will supply samples to the Navy at the end of the phase I. The Navy will provide some measurements to guide development during phase I, however, the performer should be able to track progress with simple ultrasound and density measurements.

PHASE II: Work in phase II will lead up to a demonstration item. Work will continue toward optimization of acoustic performance. Specifications for the demonstration item may include increased mechanical and thermal properties beyond that required in phase I and optimization of the noise attenuation properties.

PHASE III: Successful completion of Phases I & II will lead to manufacture of a large scale test item with full acoustic characterization and possibly a new approach to rigid acoustic windows for the Navy.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Acoustic sensors are no longer purely the business of the Navy. Improved acoustic windows would find application in the medical instrument industry, as well as instruments used in the oil exploration and commercial fishing industries.

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KEYWORDS: acoustic windows; fluoropolymer; composite; polymer; sonar; matrix resin

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N06-085 TITLE: Understanding of Multi-Source Wireless RF Network Structures

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop an automated, near real time approach to achieve understanding of multi-source wireless RF network structures.

DESCRIPTION: Traditionally, analysis of wireless RF networks has provided only limited operational information and understanding of wireless organizational structures.

Continuing interest in the structure of wireless RF networks is articulated in current Information Operations doctrine. Requirements for understanding wireless network capabilities have also been articulated in multiple requirements documents throughout the military services.

Recent efforts to analyze multi-source wireless RF networks have focused on the graphical display of links and nodes. However, the analytic process behind many of these systems remained distinctly manual with individual analysts responsible for determining network details and updating the graphical system. These tools are distinctly non-real time and are not operationally oriented.

Future wireless networks will be increasingly complex and no longer constrained to a single well defined structure. With technology supporting high bandwidth, reliable and secure networks over local areas, the “last mile” is now a critical element in understanding multi-source RF wireless networks. The social hierarchy operating a wireless network may remain constant, but the growing ability of multi-source wireless networks to expand, contract, self organize and repair themselves dynamically now present major challenges. These dynamic technologies require a novel approach to achieve understanding of these multi-source wireless RF network structures.

Development of an automated, near real-time and reliable network tool is necessary to understanding emerging wireless network structures and capabilities.

PHASE I: Develop a system design for understanding of wireless networks structures that will have input from multiple disparate, geographically dispersed sensors. Include proposed system architecture for Phase II development. Identify key parameters for input to fusion algorithm and provide detailed discussion of a network understanding protocol/algorithm.

PHASE II: Develop and test the Multi-Source RF Network Understanding tool. Include interface design for accepting diverse data streams. Rigorously test and evaluate the network understanding algorithm.

PHASE III: Prepare user-friendly Multi-Source RF Network Understanding software toolkit. Complete interface for diverse data sensor streams. Complete Graphical User Interface and coding for integration into other data bases.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Automated understanding of diverse network structures has application in computer forensics as applied to military, industrial and law enforcement problems. Advances in understanding the interface of wireless structures would have potentially wide applicability to supporting the development of commercial RF systems feeding consumer voice/data requirements.

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3. Wireless Sensor Networks: Architectures and Protocols by Edgar H., Jr. Callaway, Edgar H. Callaway, Publisher: Auerbach Publications (August 26, 2003) Language: English ISBN: 0849318238

KEYWORDS: Sensors, Fusion, Automation, Algorithm, Expert System, Learning, Network.

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N06-086 TITLE: Tactical Secure Voice/Variable Data Rate Inter Working Function

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Develop a system architecture for a Inter Working Function (IWF) (i.e: gateway), combining an open platform based telephony switch interface to a Secure Voice over Internet Protocol (SVoIP) type terminal. In addition, this device shall utilize the Naval Research Lab (NRL) developed Variable Data Rate (VDR) Vocoder. This solution shall provided the capability to merge legacy secure voice systems, commercial telephony systems, and IP networks with a tactical capability for secure voice over IP. This solution improves voice quality, interoperability, reconfigurability, and upgrade capability for Fleet narrowband secure voice.

DESCRIPTION: Operation Iraqi Freedom illustrated a huge surge in the use of secure voice. A significant portion of this surge was the employment of secure voice involved tactical radio links and mobile users. Normally these links are subjected to extremely low data rates, where the voice quality was inadequate. Efforts to align the Secure Voice program with FORCEnet and the Global Information Grid (GIG) Net-Centric architecture have made it possible for users to efficiently and dynamically share communication and data networks. The practical, flexible resource sharing and utilization capabilities presented by this technology offer advantages for the Department of Defense (DOD) and Department of Navy (DoN) communications. It is possible to support the requirement for secure voice over IP data networks, given sufficient data throughput capacity, acceptable data delivery latency at the link layer, and proper application design. Integration of voice communication services along with other data services offers the following advantages.

1. An efficient utilization of limited communications bandwidth and resources.
2. More efficient communication resource utilization by reducing the need for dedicated, leased voice coordination circuits.
3. A potential common core technology for secure voice applications for DOD and DON.

This effort will concentrate on designing an open architecture IWF and identifying technical solutions for the development of a bridging capability for SVoIP to legacy crypto. This will be the first step towards integrating legacy secure voice systems and modern commercial telephony. The purpose of this effort is to initiate this technology transition, while developing some of the more essential features of a prototype radio gateway and the tactical VoIP application. For example, a dynamic variable data rate processor that provides most efficient use of IP bandwidth (a FORCEnet goal) for voice traffic. This enhancement will allow secure voice operation in a net-centric environment on and across any platform, where all voice must be IP based. The variable data rate processor and a multicast capability will provide a dynamic bandwidth management tool for support to multiple platforms. The gateway will provide a reliable, secure and a modern to legacy device bridging communications service, which is a major FORCEnet objective. This device should incorporate the Future Narrowband Digital Terminal-210/230 (FNBDT-210/230) signaling plan and be able to support low bandwidth secure voice and data applications over High Frequency (HF), Ultra High Frequency (UHF) Line of Sight (LOS), Extreme High Frequency (EHF), Low Data Rate/Medium Data Rate (MDR), and Super High Frequency (SHF) designated Radio Frequency (RF) mediums. This pertains to both netted and point-to-point operations. This effort will provide a Joint Interoperable narrowband secure crypto capability for DOD and DoN with enhanced capabilities such as rapid reconfigurability, improved security and improved voice quality.

PHASE I: Design an Inter Working Function (IWF) that will support the insertion of new technologies and algorithms while maintaining backward compatibility with legacy tactical secure voice devices (ANDVT/KY-58). This IWF will be based on the Variable Data Rate vocoder and allow for a necessary interface which shall bridge modern and legacy secure voice cryptos. This baseline investigation will lead to solutions to be developed in Phase I and II.

PHASE II: Develop a prototype IWF system supporting Voice over Internet Protocol (VoIP) to a narrowband tactical device. This solution shall integrate the more essential features of a prototype radio gateway and the tactical VoIP application, e.g., the dynamic variable data rate processor that provides most efficient use of IP bandwidth.

PHASE III: Develop and integrate a tactical secure voice variable data rate device for SVoIP capability. This effort will pave the way for a tactical secure VoIP capability, which is the first step towards integrating legacy secure voice systems and modern commercial telephony which is critical for the DOD and DON. This tactical VoIP application technology transition, while implementing some of the more essential features of a prototype radio gateway provides a most efficient use of IP bandwidth (a FORCEnet goal) for voice traffic.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This open architecture design will support the various requirements and technologies, provides interoperability among DoD, coalition, FEMA, homeland security, and first responders. Health care, banking and security organizations can both use and contribute to this architecture and technology for SVoiP..

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4. Selsius Skinny Station Protocol
5. H.323 Call signaling and control
6. MIL-C-28883 Military Specification for the Advanced Narrowband Digital Voice Terminal (ANDVT) Tactical Terminal (TACTERM) CV-3591.
7. CJCSI-6510
8. NRL/FR/5550--01-10,016

KEYWORDS: Crypto; Secure; Mobile; Encryption; Data; Tactical, Variable Data Rate

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N06-087 TITLE: Service Oriented Architecture (SOA) Adaptation for Realtime Intelligence, Surveillance, Reconnaissance

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics, Battlespace

OBJECTIVE: Investigate and develop a Service Oriented Architecture (SOA) software framework to enable realtime multi-INT ISR sensor networking within Navy Fleet and Airborne operational environments. The proposed SOA should support transition from existing Joint Force standards to emerging frameworks for interoperation.

DESCRIPTION: Service Oriented Architectures (SOA) that enable automated discovery and interoperation among heterogeneous assets are required to manage the growing complexity of Joint Force operations for persistent multi-INT ISR. Most SOA research efforts to date have focused on backend systems for data management, sharing, exploitation, fusion, and analysis. There is a corresponding critical need for SOA techniques applied to front end sensor networking applications to manage increasing complexity in that domain. However, such realtime control applications operating over disadvantaged data communications networks in multi-level security (MLS) environments present special challenges. In addition, seamless transition is needed from existing sensor network control systems based on legacy techniques (such as fixed format binary messaging), to emerging SOA frameworks to avoid capability gaps. Existing approved Joint Force standards of interest include, but are not limited to, the Airborne Overhead Interoperation Office Joint Interface Control Document (AOIO JICD) for COMINT and ELINT interoperation, and NATO STANAG 4586 for IMINT interoperation. Emerging architectures of interest include, but are not limited to, the Net-centric Enterprise Solutions for Interoperability (NESI) and the DCGS Integration Backbone (DIB).

PHASE I: Perform a feasibility and design study to assess technical issues and risks associated with applying SOA techniques to real-time sensor networking applications in Navy operational environments. Show how the proposed SOA framework can be used to support both existing standards and emerging architectures.

PHASE II: Develop a prototype sensor networking system based on the SOA framework developed in Phase I. Under the Phase 2 Option task, the prototype software will be demonstrated in a distributed testbed facility supplied by either the government or the contractor.

PHASE III: Refine the Phase 2 prototype and demonstrate it as part of a Navy exercise. Transition the prototype to production readiness for incorporation into Navy ISR systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Adaptation of SOA frameworks for use in realtime sensor networking applications can be applied to many commercial problems including monitoring of large civilian infrastructure such as bridges and dams.

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2. Distributed Sensor Networks : A Multiagent Perspective (Multiagent Systems, Artificial Societies, and Simulated Organizations) by Victor Lesser (Editor), Charles L. Ortiz Jr. (Editor), Milind Tambe (Editor), Springer, 2003, ISBN: 1402074999.

KEYWORDS: Net-centric, ISR, SOA, NESI, sensors, software

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N06-088 TITLE: Biometric Identity Verification for Sailors in Battle Dress

TECHNOLOGY AREAS: Information Systems, Electronics, Human Systems

OBJECTIVE: This project intends to demonstrate biometric identity verification while the person being identified is in Navy battle dress, which denies access needed to collect ‘traditional’ biometric identifiers.

DESCRIPTION: Verification of Sailors’ identities on a warship is important for maintaining security of classified information. Applications for biometric identification include physical access control to spaces containing classified information and logical access control to classified information systems. However, conditions which require battle dress make ‘traditional’ biometrics unusable because battle dress covers the sampling sites such as the fingertip, iris, and face for intrinsic biometrics, or obscures transmission of performance biometrics such as voiceprints. A biometric is needed that is able either to physically penetrate the margins of Navy battle dress to verify the wearer’s identity without compromise to the user’s safety, or to sample a biometric identifier satisfactorily through battle dress.

- Solutions involving biometric sensors embedded in the Sailor's uniform or battle dress components are not acceptable because of inflexible cost and maintainability constraints upon these items and because shipboard battle dress components are standardized (i.e. matching components to a particular person or watchstanding function is forbidden by damage control doctrine).

- To support integration with prior biometric access control work, the proposed solution must be able to compel the individual to be located in a particular place at the time the biometric sample is taken; an implementation approach such as tethering a sensor probe to the remainder of its electronics would satisfy this requirement.

PHASE I: Familiarize company with prior Navy and other DoD agency biometric access control concepts and prototypes. Prepare a feasibility study assessing the practicality of building demonstration equipment to implement a biometric sample for personnel identification in Navy battle dress conditions with the users wearing standard (i.e. not customized for this application) Navy uniforms and battle dress. The technical challenge presented in this SBIR topic is not building an access control system; it is building a sensor capable of identifying previously-enrolled persons while they are wearing Navy battle dress comprised of only standard components.

PHASE II: Design a sensor useful in the scenario discussed above. Develop a concept of operations appropriate to the proposed biometric. Both the hardware and concept of operations must be able to be integrated into previously-developed Navy and other DoD agency biometric access control systems. Build and demonstrate a working prototype biometric sensor that could be used in conjunction with a battle dress uniform without compromising the protection that battle dress provides the wearer. Develop a marketing plan.

PHASE III: After a successful demonstration, system commands from all Services and USSOCOM will likely have an interest in using such a biometric for applications where identity verification is important and battle dress or chemical warfare protective conditions may exist.

PRIVATE SECTOR COMMERCIAL POTENTIAL: Identity verification is an important part of physical and information security, industrial safety (particularly for personnel accountability in hazardous areas such as mines or prisons), and other business processes. Biometrics are an alternative to passwords, PINs, identity tokens (such as badges, tags, and chits), keys, etc. for these applications, and offer several compelling advantages. However, 'traditional' biometrics require unimpeded access to a sampling site on the person being identified. In many hazardous situations, industry has requirements for protective gear similar to Navy battle dress (e.g. eye protection, steam suits, chemical protective gear, clean room 'bunny suits') which impedes this access. Any industry needing to positively identify personnel dressed in protective gear could use the results of this effort. Specific applications could range in sophistication from door-locks to integrated personnel tracking and access control systems.

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2. NAVSEA's page for the shipboard General Quarters hood at http://www.dcfp.navy.mil/equip/gqhood.htm
3. NAVSEA's damage control and firefighting equipment website at http://www.dcfp.navy.mil/equip/equip.htm
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KEYWORDS: biometric, identification, access control, hazardous environment, battle dress, noninvasive trait measurement

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N06-089 TITLE: Cross-Domain RSS Processor and Router

TECHNOLOGY AREAS: Information Systems, Sensors

OBJECTIVE: Create Service Oriented web tools enabling cross-domain data flows while reducing bandwidth utilization. Near-real time C2ISR data feeds are ubiquitous across military networks. Such feeds provide SAR images, tracks, ordnance loads, force dispositions, and so on. This research proposal seeks integrated solutions to three key problems with existing information feeds: support for legacy systems and legacy data sources, ability to route data to where it is needed, across network and even across classification boundaries, support for delivery to the wide range of devices in use at the network edge.

DESCRIPTION: Almost-real time information feeds are ubiquitous across military networks. Such feeds provide SAR images, tracks, ordnance loads, force dispositions, and so on. The need has been established for advancements in the processing of these feeds, especially toward the goal of making them accessible to edge devices. This research proposal seeks integrated solutions to three key problems with existing information feeds:

1. Legacy Systems: Messages feeds come from a variety of legacy sources, with little standardization of security markings and other meta-data. Research is required into methods and technology to allow legacy gateways to be developed which can convert legacy message feeds into a modern message format such as RSS with appropriate XML-based meta-data markup, and using modern TCP/IP networking for message forwarding. The large number of legacy feeds means gateways must be highly and rapidly configurable.

2. Cross-domain Systems: Messages come from distinct networks and sensor feeds. The security marking of a message is often implied by the network the data originated in. However, a message is only useful if it can reach those who need the information. Typically, this means some messages may need to cross network, and hence potentially classification, boundaries. Research is required into methods and technology for specifying how messages may be downgraded, filtered, merged, and routed between networks using a message router node in a way which respects the security policy.

3. Message Delivery: As portable and handheld devices becoming more prevalent, it becomes possible to push message feeds all the way to the network edge. However message feeds must be delivered in a way appropriate for the available bandwidth and display capacity of the client. Research is needed into methods and technology for specifying how information should be simplified using a message front-end for delivery to such devices, especially when using COTS HTML and RSS browsers.

RSS is an example of an XML syndication standard. What this means is that the data format is self-describing XML, and that the server (in the diagram above, the message front ends) supports a “publish and subscribe” data dissemination model. In this model, a device registers interest in a particular feed (by subscribing). As a result, when the front-end receives new information in that feed, the device is directly notified of the availability of new data. This contrasts with the “polling” model supported by traditional web servers and browsers, in which devices must constantly ask each data source whether there is new information in a feed.

RSS is particularly appropriate for processing and routing C2ISR data feeds because it scales both to high-performance systems as well as low-power edge devices such as handheld or embedded devices. A high-performance system, either in a server, desktop, or broadband-connected laptop can run COTS “RSS Aggregators” that process many streams of high bandwidth data feeds. A low-power embedded device can subscribe to a smaller number of select feeds and format them for appropriate display or action.

Any potential solution to cross-domain data feed processing and routing must be High Assurance, evidenced by being certifiable to EAL6, so that it may be used to span at least three clearance levels (Confidential / Secret / Top Secret). Any COTS components such as operating systems and application software that are used in the solution architecture must operate at a single level only. In particular, the architecture of such a system must not incorporate such COTS software into the trusted computing base (defined as all those software and hardware components which could cause a breach of the multi-level security constraint were they to be designed, implemented, configured or operated incorrectly). It is an essential part of this SBIR topic that COTS technologies be used, but that the use of COTS technologies does not interfere with the certifiability of the total MLS architecture.

In summary, this SBIR requires research into solutions meeting the following technical requirements:
1. Multi-level data feeds: process data feeds at multiple levels, with different formats and transform them into an XML syndication format with metadata that includes security and network labeling.
2. Multi-level routing: filter, aggregate, downgrade (when necessary) and route data from source feeds to destination devices. The cross-domain regrading may involve data-type specific filtering, integrity or "dirty-word" filters. In addition, perform other domain-specific transformations based on the data type or the edge device requirements or environment.
3. High assurance: the solution must be certifiable for deployment in Secret and Below environments. Both design and implementation must use formal techniques to achieve the desired certification.

PHASE I: Develop a system and software architecture for cross-domain data feed filtering and routing. Identify at least two use cases with differing data feed sources and edge devices.

PHASE II: Develop a low-level design and implementation of a proof-of-concept system that demonstrates the feasibility of multi-level data feed processing and routing.

PHASE III: Build the multi-level data feed processor and router, and certify it to EAL6. Identify a target environment within the Navy and/or DoD, and deploy the finished, certified product.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Air Force BAA GIGSG/ES 01-Jan-2005
Data Fusion and Edge Devices
Multiple platforms have the capability to create and publish C2ISR data feeds as web services to both the classified and unclassified networks. These include SAR images, FLIR, video, Blue and Red force tracks, force dispositions, ordnance loads, GMTI, and hundreds of other distinct data feeds. Research is needed on innovative web services for fusion of such feeds into information accessible to the edge devices (i.e., low bandwidth, portable or handheld systems) used by the warfighter in many diverse scenarios and operations.

In the commercial sector, RSS is a common protocol for distributuing summaries of news stories and new postings to web portals. Enabling highly secure RSS data flows has the potential to be leveraged by industry, government organization, and anyone with data to protect and information to disseminate.

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2. http://blogs.law.harvard.edu/tech/rss

KEYWORDS: RSS, Cross Domain, multilevel security (MLS), EAL-6, certified

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N06-090 TITLE: Dynamic Broadband RF Spectrometer

TECHNOLOGY AREAS: Information Systems, Electronics, Weapons

ACQUISITION PROGRAM: MCS (ATCCS)

OBJECTIVE: To develop a broadband RF spectrometer that will enable true real-time spectrum management, with dynamic band reallocation and optimal spectral utility.

DESCRIPTION: Current communication systems are limited to static band allocation in order to avoid potential spectral conflict and reduce possible RF interference. A broadband spectrum monitoring system is essential for maximal utilization of available spectral resources to meet the growing demands on information throughput. The Joint Tactical Radio System (JTRS) requires accurate monitoring of about 2 GHz of spectrum with the ability to zoom in, under software control, on narrow sub-bands (1 MHz or smaller) with frequency resolution in the kHz range. Other military applications (SIGINT and EW) require monitoring of wider bandwidths, 20 GHz and beyond. Broadband spectrum monitoring schemes that scale to ultra-wide frequency ranges are required.

PHASE I: Devise a broadband spectrometer scheme with zoom capability that can be integrated in a multi-channel receiver. Approaches that perform direct digitization at RF for both spectrum calculation and signal reception, avoiding analog down-conversion, are preferred.

PHASE II: Develop and demonstrate spectrometer hardware implementing the scheme developed in Phase I. Build a communications transceiver subsystem that incorporates the broadband spectrometer.

PHASE III: The broadband spectrometer could be inserted into future JTRS radio family members as a pre-planned product improvement. Other applications include SIGINT, SSEE and EW systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Broadband spectrometers have various applications, such as spectroscopy for Homeland Security, commercial wireless communications and astronomy.

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KEYWORDS: Broadband; Autocorrelating; Spectrometer; Spectrum Monitoring; UWB frequency; direct digitization.

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N06-091 TITLE: Micro-Camera for oceanographic properties and shallow water hydrography

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles, Sensors, Battlespace

OBJECTIVE: Develop a small, low-cost video camera with an integrated inertial measurement unit and navigation system to accurately geo-reference the ocean's surface within the cameras view with sufficient accuracy to estimate spatial character of the directional wave spectra and infer water depths. In addition, the system should have the ability to process the georectified video images into hydrographic (water depth) maps. The entire sensing subsystem system should be small enough to be integrated into small inexpensive UAV platforms. Minimizing weight, size and power are key design constraints needed to increase the utilization on very small vehicles. The goal is to provide an accurate map of water depth based on the output sensing system without use of any other information.

DESCRIPTION: The very shallow water and surf zone is a highly dynamic environment and the ever-changing morphology makes wave, current and surf forecasting difficult if not impossible. These characteristics also are critical factors that govern future evolution or erosion of the coastal environment. The ability to forecast these changes are critical for Naval operations in the littoral but are also important to ocean engineers and communities that are located along coastlines. An inexpensive and rapid technique to monitor coastal conditions would be valuable to both military and civilian planners. This topic suggests a solution through the development of a small inexpensive sensing system composed of tightly coupled video-navigation-inertial measurement components into a compact integrated system that can be installed and operated on small Unmanned Aerial Vehicles. This system must have the ability to provide a mosaic of images through very accurate geo-rectification without use of ground/ocean surface based landmarks. The accuracy must be sufficient to accurately estimate wave characteristics and infer water depths from the very shallow water wave structure.

PHASE I: Develop a prototype system with interpretation algorithms and test the system to evaluate accuracies in camera orientation and estimate level of motion correction expected. Integrate with navigation subsystem and define the camera system's resolution and ultimate accuracy of geo-rectification without any ground-based landmarks.

PHASE II: Develop a fully functional unit with data processing algorithms. Conduct flight tests and refine design for production and integration in two candidate UAV platforms. Provide a quantitative measure of the accuracy of the inferred environment properties (directional wave spectra and water depths) in a complex shallow water setting. Document the accuracies in water depth and wave spectra with respect to the known conditions over a realist range of shallow-very shallow water settings.

PHASE III: Develop a transition plan to use the system for both Naval applications as well as civilian application such as coastal engineering and erosion monitoring. Specifically, the developer shall work with the Littoral Battlespace Sensing, Fusion and Integration Program at PMW180 to transition the technology onto small UAV platforms used in Littoral Warfare operations.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Transition plan for cost effective coastal monitoring to permit rapid assessment of hydrographic changes such as those caused by significant storm events. In many cases, surface based in-situ techniques are not possible or are dangerous due to debris and unknown Bathymetric changes. Also, this technology can make a direct contribution to improving the accuracy of remote surveillance and targeting systems on small aircraft

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KEYWORDS: Hydrographic measurements, directional wave spectral, Unmanned Aerial Vehicles, littoral warfare

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N06-092 TITLE: Wi-Fi From the Sea

TECHNOLOGY AREAS: Information Systems, Ground/Sea Vehicles, Sensors, Battlespace

OBJECTIVE: Investigate and develop a long range (goal 25 nm) Wi-Fi (802.11/802.11b/g/n) ship-to-ship and ship-to-shore communications and detections capability suitable for use in a dense interference environment present aboard a Navy surface combatant ship.

DESCRIPTION: The Navy requires a long range S-band Wi-Fi capability to facilitate high bandwidth data communications and detection capability in the littoral (near shore) and blue water (at sea) environments onboard surface combatant ships. The interference environment is expected to be significant primarily from near continuous scanning pulsed radar emissions expected to approach +40 dBm at specific frequencies in the P through X-bands. The desired Wi-Fi link range goal is 25 nautical miles linking from the ship to conventional omni-directional Wi-Fi access points. Directive antennas will be required to achieve necessary power gain and narrow beamwidth for selectivity from interfering nodes. Directive antennas must comply with Navy combatant radar cross section reduction and relevant MIL-STD-810 environmental requirements. Directive antennas must include integrated capability to interface with ship's gyroscope systems to provide a stabilized system which will allow operators to train the antenna based on true (vice relative) bearing. Innovative electronic techniques (such as high temperature superconducting filters in combination with cryocooled LNAs) will be required to reduce noise figure to near zero while at the same time rejecting the intense onboard interference environment.

PHASE I: Survey, evaluate, and select technologies and design an architecture to achieve the required capabilities. Conduct a link analysis of the proposed technologies/architecture to predict the expected range against conventional omni-directional access points that are within the line of sight. Develop a plan for the development of the required capabilities including cost, schedule, and required support.

PHASE II: Develop a prototype and demonstrate the ability to link 25 nm to a line of sight (and beyond) conventional omni-directional Wi-Fi access point while operating in a high interference environment. To save costs for the prototype demonstration the system antenna system may be waived from the requirements for gyroscopic stabilization and environmental requirements.

PHASE III: Develop a highly reliable fully military specification compliant system suitable for the intended employment onboard Navy surface combatant ships. Fully developed system must effectively communicate with onboard communications networks and surveillance systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL: The Wi-Fi from the Sea topic will encourage the development of technologies and architectures that will be of great interest to both military and commercial organizations. These organizations desire the capability to inexpensively leverage commercial network communications standards over much greater than the originally intended distances. The maritime industry seeks inexpensive and higher capacity alternatives to scarce and expensive satellite data bandwidth. All branches of the military are seeking wide bandwidth data communications that is survivable in a high interference environment.

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KEYWORDS: Superconductor; Wi-Fi; 802.11; Surface Ship; Data Communications. Sensors

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N06-093 TITLE: Future Antennas

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

OBJECTIVE: To improve the performance of the antennas located in the OE-538 mast. This improvement could be either increased gain to support higher data rates or increased bandwidth antennas to support multiple RF frequency bands. By using the same antenna for multiple frequency bands, the number of antennas located in the mast can be reduced, thereby freeing up space for other critical capabilities to be located in the mast, for example Iridium (L-Band) and Ku Band.

DESCRIPTION: The OE-538 is the multifunction mast on US submarines. This mast provides RF communications for the submarine covering the VLF, MF/HF, VHF, UHF frequency bands as well as GPS and IFF functions. There are several antennas inside the mast to support theses bands, therefore, the space available inside the mast is compact and is currently fully utilized. The limited space available in the mast will limit the gain and bandwidth of the existing antennas, therefore, limiting the submarines ability to support high data rate communications. Additional performance will require innovative solutions possibly in areas such as erectable antennas, radome embedded antennas, mutli-band antennas and steerable antennas.

PHASE I: Explore and define innovative approaches to provide more efficient use of the OE-538 antennas. Develop a design for either a broadband, high gain or multi-band antenna that will support communications using the OE-538 mast. The design must nominally conform to the volume of the OE-538, take into account the effects of the radome on the antenna pattern, and mitigate multi-path and other issues arising while operating in a seawater environment. Show how this design will improve communications when used in place of the existing antennas. The antenna design must be compatible for use in the submarine environment.

PHASE II: Build a prototype of the antenna design. Measure the antenna parameters in free space and then within an OE-538 radome and show the improvement over the existing antennas. Show how this antenna will integrate inside an existing OE-538 mast.

PHASE III: Build a final antenna prototype and integrate this antenna into an OE-538 mast. Measure the pattern over seawater. Provide 2 units of the antenna assembly.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This antenna technology would support high gain and multi-band antennas for use in the VHF marine communications equipment. Another commercial application would be supporting L-Band satellite communications, Personal Communications Services and GPS on a single antenna.

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KEYWORDS: high gain; broadband; multi-band; antenna; OE-538; mast

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N06-094 TITLE: Cross-Domain Collaboration Web Portal

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Enable new flexibility in cross-domain collaboration by developing technologies and techniques to enable secure and certifiable groupware capabilities (e.g., wiki-style multi-level document viewing, sharing, and editing, calendaring, multi-level chat, multi-level project and resource management, etc.) in environments that span multiple security levels.

DESCRIPTION: A fundamental goal for Multi-Level Secure (MLS) systems is to allow users with varying clearance levels to co-ordinate, organize, interact, and collaborate in the production, utilization, and dissemination of materials whose contents have varying sensitivity levels, while enforcing the required security constraints. All existing web-based groupware tools (such as the many variants on the “wiki” idea) are either open source or commercial off-the-shelf (COTS), and lack any provision for multi-level security. Furthermore, the size and complexity of such software (and the operating system it runs within) makes it extremely unlikely that any potential extensions to support multiple security levels could ever be certified or accredited across clearance levels.

The current approach is to sidestep the issue and to allow collaboration only between users of the same clearance level. Multiple networks, file servers, and web servers are constructed for each sensitivity level, and individual documents are implicitly labeled by virtue of the network they each are accessible from. Similarly, a user's workstation is attached to a network matching their clearance level. This separation-of-networks approach has many disadvantages. For example, many users have to use multiple workstations (with a consequent high hardware, space, weight and power cost), and the network infrastructure is inflexible in response to the formation of new coalitions.

The goal of this SBIR topic is to explore alternative approaches that break free of the separated network constraint, while enabling web-based collaboration across multiple security levels. The guiding analogy is that of a cross-domain wiki.

A wiki looks and feels like a normal Intranet or Internet web site. However it also has an edit link at the bottom of every topic (web page), allowing anybody to change a topic or add content by just using a normal (COTS) browser. Wikis may be used to run a project development space, a document management system, a knowledge base, a group calendar or any other groupware tool, on an intranet or on the internet. Web content can be created collaboratively by using just a browser. Wiki systems such as TWiki [2] may be extended via plug-ins, to provide new, domain-specific functionality.

The following example, which demonstrates the requirements, is drawn from military acquisitions, though corresponding scenarios exist in many other settings.

A complete acquisitions document should describe technical requirements, operational requirements, and timeline and contractual details. Each section of the acquisitions document is typically prepared by distinct groups of people, with final editorial control restricted to just a few key personnel. In addition, technical details may exist at differing classification levels. For example, a military satellite may use mostly existing COTS components for telemetry, tracking and control, and orbit stabilization, yet key aspects of its imaging systems may be highly classified. A multi-level-secure wiki system would allow the appropriate personnel to interact and co-ordinate their efforts, while also enabling the acquisitions document to be constructed by appropriate personnel according to sensitivity level and subject area. Similar multi-role and multi-classification scenarios arise in many aspects of the military endeavor.

Any potential solution to the cross-domain web-based collaboration problem must be High Assurance, evidenced by being certifiable to EAL6 [1], so that it may be used to span at least three clearance levels (Confidential / Secret / Top Secret). Any COTS components such as operating systems and application software that are used in the solution architecture must operate at a single level only. In particular, the architecture of such a system must not incorporate such COTS software into the trusted computing base (defined as all those software and hardware components which could cause a breach of the multi-level security constraint were they to be designed, implemented, configured or operated incorrectly). It is an essential part of this SBIR topic that the use of plug-ins does not interfere with the certifiability of the total MLS architecture.

In summary, this SBIR requires research into solutions meeting the following technical requirements:
1. Multi-level wiki: single web pages may contain multiple sections of varying classification and compartmentalization. User may edit web pages without disturbing sections of the document for which they do not have sufficient clearance and approval.
2. Secrecy: users may never view sections of web pages for which they do not have clearance or approval.
3. High assurance: the solution must be certifiable for deployment in Secret and Below environments. Both design and implementation must use formal techniques to achieve the desired certification.

PHASE I: Develop a conceptual system and software architecture design to enable cross domain web-based collaboration. A key part of the design shall be a certifiability concept that demonstrates how the proposed design can be certified to EAL6, while also enabling the use of wiki plug-ins.

PHASE II: Develop a detailed design and prototype a system that enables cross domain web-based collaboration. Identify appropriate protection profiles and complete certification and accreditation plans, with emphasis on the security target, and the process for obtaining EAL6 verification.

PHASE III: Build the cross domain collaboration web portal, and certify it to EAL6. Identify a target environment within the Navy and/or DoD, and deploy the finished, certified product.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technologies and techniques identified in under this SBIR topic have potential application in a wide range of public and commercial settings. Patient records have stringent requirements on releasability, yet multiple individuals have needs to access and update information. Similarly, universities require confidentiality of student records, and grades, again with many access roles defined. In the commercial world, inter-corporate collaboration can be significantly enhanced through the use of shared documents that limit information exposure, from confidential comments, through proprietary information, to enforcing Chinese wall style integrity policies.

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KEYWORDS: Collaboration; GroupWare; Wiki; Multi-level security; high assurance; COTS; EAL-6

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N06-095 TITLE: Optical Filter for Undersea Blue-Green Laser Communication

TECHNOLOGY AREAS: Ground/Sea Vehicles, Electronics

ACQUISITION PROGRAM: The topic is related to SPAWAR PMW-770 Comms at Speed and Depth program.

OBJECTIVE: Design and develop a narrow bandwidth, wide field-of-view (FOV), large aperture optical filter in the blue-green portion of the electromagnetic spectrum for high data rate underwater laser communications. Bandwidth should be less than 1 nanometer, FOV should be +/- 45 degrees in water, aperture should be 1 inch or greater. Out of band rejection should be high. Preferred center wavelengths of operation would be at one or more of the following 1) 532 nm 2) 486.1 nm H-beta line 3) a wavelength around 530 nm +/- 20 nm 4) a wavelength within the blue-green spectrum where transmission through the water is highest for a given water type. Filters that have a tunable center wavelength with the same FOV, bandwidth and aperture size parameters would be desired but not required.

DESCRIPTION: The state-of-the-art technology has limitations in high data rate communication between mobile platforms both above and below water. Underwater communication links preclude the use of all forms of electromagnetic radiation with the exception of very low frequency (low data rate) and blue-green visible frequency (very high data rate). Underwater communication links provided by acoustic systems are limited in data rate. A free space laser communication system operating in the blue-green portion of the spectrum has the potential to transmit at very high data rates to submarines at speed and depth. Operation during the day requires the ability to receive the maximum of light from the laser source coming from a wide range of angles into the receiver and simultaneously filtering out solar background noise. Therefore, it is advantageous to develop a narrow bandwidth, large FOV, optical filter operating in the blue-green portion of the spectrum. Several types of filters have been made for this application in the past ranging from Cs and K atomic line filters and quartz and CdS Lyot and Solc filters. The most readily available laser sources for this application are doubled Nd:YAG (532 nm wavelength) and doubled fiber lasers (around 530 nm).

PHASE I: A study and design phase to include modeling and laboratory experimentation. The result of Phase I will be the design of a filter capable of meeting all of the objective requirements. The filter design will be proven in a laboratory environment in a prototype configuration, traceable to a compact, low power consumption (if applicable) system.

PHASE II: Develop, test and deliver as specified by the government a prototype filter meeting all objective requirements. A full-scale undersea demonstration will be included. Design, construction, characterization and test of the prototype are to be conducted by the contractor.

PHASE III: Integrate prototype into a undersea laser communications receiver. Design, construction, characterization and test of system will be performed jointly by government and integration contractor. The receiver will be placed in a submarine or submerged platform for air platform to undersea platform laser communication link.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Underwater high data rate communications could be beneficial in transmission of data (e.g. video) between commercial platforms where at least one of the platforms is located underwater.

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KEYWORDS: Filter; Optical; Blue-green; narrow bandwidth; large field of view; laser communication

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N06-096 TITLE: Blue-Green Laser for Undersea Communication

TECHNOLOGY AREAS: Ground/Sea Vehicles, Electronics

ACQUISITION PROGRAM: The topic is related to SPAWAR PMW-770 Comms at Speed and Depth program.

OBJECTIVE: Design and develop a high repetition rate, high peak power, low size, weight and power consumption solid-state laser operating in the blue-green portion of the electromagnetic spectrum for high data rate underwater laser communications. Pulse repetition frequency (PRF) should be on the order of 100’s to 1000’s of kHz, pulse widths on the order of 10’s of nanoseconds and pulse energies on the order of 1-200 microjoules. The exact PRF must be variable and will be dependent on the communications modulation rate. Preferred operating wavelengths of operation would be at one or more of the following 1) 532 nm 2) a wavelength around 530 nm +/- 40 nm 3) a wavelength within the blue-green spectrum where transmission through the water is highest for a given water type. Lasers that have a tunable center wavelength with the same PRF, pulse widths and energies as specified above would be desired but not required.

DESCRIPTION: The state-of-the-art technology has limitations in high data rate communication between mobile platforms both above and below water. Underwater communication links preclude the use of all forms of electromagnetic radiation with the exception of very low frequency (low data rate) and blue-green visible frequency (very high data rate). Underwater communication links provided by acoustic systems are limited in data rate. A free space laser communication system operating in the blue-green portion of the spectrum has the potential to transmit at very high data rates to submarines at speed and depth. Operation at high data rates requires the ability to receive the maximum of pulse energy from the laser source and a high repetition rate. The exact PRF is dependent on modulation scheme. Therefore, it is advantageous to develop a high PRF, high pulse energy, narrow pulse width laser. Operation on various mobile platforms requires the laser to have a high power conversion efficiency. Therefore, it is advantageous to develop a low size, weight and power consumption (including cooling systems) laser. Several types of green lasers have been made for this application in the past including low PRF doubled YAG lasers. Single wavelength, doubled Yb fiber lasers have also been demonstrated recently.

PHASE I: A study and design phase to include modeling and laboratory experimentation. The result of Phase I will be the design of a laser capable of meeting all of the objective requirements. The laser design will be proven in a laboratory environment in a breadboard configuration, traceable to a compact, low power consumption system.

PHASE II: Develop, test and deliver as specified by the government a prototype laser meeting all objective requirements. A full-scale undersea demonstration will be included. Design, construction, characterization and test of the prototype are to be conducted by the contractor.

PHASE III: Integrate prototype into a undersea laser communications transmitter. Design, construction, characterization and test of system will be performed jointly by government and integration contractor. The transmitter will be placed in a submarine or submerged platform or air plaform for air platform to undersea platform laser communication link.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Underwater high data rate communications could be beneficial in transmission of data (e.g. video) between commercial platforms where at least one of the platforms is located underwater.

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KEYWORDS: Laser; Blue-green; high PRF; high efficiency; high peak power; laser communication

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N06-097 TITLE: Placement of Sensing and Communications platforms for Enhanced C4ISR Operations

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles, Sensors, Battlespace

OBJECTIVE: Develop algorithms and a prototype software application for the calculation for the optimum positioning of sensing and communications platforms to enhance C4ISR operations.

DESCRIPTION: Sensing and weapon platforms must be placed at proper locations to provide effective detection, tracking and engagement of target entities. To best utilize system resources, a network centric operation dynamically configures a mobile wireless ad hoc network, in conjunction with the use of a fixed terrestrial and space and airborne communications sites and links. The communications networks must be dynamically configured to permit the transport of sensed target and environmental based multimedia data flows at proper quality-of-service levels to management and command entities. The latter must employ efficiently system sensing, engagement and communications assets so that the underlying mission is executed at the highest possible probability of success.

To enhance the operation of the C4ISR system, it is necessary to develop algorithms for the best positioning in realtime of ground, space and airborne communications relay, sensing and engagement platforms, including individual entities and swarms of unmanned ground and aerial vehicles (UGVs and UAVs), to enhance the probability of mission success. This operation provides for joint tasking of the involved platforms for best ISR, communications and engagement operations. The algorithms incorporate terrain features, communications link and network capacities, sensor data as it relates to detected and tracked targets, considering the precision levels required to initiate an effective counter action. Also involved are sensor and weapon to target allocations based upon the above mentioned networked system conditions. Sensor information includes Health & Status, capabilities and topographies, and communications constraints that include RF (HF-S-Band)/LOS limitations. Such features are involved in calculating the optimal structure of the sensor grid for the effective prosecution of identifiable targets and for the geolocation of coordinates for precision strike. Also considered are Joint requirements and the use other service multi-INT sensors.

PHASE I: Characterize the underlying system assets, scenarios and architectures providing for network centric operation. Identify the approaches used for constructing the involved resource allocation algorithms, and provide validations of the techniques developed under unmanned vehicle (UV) aided C4ISR networked system scenarios.

PHASE II: Develop, test, and demonstrate the performance characteristics and effectiveness of the developed algorithms for the best positioning of the sensing, engagement and communications platforms. Develop a realtime analytically based simulation prototype tool to plan, design and evaluate in realtime the best allocation of assets in relation to the performance behavior of the system. Such a tool includes ISR operations, and self configuring UAV and UGV aided mobile ad hoc wireless communications networks that provide for the QoS (quality of service) guaranteed transport of multimedia sensor flows at desired performance levels, and account for engagement of the detected and tracked targets. Employ the tool to demonstrate the features and performance advantages of the developed positioning and resource allocation algorithms, as well as for the realtime planning of asset assignment for Navy C4ISR missions.

PHASE III: Transition to the Fleet via the customization to specific classes of UV aided C4ISR system operations.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial applications to meshed interconnected wireless LANs, home entertainment networks, home security networks, metropolitan area public safety networks, UAV-aided homeland security sensing and communications networked systems.

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KEYWORDS: C4ISR networks; UAV aided sensor and communications networks; wireless networks; UAVs; UGVs; airborne communications relays; communications relay platforms.

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N06-098 TITLE: Event correlation capability for the Joint Protection Enterprise Network (JPEN)

TECHNOLOGY AREAS: Information Systems, Ground/Sea Vehicles, Materials/Processes

OBJECTIVE: Enable JPEN to automatically correlate data points from different JPEN events and event categories in order to notify JPEN users when trends appear.

DESCRIPTION: During its prototype phase, once a JPEN user created and submitted an event, the system (scoring engine) filtered the event in order to determine which policies applied to the event, and executed the policies' scoring models on the event. This required each installation utilizing JPEN to develop "event scoring" models based on a huge variety of event categories, and created the possibility of various organizations / installations utilizing different scoring models for the same types of events. For example, a suspicious person taking photos of a main gate could be scored differently based on pre-determined event scoring models.

Due to the complexity of the initial implementation and the impact of the scoring engine on JPEN performance and scalability, the scoring engine was removed with the release of JPEN V2.0. The capability to automatically correlate data points from different events would significantly enhance JPEN by removing the burden from JPEN users of anticipating all of the possible threatening scenarios. Rather than attempting to "score" individual events, the system would listen for a "series" of events that might provide an advanced warning of increased terrorist activity. While the functionality is similar to the original scoring engine, the approach is significantly different and would greatly simplify managing conditions of interest and impact on system performance and scalability. For example, the system would issue an alert if 3 individuals were denied entry within a 24 hour period at bases located within a 50 mile radius.

PHASE I: Development of the Event Correlation Capability shall focus on obtaining operational requirements and translating those requirements into programmatic structures that are interoperable within the JPEN Data Architecture.

PHASE II: Testing of the Event Correlation Capability shall validate operational requirements, as well as provide for a means of certifying system load and system security components. DoD Information Assurance compliance shall be a key aspect of the Test Phase.

PHASE III: Initial delivery of the Event Correlation Capability shall focus on a pilot group within the Joint Protection Enterprise Network. Once the pilot has been successfully proven this capability can be transitioned to the acquisition command to productize and field the capability across the enterprise.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Financial Service organizations could utilize this type of technology for developing hedging strategies in order to mitigate risks associated with changing market conditions.

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KEYWORDS: Anti-Terrorism/Force Protection; Event Correlation; Homeland Security; Net-Centric Operations and Warfare; Information Sharing

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N06-099 TITLE: Automated Assimilation and Fusion of Huge Volumes of Disparate Data Sets

TECHNOLOGY AREAS: Information Systems, Sensors, Battlespace

OBJECTIVE: Develop a system that would automatically quality control, assimilate, and fuse a huge volume of disparate MetOc data from remote, tactical, and in-situ sensors of various types into a coherent picture of the battlespace environment for real-time to near-real-time use by the warfighter. The various data must be fused with climatological or historical data, where applicable, and the process must be constrained by operational numerical ocean and atmospheric prediction models.

DESCRIPTION: Driven by national security interests, our Navy needs to operate in littoral regions around the world through the foreseeable future. Because of this, there is a need for Intelligence Preparation of the Environment (IPE). This means the Navy must develop a capability to collect high fidelity (both spatially and temporally) environmental datasets consisting of volumetric ocean properties, ambient acoustic noise, bathymetry, sea bottom characteristics as well as various atmospheric forcing of the hydrodynamic conditions. These properties affect the tactical performance of various Naval sensor and weapons systems. Littoral operating areas can extend to hundreds of square nautical miles. To this end, the Navy has created the Littoral Battlespace Sensing, Fusion, and Integration (LBSF&I) program.

The LBSF&I program consists of the exploitation of tactical sensors and the development of long life MetOc specific sensors (in-situ, remote, and space based) that can saturate an area of interest in support of IPE. The result will be the generation of huge datasets, some consisting solely of point measurements and many consisting of time series datasets. Some of these datasets will require on-scene fusion while others will be sent back to operational Navy Meteorological and Oceanographic (METOC) Production Centers for fusion and subsequent transmission to the warfighter for use in various planning systems. There currently exists a technology shortfall in the LBSF&I architecture that can adequately satisfy the core need to quantitatively fuse a wide range of very dynamic oceanographic and atmospheric data types with high temporal and spatial fidelity and provide a representative view of the littoral oceanographic environment.

In order to address this technology need, this topic is focused on the develop of fast and reliable algorithms to assimilate large volumes of space based sea surface data and/or in-situ point measurements of water properties measured by undersea gliders and unmanned underwater vehicles. The assimilation or fusion of this information must be implemented in near real time (as data is made available with latencies ranging from a few minutes to 1-2 hours) in an automated manner with built-in quality control. The algorithms should use Navy databases, climatology and operational regional numerical ocean models as primary process constraints and assimilate data with both time and space as independent variables to minimize smoothing and maximize data use. The resulting analysis provided by the process must provide a quantitative measure of uncertainty for the physical characteristics of the ocean. The algorithms will be designed to function within an architecture that is interoperable with atmospheric forecast systems to enable rigorous coupling with ocean assimilation and forecasting systems.

PHASE I: Propose a conceptual design, based a four dimension (time and space) assimilation scheme that is constrained by both the data and physics based numerical models. This architecture must take into account the various confidence levels of collected data and provide for methodologies to develop advanced data quality control and assimilation algorithms for use by the Naval METOC Production Centers. The design must also address the uncertainty associated with any data fusion and business logic processes in terms of the parameters provided to operational TDAs.

PHASE II: Build and test the prototype data assimilation system. The prototype planning system must include Navy human system interface (HSI) considerations and contain easily readable/interpretable displays that facilitate the quality control process. Demonstrate the value of the proposed system with the use of performance metrics – e.g. the assimilation and fusion process must be completed within tactical time constraints and take into account the perishability of the specific data type being fused. Work with the METOC Production Centers to develop an acceptable concept of operation (CONOPS) for the fusion capability and define logical needs within the constraints provided by the CONOPS and system requirements.

PHASE III: The Phase II prototype capability will be transitioned and integrated into the LBSF&I program of record and provided to the Naval Oceanographic Office to support Reach-back Concept of Operations.

PRIVATE SECTOR COMMERCIAL POTENTIAL: The commercial potential of this SBIR effort is extensive. Some applications include commercial satellite data assimilation for use in commercial fishing, ocean quality monitoring, marine mammal monitoring, and the oil industry.

REFERENCES:

1. Naval Transformation Roadmap 2003

2. The Navy Unmanned Undersea Vehicle (UUV) Master Plan

3. Universal Joint Task List; Chairman, Joint Chiefs of Staff Manual 3500.04C

4. Littoral Battlespace Sensing, Fusion and Integration (LBSF&I) Initial Capabilities Document (ICD) DRAFT Ver 1.1, June 2005

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