NAVY
PROPOSAL SUBMISSION
INTRODUCTION

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research (ONR). The Navy SBIR Program Manager is Mr. Vincent D. Schaper (703) 696-8528). The Deputy SBIR Program Manager is Mr. John Williams ((703) 696-0342). If you have any questions, problems following the submission directions, or inquiries of a general nature, contact one of the above persons. For technical questions about the topic contact the Topic Authors listed on the website on or before 30 June 2000. Mail one original and four copies of your Phase I proposal to the address below. Proposals must be received by **16 August 2000**.

Office of Naval Research
ONR 364 SBIR
800 North Quincy Street, RM 633
Arlington, VA 22217-5660

The Navy's SBIR program is a mission-oriented program, which integrates the needs and requirements of the Navy through R&D topics, which have dual-use potential. All Navy SBIR topics fall within the DoD Science and Technology areas and the Navy Science areas, listed in Table 1. Navy topics will be funded from these areas according to a priority it has established to meet its mission goals and responsibilities. Information on the Navy SBIR Program can be found at **http://www.onr.navy.mil/sbir**. Additional information pertaining to the Department of Navy mission can be obtained by viewing various Navy World Wide Web sites at http://www.navy.mil.

UNIQUE NAVY REQUIREMENTS:

1. Navy requires a DoD Proposal Cover Sheet (formerly Appendix A & B) to be submitted electronically through the Navy SBIR Website or DoD SBIR Website at http://www.dodsbir.net/sbirsubmission. The company must print out the forms directly from the Website, sign the forms and submit them with their proposal.
2. All Phase I award winners must electronically submit a Phase I summary report through the Navy SBIR Website at the end of their Phase I.
3. Phase II award winners must also submit Phase II Summary reports through the Navy SBIR Website.
4. The Navy requires that all Phase II proposers submit a Proposal Cover Sheet & Commercialization Report through the Navy SBIR Website and mail only the appendices to the Navy SBIR Program Office listed above.
5. The Navy only accepts PH I proposals with a base effort less than $70,000 with an option less than $30,000.

NEW IN FY 2000:

1. The Small Business Administration (SBA) has made a determination that will permit the Naval Academy, the Navy Post Graduate School and the other military academies to participate as subcontractors in the SBIR/STTR program, since they are institutions of higher learning.

2. The Navy will allow firms to include with their proposals, success stories that have been submitted through the Navy SBIR Website at **http://www.onr.navy.mil/sbir**. A Navy Success Story is any follow-on funds that the firm has received from a past Phase II Navy SBIR or STTR award. To qualify the firm must submit these success stories no later than **14 July 2000,** through the Navy SBIR Website. The success story should then be printed and included as appendices to the proposal. These pages will not be counted towards the 25-page limit. The success story information will be used as part of the evaluation of the third criteria, Commercial Potential (listed in Section 4.2 of this solicitation) which includes the Company's Commercialization Report (formerly Appendix E) and the strategy described to commercialize the technology discussed in the proposal. Commercialization is viewed as any follow-on funds, from the DoD, DoD contractors or the private sector, used to further develop the technology or from sales of a product. The Navy is very interested in companies that transition SBIR efforts directly into Navy and DoD programs and/or weapon systems. If a firm has never received a Navy SBIR Phase II it will not count against them, and they will be evaluated on the other evaluation criteria listed in Section 4.2 Phase I Evaluation Criteria.
3. Effective with the Fiscal Year (FY) 2000, no Navy activity will issue a Navy SBIR Phase II award to a company where 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 has 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 (1) year will be ineligible for a Navy SBIR Phase II award using SBIR funds.

4. The Navy has adopted a New 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 will provide a 1 to 4 match of Phase II to Phase III funds that a company obtains from an acquisition program up to $250,000 in additional SBIR funds as long as the Phase III is awarded and funded during the Phase II.

5. If you did not submit under the 99.2 Solicitation, be aware that there is a new DoD report required to be filed pertaining to commercialization of prior SBIR awards. You can access the required DoD report information through the SBIR electronic submission site (http://www.dodsbir.net/submission).

6. The Navy typically provides a firm fixed price contract or awards a small purchase agreement as a Phase I award; and a cost plus fixed fee or an Other Transition Agreement (OTA) as a Phase II award. The type of award is at the discretion of the contracting officer.

PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria must be met or your proposal will be REJECTED.

1. The Navy will not accept any proposals from companies that have not submitted the DoD Proposal Cover Sheet (formerly Appendix A & B) and the DoD Commercialization Report (formerly Appendix E) electronically over the Internet. These forms must be printed out directly from this site and be included with the entire proposal and proposal copies that are mailed to the Navy and received by 16 August 2000.

2. Your Phase I proposed cost for the base effort can not exceed $70,000. Your Phase I Option proposed cost can not exceed $30,000. The costs for the base and option should be clearly separate, and identified on the Proposal Cover Sheet, in the cost proposal, and in the work plan section of the proposal.

4. Your proposal must be received on or before the deadline date. The Navy will not accept late proposals, or incomplete proposals. If you have any questions or problems with submission of your proposal allow yourself time to contact the Navy and get an answer to your question. Submit electronic Internet forms early. As the deadline for proposal submission approaches and as computer traffic increases, computer speed slows down. Do not wait until the last minute.

ELECTRONIC SUBMISSION OF PROPOSAL COVER SHEET AND COMMERCIALIZATION REPORT:

Submit your DoD Proposal Cover Sheet (formerly Appendix A & B) and the DoD Commercialization Report (formerly Appendix E) to the Navy using the DoD online submission at http://www.dodsbir.net/sbirsubmission and as discussed in Section 3.4b and 3.4n of this solicitation. This site allows your company to access your company's submitted information any time (prior to the closing of the solicitation) and to edit or print out your appendices. **The Navy WILL NOT accept any forms from past solicitation books or any electronic download version except those from the DoD SBIR Website as valid proposal submission forms.** Detailed instructions can be found by selecting the Help button on this site once you have registered. If you have any questions or problems with the electronic submission contact the DoD SBIR Helpdesk at 1-800-382-4634.

ELECTRONIC SUBMISSION OF PROJECT REPORTS:

The submission of an electronic Phase I Summary Report will now be required at the end of Phase I. The Phase I Summary Report is a non-proprietary summary of Phase I results and should include potential applications and benefits and not exceed 750 words. It should require minimal work from the contractor because most of this information is required in the final report. The summary of the final report will be submitted through the Navy SBIR/STTR Website at: http://www.onr.navy.mil/sbir, click on "Submission", then click on "Submit a Phase I or II Summary Report".

NAVY FAST TRACK DATES AND REQUIREMENTS:

All Fast Track Applications and required information must be sent to the Navy SBIR Program Manager at the address listed above, to the designated Contracting Officers Technical Monitor (the Technical Point of Contact (TPOC)) for the contract, and the appropriate Administrative Point of Contact listed at the end of this Introduction. A copy of the Fast Track application cover sheet (Reference B of this solicitation) must also be sent to the DoD SBIR Program Manager, at the address listed on the back of this sheet. The dates and information required by the Navy are the same as the dates and information required under the DoD Fast Track described in the front part of this solicitation.

ARE YOU A SUPPORT CONTRACTOR FOR A NAVY ACTIVITY?

Do you have employees occupying space in a Navy activity? Or do you have a support contract to provide services outside of an SBIR Phase I, II or III contract award? Then you must indicate so on the Proposal Cover Sheet form. The Navy is concerned with potential conflict of interest and if you reply “yes” to either of the above you may be precluded from participation in the Navy’s SBIR Program.

YOUR SUBMISSION TO THE NAVY SBIR PROGRAM:

This solicitation contains a mix of topics. When preparing your proposal keep in mind that Phase I should address the feasibility of the solution to the topic. Be sure that you clearly identify the topic your proposal is addressing. The Phase I option should address the transition into the Phase II effort. The Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which have been invited to submit a Phase II proposal by the Navy Technical Point of Contact (TPOC) during or at the end of a successful Phase I effort will be eligible to participate for a Phase II award (with the exception of Fast Track Phase II proposals). If you have been invited to submit a Phase II proposal to the Navy by the TPOC, obtain a copy of the Phase II instructions from the Navy SBIR Webpage or request the instructions from the Navy Administrative POC listed at the end of this Introduction. Phase III efforts should also be reported to the SBIR program office noted above.

The Navy will provide potential awardees the opportunity to reduce the gap between Phase I and Phase II if they provide a $70,000 maximum feasibility Phase I proposal and a fully costed, well defined ($30,000 maximum) Phase I Option to the Phase I. **The Navy will not accept Phase I proposals in excess of $70,000 (exclusive of the Phase I option).** The technical period of performance for the Phase I should be 6 months and for the Phase I option should be 3 months. The Phase I Option should be the initiation of the next phase of the SBIR project (i.e. initial part of Phase II). The Navy will also offer a "fast track" into Phase II to those companies that successfully obtain third party cash partnership funds ("Fast Track" is described in Section 4.5 of this solicitation). When you submit a Phase II proposal it should consist of three elements: 1) a $600,000 base effort, which is the demonstration phase of the SBIR project; 2) a transition or marketing plan (formerly called a "commercialization plan") describing how, to whom and what stage you will market your technology to the government and private sector; and 3) at least one Phase II Option ($150,000) which would be a fully costed and well defined section describing a test and evaluation plan or further R&D if the transition plan is evaluated as being successful. Phase II efforts are typically for two (2) years and Phase II options are typically for an additional six (6) months. Some SYSCOMS have different schedules and award amounts; you should get specific guidance from them before submitting your Phase II proposal. You must also submit your Phase II Proposal Cover Sheet and Commercialization Report electronically to the Navy SBIR Program Office at the address above through the Navy SBIR Website. While Phase I proposals with the option will adhere to the 25 page limit (section 3.3), Phase II proposals together with the Phase II Option will be limited to 40 pages (unless otherwise directed by the TPOC or contract). The transition plan should be in a separate document.

The Navy will evaluate and select Phase I proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. 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.

TABLE 1. NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY AREAS

TECHNOLOGY AREAS	SCIENCE AREAS
Aerospace Propulsion and Power	Atmospheric and Space
Aerospace Vehicles	Biology and Medicine
Battlespace Environment	Chemistry
Chemical and Biological Defense	Cognitive and Neural
Clothing, Textiles and Food	Computer Sciences
Command, Control and Communications	Electronics
Computers, Software	Environmental Science
Conventional Weapons	Manufacturing Science
Electron Devices	Materials
Electronic Warfare	Mathematics
Environmental Quality and Civil Engineering	Mechanics
Human-System Interfaces	Ocean Science
Manpower, Personnel and Training Systems	Physics
Manufacturing Technology	Terrestrial Sciences
Materials, Processes and Structures	
Medical	
Sensors	
Surface/Undersurface Vehicles/Ground Vehicles	
Modeling and Simulation	

NAVY SBIR PROGRAM MANAGERS OR ADMINSTRATIVE POINTS OF CONTACT FOR TOPICS

POINT OF CONTACT

N00-096 to N00-111
Ms. Carol Van Wyk
301-342-0215

N00-112 to N00-119
Mr. Douglas Harry
703-696-4286

N00-120 to N00-126
Mr. Bill Degentesh
703-602-3005

NAVY 00.2 SBIR TITLE INDEX

Naval Air-Systems Command

N00-096	Reliable Captive Structural Panel Fasteners
N00-097	Aircraft Constrained Ejection System (ACES)
N00-098	Extending the Service Life of Fasteners and High-Value Propulsion System Components Through the Elimination of Galling and Fretting
N00-099	High-Speed Dual-Mode Missile Radome (HiSMR)
N00-100	Large-Area Appliqué Removal
N00-101	Innovative Tooling for Composites
N00-102	Definition of Software Architecture in Support of Virtual Instrumentation
N00-103	Ytterbium (Yb) Laser Transmitter
N00-104	Compact Laser Designator and Eye-Safe Laser Rangefinder
N00-105	Processor Technology Insertion Recertification
N00-106	Towbody Towlines
N00-107	Automatic Wake Detection Algorithms
N00-108	Real-Time Automatic Enhancement of Corrupted Video
N00-109	Avionic Schematics on Demand
N00-110	Multiple Small ‘Smart’ Weapons Carriage
N00-111	Integrated Missile Seeker Signal-Processor Development and Implementation

Office of Naval Research

N00-112	MCM Technologies for Detection, Classification, and Identification/Localization of Sea Mines and Submarines
N00-113	Maritime Intelligence, Surveillance, Reconnaissance (ISR) and Space Exploitation
N00-114	RF Transparent, Optically Tailorable Appliqué
N00-115	High-g Micro Electro Mechanical Systems Inertial Measurement Unit (High-g MEMS MU)
N00-116	Modular 100 kW Wave Powered Electric Generator
N00-117	Submarine Forward Escape Trunk Cofferdam
N00-118	Liquid Fuel Atomizer
N00-119	Power Generation During Buoy Operations

Naval Sea Systems Command

N00-120	Electronic Warfare Adaptive Spatial/Spectral Cancellation
N00-121	Galley Food Waste Disposal
N00-122	Smart Circuit Breakers and Switches
N00-123	Ship Mission Readiness Measurement System
N00-124	Aerosol Can Voiding Device
N00-125	Low Hydrodynamic Drag Cable for Mine Countermeasures
N00-126	High Strength Fiber Optic Sensor Grating Arrays

NAVY 00.2 SBIR WORD/PHRASE INDEX

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Naval Air-Systems Command

N00-096 TITLE: Reliable Captive Structural Panel Fasteners

TECHNOLOGY AREAS: Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-275, V-22 Osprey

OBJECTIVE: Develop and demonstrate a captive structural panel fastener that can transfer shear loads; has a high fatigue life, low failure rate, low weight, and high reusability. The panel fastener must work in composites or metals and be impervious to environmental effects (corrosion, oil, dirt, etc), while maintaining captive properties to reduce the risk of foreign object damage (FOD). The new panel fastener must not require modification of the V-22 structure.

DESCRIPTION: Panel fasteners on military aircraft must carry structural loads while being maintainable and interchangeable. This is especially true of aircraft with composite access panels and structures. To meet structural integrity requirements, fastened joints need close tolerance holes. On the other hand, to meet maintainability/interchangeability requirements, fastened joints need loose tolerance holes. Structural integrity and maintainability requirements are constantly at odds with each other. Efforts to reduce aircraft weight compound the situation by encouraging designers to specify relatively small-diameter structural panel fasteners. Structural integrity of an aircraft cannot be sacrificed. Small diameter fasteners drive designs to close-tolerance holes at the expense of maintainability/interchangeability. The V-22's current panel fastener is exhibiting deficient reliability and maintainability performance. Frequent removals of V-22 access panels are resulting in premature failures of fastener components. Panel fastener repairs are labor-intensive and degrade the aircraft's readiness. The V-22 requires a panel fastener that can not only transfer shear loads with a high fatigue life, but is captive and rated for high reusability. The development of a reliable captive structural panel fastener will substantially reduce the manpower required to perform aircraft maintenance actions, will not adversely affect aircraft readiness, and will preserve structural integrity. The new panel fastener must not require modification of the V-22 structure. The current V-22 panel fastener is of the screw and floating nut-cage type. Nut cages are single and double lug with standard nut cage hole spacing. The hole size in V-22 access panels is 0.240 ± 0.001 inches. The hole size in the V-22 structure is 0.2455 ± 0.0015 inches. Panels and structure vary in thickness. The V-22 requires a self-locking fastener that is rated for a minimum of 500 reuse cycles, and a 130º flush or protruding head. Also, the fastener must be captive and contain a holdout feature. The fastener needs to attach highly contoured access panels. For applications in composite materials, grommets are required. Panel fastener applications in the rotor and nacelle are subjected to high-cycle load reversals. The fastened panel fastener joint should be capable of carrying some tension loads and approximately 1,725 lbs. in single shear.

PHASE I: Develop an alternative panel fastening system. Develop a detail design of an alternative panel fastener and perform stress and fatigue analyses. Prototype fasteners will be fabricated and screen tested to demonstrate concept feasibility.

PHASE II: Determine static and fatigue strengths of panel fastening system. Fabricate the panel fastener and joint test coupons. Conduct static and fatigue tests. Determine reliability and reusability characteristics of the fastening system.

PHASE III: Demonstrate producibility and develop an implementation plan for new production and replace via attrition for in-service fasteners.

COMMERCIAL POTENTIAL: The commercial derivative of the V-22, the 609, will benefit directly by this fastening system. As commercial aviation migrates to greater use of composite panels with optimized structures, the need to transfer load through panels will increase.

REFERENCES:
1. Handbook of Composites, George Lubin, Ed., Van Nostrand Reinhold Company, NY (1982). pp. 602-632.
2. Composite Airframe Structures, Michael C. Y. Niu, Conmilit Press Ltd., Hong Kong (1992). pp.290-330.

KEYWORDS: Captive; Structural Panel; Fasteners; Usability; Environmental Factors; Maintainability

N00-097 TITLE: Aircraft Constrained Ejection System (ACES)

TECHNOLOGY AREAS: Air Platform, Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: F/A-18E/F (Naval Strike Fighter) and Joint Strike Fighter (JSF)

OBJECTIVE: Develop a lightweight, low-cost, aircraft constrained ejection system (ACES) for the aircraft that uses a nonpyrotechnic power source.

DESCRIPTION: This effort will identify the technology and build a lightweight, low-cost system for suspension and constrained ejection of stores from the F/A-18E/F and JSF aircraft using a nonpyrotechnic power source. The ACES will have a goal of a 30 percent reduction in parts count and weight (relative to the current BRU-32 bomb rack) to significantly reduce acquisition and operations and support (O&S) costs. ACES will constrain the store throughout the ejection stroke to safely eject weapons with minimal clearance from the internal weapon bay of low-observable aircraft. In addition, a nonpyrotechnic power source will eliminate the safety and maintenance burdens associated with handling cartridges, cleaning cartridge residue, and the high failure rate of bomb rack components. Compatibility with standard 14/30-inch suspension along with AIM-120 advanced medium-range air-to-air missiles (AMRAAM) will eliminate the need for a peculiar ejection system for AIM-120 to further reduce O&S costs.

PHASE I: Develop a system design for a constrained ejection system for safe carriage and release of stores from the F/A-18E/F and JSF aircraft using a nonpyrotechnic power source. The system should be lightweight with reduced parts count. The system should be compatible with current stores carried on the F/A-18E/F parent BRU-32 bomb rack, and planned loadouts for the main bay of the JSF including joint direct attack munitions (JDAM), joint stand-off weapon (JSOW), and AMRAAM. MIL-STD-2088, General Design Criteria for Aircraft Bomb Rack Unit, and MIL-A-8591H, General Design Criteria for Airborne Stores and Associated Suspension Equipment shall be used as a guideline for design of the constrained ejection system.

PHASE II: Manufacture a prototype of the ACES; perform aircraft weapon fit checks; and perform environmental, performance, and endurance testing to verify compatibility with the F/A-18E/F and JSF aircraft. MIL-T-7743, General Specification for Testing Store Suspension and Release Equipment, shall be used as a general guideline for test and evaluation of the constrained ejection system.

PHASE III: Develop production representative design documentation including drawings, finite element analysis (FEA), performance characteristics, and interface control drawing.

COMMERCIAL POTENTIAL: This technology could be used in the commercial reusable shuttle being developed to transport and deploy commercial satellites into orbit, or emergency jettison of external tanks from private aircraft.

REFERENCES:

1. MIL-STD-2088, General Design Criteria for Aircraft Bomb Rack Unit
2. MIL-A-8591H, General Design Criteria for Airborne Stores and Associated Suspension Equipment
3. MIL-T-7743, General Specification for Testing Store Suspension and Release Equipment

KEYWORDS: Constrained; Ejection; Suspension; Nonpyrotechnic; Aircraft; Bomb Rack

N00-098 TITLE: Extending the Service Life of Fasteners and High-Value Propulsion System Components Through the Elimination of Galling and Fretting

TECHNOLOGY AREAS: Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-275, V-22 Osprey

OBJECTIVE: Develop a process, that will effectively eliminate galling and fretting of critical metal parts in aircraft and ships

DESCRIPTION: The Navy has an immediate need for galling and fretting reduction in thousands of critical metal parts in aircraft, engines, turbines, and nuclear-powered ships where high-alloy components are subject to premature failure. Galling is caused by direct metal-to-metal contact of similar metals (composition or hardness) under elevated torque, temperature, or surface loads. Fretting is a vibrational condition also exacerbated by direct contact of similar metals. Critical engine and turbine parts fail prematurely in many cases because of these two destructive mechanisms. During critical maritime operations, premature failures of mechanical parts or extended maintenance downtime could prove disastrous. Many critical metal parts on nuclear powered submarines and ships are difficult to access because of their proximity to radioactivity. Reactor parts that have galled create unnecessary radioactive waste. Conventional lubricants also create additional waste and environmental hazards in a nuclear environment. All of these problems lead to significantly increased life-cycle costs and critical-path downtimes for both aircraft and ships. The service lives of components subject to galling or fretting conditions vary significantly, therefore it is desirable to eliminate the possibility of galling and fretting through use of an advanced coating. An Advanced Ion Deposition process that protects against galling and fretting failures or another relevant coating process may provide the solution to these problems through thin film coatings of critical metal parts, thereby significantly extending their service lives.

PHASE I: Identify coatings available to solve this problem. Characterize the coatings' potential effectiveness based upon available data and design a comprehensive testing program for several types of critical metal parts used in gearboxes and at least two coating technologies. Candidate coating technologies must be environmentally benign and must eliminate galling and fretting conditions. Identify a candidate V-22 drive system component for coating application.

PHASE II: Perform testing program as defined during Phase I. Testing program will be used to quantify the effectiveness of the candidate coating technologies as well as to refine the coating process. Testing program will include cyclic loading of bolted-joint coupons consisting of bare and coated specimens of various base metals to verify that the coating eliminates both fretting and galling conditions. As a final task, the successful coating process will be applied to representative V-22 drive system components to prove capability to produce flight quality coated assets.

PHASE III: Demonstrate use of the developed coating process on in-service ship and aircraft components.

COMMERCIAL POTENTIAL: Galling and fretting elimination would have significant potential for civil as well as military applications.

KEYWORDS: Galling; Fretting; Lubricants; Aircraft; Deposition; Nuclear

N00-099 TITLE: High-Speed Dual-Mode Missile Radome (HiSMR)

TECHNOLOGY AREAS: Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-259, AIM 9X (Sidewinder)

OBJECTIVE: The U.S. Navy is currently trying to improve the capability of deployed missile systems, such as high-speed anti-radiation missile (HARM), by developing improved seekers that utilize both radio frequency (RF) and millimeter wave (W-band) technology. Advanced dual-mode RF seekers utilizing these technologies require radomes that are compatible with both wavelengths and can survive the U.S. Navy's thermal-structural environment. This SBIR topic is focused on providing viable, low-cost seeker radomes that can meet these requirements.

DESCRIPTION: Performance characteristics of dual-mode RF radomes require that materials be thin enough to pass the short wavelength of the millimeter-wave energy (W-band) and also be compatible with comparatively longer wavelength RF energy without distortion or boresight errors. The radomes must also meet extremely rigorous loads and environments when subjected to both very high-speed flight and captive carriage on U.S. Navy aircraft. There are currently few materials in use that can meet the electronic requirements of dual-mode RF seekers and provide the necessary structure for use in a high-speed missile radome. One material currently being evaluated is Pyroceram. It has been successfully used in other U.S. Navy systems such as advanced medium-range air-to-air missiles (AMRAAM). However, the current application calls for a much thinner structure than previously employed. This results in added complexities and risk due to manufacturing variables in material properties and the need for the radome structure to carry higher loads with less material. Statistical variations of material properties, effects of inclusions, and highly stressed attachments are all magnified as the amount of structure is reduced to provide electrical compatibility with W-band radiation. There is a distinct need for new approaches and an examination of new materials and fabrication techniques to resolve some of these problems. This program will examine alternative materials, fabrication, and mounting techniques to develop and demonstrate affordable and reliable dual-mode RF radomes.

PHASE I: Using an advanced HARM dual-mode seeker design concept, develop a catalog of potential materials and construction methods for meeting the missile radome performance. This will be accomplished by performing trade studies and analyses of the selected designs. Particular attention will be focused on affordability and reliability as it applies to materials, manufacturing concepts, and structural performance. Important electronic performance parameters will be maintained at pre-selected threshold values. One or more candidate designs will be proposed, preliminary designs will be developed. There may be a need for acquiring a materials database at elevated temperatures and for short exposure times in support of this phase.

PHASE II: Develop one or more detailed design packages for the dual-mode RF radome and fabricate a number of samples for testing. Important test parameters include aerodynamic drag, transient thermal stresses, and effects of transient heating on electronic performance. The most viable candidate radome from these tests will be engineered for production and several radome samples will be fabricated for flight testing.

PHASE III: Several actual missile firings will be performed to demonstrate the capabilities of the new radome. In addition to the mandatory electronic performance over the dual frequency bands, it will be necessary to demonstrate the radome aerodynamic and thermal-structural performance. It is conceivable that a ground test facility, such as the AeroPropulsion Wind Tunnel (APTU) at AEDC might be used in lieu of actual flight testing to demonstrate the thermal-structural performance of the dome. This facility can achieve the flight conditions, thermal and dynamic pressures, consistent with the high speed flight requirements of the HARM missile.

COMMERCIAL POTENTIAL: The materials evaluated on this program have characteristics that exhibit improved toughness and lower costs while being utilized to transmit/receive electromagnetic radiation at elevated temperatures. In addition to the specified military uses, there are several commercial applications that could make use of these improved materials. Some of the potential applications are advanced cookware and cook tops; coatings for satellite antennae and receivers; lenses for aircraft and/or automobile collision avoidance devices; and radomes for future supersonic civilian aircraft.

REFERENCES:
1. Southern Research Institute, "Thermal and Mechanical Properties of Ceramic Materials considered as Radome Candidates for Advanced Air-to-Air Missiles, Final Report for Period May 1979- October 1983", Air Force Wright Aeronautical Laboratory Report, AFWAL-TR-83-4133, December 1983.
2. Kouroupis, James B., "Flight Capabilities of High-Speed-Missile Radome Materials", Johns Hopkins APL Technical Digest, Volume 13, Number 3 (1992).
3. Miska, Herbert A., "Aerospace and Military Applications", ASM Engineered Materials Handbook, Volume 4, Ceramics and Glasses, prepared under the direction of ASM International Handbook Committee, December 1991.
4. McHale, Anna E., "Engineering Properties of Glass-Ceramics", ASM Engineered Materials Handbook, Volume 4, Ceramics and Glasses, prepared under the direction of ASM International Handbook Committee, December 1991.
5. B. J. Crowe, "Dual Band Radome Wall Design", Proceedings of the 18th Symposium on Electromagnetic Windows, pp. 61-66 (1984).
6. "Radomes for Millimeter Wave Seekers KTA-10 Final Report", The Technical Cooperation Program, Oct. (1986).
7. K. H. Breeden, "Electrical Design Techniques for Millimeter Wavelength Radomes", Proceedings of USAF Avionics Laboratory/Georgia Inst. Tech. Symposium on Electromagnetic Windows, Vol. II, pp. 41-90, June (1968).

KEYWORDS: Radomes; High Speed; Dual-Mode; Materials; W-Band, Millimeter Wave

N00-100 TITLE: Large-Area Appliqué Removal

TECHNOLOGY AREAS: Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-290 (S-3, P-3), and Joint Strike Fighter (JSF)

OBJECTIVE: To develop a depot capability to rapidly remove appliqué from an entire aircraft. The technology/method shall meet all current environmental laws/regulations and performance requirements of Society of Automotive Engineers (SAE) MA4872.

DESCRIPTION: The appliqué technology is being developed to replace the topcoat on aircraft. The current method for appliqué removal is by hand, which is feasible for field repairs. At depot/rework facilities, the entire aircraft is typically stripped of all coating systems. Therefore, removing appliqué by hand at depot/rework facilities may not be the most cost-effective or efficient method of removing appliqué from the entire aircraft. Because no appliqué has been in service for four years or longer, the level of difficulty to remove appliqué after long-term exposure (four years and beyond) is unknown. However, removal after short-term duration has demonstrated that significant residual adhesive remains on the surfaces.

PHASE I: Demonstrate large area appliqué removal capability through preliminary laboratory testing. Design a system to scale up the process for the rapid removal of appliqué from various types of aircraft substrates (metallic and nonmetallic). Estimate speed of removing appliqué based on the results.

PHASE II: Build and test a prototype system. Conduct laboratory testing that demonstrates the effect on faying surfaces and other interior areas of the aircraft (immersion corrosion, dissimilar metals, hydrogen embrittlement, crevice corrosion at in-service aircraft skin temperature range). Verify that the process does not have any detrimental life-cycle effect on the substrate mechanical properties through analysis and/or demonstration (testing).

PHASE III: Customize and implement Phase II work to appropriate aviation depot facilities for both military and commercial aircraft.

COMMERCIAL POTENTIAL: An efficient, environmentally friendly method for large area removal of appliqué has application to commercial as well as to military aircraft. Transition should occur rapidly after the process is validated for naval aircraft.

REFERENCES:
1. SAE MA4872

KEYWORDS: Environmentally Friendly; Appliqué Removal; Depot; Adhesive; Film; Large-Area Removal

N00-101 TITLE: Innovative Tooling for Composites

TECHNOLOGY AREAS: Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: Joint Strike Fighter (JSF) and PMA-265 (F/A-18)

OBJECTIVE: Develop innovative tooling concept(s) to manufacture composite components for limited production, spares, and/or depot-level maintenance application.

DESCRIPTION: Very few tooling options are available for economical fabrication of limited production, spare, and/or depot-level maintenance composite components. Examples of limited production applications are early development design concepts, design changes, or issues arising with normal production tooling. Spares activity can be sporadic, requires interrupting production, or could necessitate additional tooling for legacy systems requiring components. Examples of depot-level maintenance are repairs on component sections that require tooling to maintain dimensional tolerances and production of spares no longer available from a vendor. The Navy needs low-cost innovative tools for complex aircraft composite parts for these limited production situations, which are reusable at least ten times without repair. The requirements for the selected tooling material and processing approach are as follows:
- The selected tool system shall have tailorable coefficient of thermal expansion and dimensional stability, capable of matching the CTE and dimensional stability of all currently used full-rate production tool materials (including carbon/BMI, invar, steel and aluminum).
- This tool system shall be appropriate for use with the standard cure cycle for intermediate temperature resin systems such as 977-3 (360F and related pressures). The possibility of using this tool system for higher temperature resin systems such as BMIs or cyanate esters is highly desirable.
- The fabrication cost of tool shall be no more than 20% of the cost of a comparable full-rate production tool.
- Tool fabrication cycle time shall be at least 60% less than a comparable full-rate production tool, and shall not require highly specialized machining equipment or techniques.
- The tooling system shall accommodate repairs and moderate reconfigurations that might be needed to for design changes and multiple-configuration aircraft situations.
- Parts produced on these low-rate tools would be valid for static, fatigue and first article destruct testing such that this testing would not need to be repeated for full-rate production tools.

The fabrication process for the tooling should also be robust and affordable enough for implementation into the depots. Preferably, the airframer or depot could accomplish the fabrication and repair of these tools at their own facilities.

PHASE I: Identify tooling performance requirements. Develop tooling concept(s) and show the feasibility for composite manufacturing. Conduct limited material characterization to demonstrate the ability to tailor the thermal expansion of the material and to demonstrate the producibility of the concepts. Develop a tooling plan approach concentrating on key parameters, durability, and scaling effects. Conduct a preliminary cost analysis.

PHASE II: Fabricate and test a series of tooling and part demonstration articles. Conduct limited durability tests replicating the production environment. Establish preliminary materials/manufacturing/process specifications for using the tooling for limited production. Complete a full-up cost analysis against common low rate.

PHASE III: Qualify tooling concept for composite production, verifying life cycle cost of the tools. Complete specifications for the fabrication and use of tools made with this approach.

COMMERCIAL POTENTIAL: Tooling concepts/approaches for limited production, spares, and maintenance are applicable to commercial aerospace composites including fixed-wing and rotary-wing aircraft, rockets, missiles, and spacecraft. This also extends to any composite manufacturing application requiring high-temperature cures for structural composites, which may include structural bridges, high-speed trains, and sports equipment.

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1. Hayse, Steven, “RTM Aerospace Components Developed Using Rapid Prototype Tooling”, SAMPE Symposium, 1998, p. 1715-1723
2. Klosterman, Donald, and Chartoff, Richard, “Affordable, Rapid Composite Tooling Via Lamianted Object Manufacturing”, SAMPE Symposium, 1996, p. 220-225
3. Stover, Debbie, “Building Tools for Large Composite Parts”, Advanced Composites, 1992, Nov/Dec
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KEYWORDS: Tooling; Composites; Limited Production; Spares; Maintenance, Low Cost

N00-102 TITLE: Definition of Software Architecture in Support of Virtual Instrumentation

TECHNOLOGY AREAS: Information Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-260, Aviation Support Equipment

OBJECTIVE: Improve implementation of avionics testing by defining software interface(s) at the test instrument hardware and function levels. A clear definition of requirements and the architecture for a software interface that exists between the test program software and the Automatic Test Equipment (ATE) is desired to reach the goals of test instrument independence, test program transportability, and implementation of virtual test instruments.

DESCRIPTION: Previous work in this area by the Automatic Test Systems (ATS) Research and Development (R&D) Integrated Product Team (IPT) (ARI), part of the Department of Defense (DoD) ATS Executive Agent Office (EAO), has identified the Resource Adapter Interface (RAI) as a key element in a Standard Environment for Test. The RAI handles the transition between electrical signal descriptions (from the test program software or ATE runtime environment) to a context that allows test instruments, test resources within the ATE, to implement test actions. This interface must interact with software processes resident on the ATE, such as the manager of test instruments, and the controller of communications with instruments. The DoD ATS EAO has published standards for these software components that should be considered in the implementation of the RAI.
Work on the RAI software interface will provide several benefits. From the ATE perspective, the RAI will allow for advanced test instrument interchangeability. This will allow for instruments within an ATE to be replaced by similar instruments (produced by other vendors or with additional capability) with little impact to the existing ATE software components. From a test program perspective, the RAI will allow for a greater independence of the test program software from the ATE test instruments by providing the ability for test programs to identify requirements in terms of electrical signals versus instrument functions and/or commands. This means that the test programs will not need to be modified with a different instrument command set whenever an instrument is replaced in an ATE. From a modeling and simulation perspective, the RAI would allow for the development of an instrument “simulator” because of the separation of test actions from instrument specific commands.

PHASE I: Through R&D efforts, define the requirements for the RAI a software interface that is functional within the DoD’s prescribed Standard Environment for Test. In particular, the RAI requirements must address the functions that the RAI must provide to an ATE, the interfaces between the RAI and other related components in the Standard Environment for Test, and how electrical signals may be used to pass test information requirements from a test program to test instruments on an ATE. A description of the Standard Environment for Test and the RAI interface are provided in the ATS Annex of the DoD’s Joint Technical Architecture.

PHASE II: Define and implement the architecture of the RAI which meets the requirements identified in Phase I. The implementation must be and demonstrated on either a a DoD or a commercial ATEtest platform. Platforms selected must also contain that incorporates other key elements related to the RAI as defined in the Standard Environment for Test by the DoD ATS EAO. If no platform which contains these other elements is identified, prototype versions of these elements must be developed and incorporated in the selected ATE as part of the Phase II effort.

PHASE III: Complete the previous R&D efforts to a level suitable for commercialization. This includes software documentation, generation of executable versions of the software with sufficient instructions on installation and use, delivery of program source code, documentation of interfaces to other components in the Standard Environment for Test, and a description of the RAI which is suitable for submission to a commercial standards body (e.g. IEEE).

COMMERCIAL POTENTIAL: Commercialization potential is high for this topic because of recent DoD policies and mandates associated with ATE. There is common ground between the commercial and military worlds in the sources of expense related to test program development, test program set rehost activities, and instrument obsolescence. A software product that is “plug-n-play” with existing ATS architectures and removes the hard links between test programs and the ATE offers great flexibility to end users. Reduced total cost of ownership and improved ATE capability/flexibility are some of the projected benefits.

REFERENCES:
1. IEEE 1226.0 Standard for ABBET Overview and Architecture
2. IEEE 1226.3 Resource Management Services
3. VPP 4.x Virtual Instrumentation Software Architecture family of documents
4. DoD Joint Technical Architecture (JTA)

KEYWORDS: Automatic Test Equipment; Virtual Instruments; Software; Interface; Architecture; Resource Adapter Interface

N00-103 TITLE: Ytterbium (Yb) Laser Transmitter

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-272 (ATAPS), PMA-265 (F/A-18)

OBJECTIVE: Develop a compact and efficient Yb laser transmitter for use in laser rangefinder/laser target designator (LRF/LTD) systems.

DESCRIPTION: There is a need for the development of a compact and efficient 1-m laser source for use in LRF/LTD systems. Current airborne targeting systems use Nd:YAG lasers, which are pumped by diode lasers and produce energy outputs in excess of 100 mJ at a pulse rate of 20 Hz. It is desirable to increase the output power and reduce the cost of the LRF/LTD systems. Because of their long upper state lifetime, Yb lasers offer a significant improvement in output energy and reduction in cost over Nd:YAG lasers. The goal of this task is to demonstrate the operation of a diode pumped, Yb laser with an output of a few hundred millijoules and a pulse repetition frequency (PRF) of 20 Hz. The baseline lasing medium is Yb:YAG. However, because of their larger stimulated emission cross section other crystal materials such as Yb:GdVO4, Yb:YVO4, and Yb:SFAP will be investigated. The laser crystal will be excited with InGaAs laser diode arrays with emission wavelengths that match the crystal absorption.

PHASE I: Evaluate the status of the various Yb crystal options. Provide the overall design and layout of a diode pumped, Yb transmitter. Analyze the “Q”-switched laser performance and beam quality. Survey AlGaAs laser diode pump arrays and costs. Design a reliable “Q”-switch operating in a military environment.

PHASE II: Build and demonstrate a prototype laser diode pumped Yb laser with a “Q”-switched output energy in excess of 200 mJ’s at 20 Hz PRF.

PHASE III: Build and demonstrate an engineering model field use.

COMMERCIAL POTENTIAL: Potential commercial applications of a diode pumped, Yb-laser include material processing, medical therapeutic instrumentation, telecommunications, remote sensing, image recording, optical data storage, inspection/measurement/control, and entertainment.

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1. H. W. Bruesselbach, D. S. Sumida, R. A. Reeder and R. W. Byren, Jr., Quantum Electronics, Vol. 3, No. 1, February 1997.
2. D. S. Sumida, T. Y. Fan, Optics Letters, Vol. 19, No. 17, September 1994.

KEYWORDS: Ytterbium (Yb) Laser; Laser Target Designator (LTD); Laser Rangefinder (LRF); Laser Diode; Nd:YAG Laser; High Power Lasers

N00-104 TITLE: Compact Laser Designator and Eye-Safe Laser Rangefinder

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace, Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-231 (E-2C, Reproduction)

OBJECTIVE: Develop a compact unmanned air vehicle (UAV)-mounted laser designator (LD) for precision-guided munitions.

DESCRIPTION: A compact LD for a UAV platform will be integrated along with a compact eye-safe laser rangefinder (LRF) into and bore-sighted an existing 12 inch turrett of electro-optic infrared (EO IR)/visible payload Wescam Model 12DS200. This will enable forward observers, forward air controllers, gunfire spot teams, and reconnaissance teams to process targets for precision-guided munitions. The UAV-mounted EO IR/visible payload with LD and LRF integration will be able to:

- Rapidly acquire target range
- Accurately calculate observer and target locations
- Designate targets for laser-seeking precision guided munitions, both surface delivered and air delivered
- Digitally transmit fire support data in preformatted and free-text messages to supporting arms platforms and agencies.

The modular LD should not weigh more than 7 pounds. The EO payload (day/night passive imagery sensor integrated with the LD and eye-safe LRF) must have the capability to identity and designate a standard NATO target of 2.3 square meters from a slant range of at least 6 km. This EO payload interfaces with the global positioning system receiver (GPSR) and data automated communication terminal (DACT) or airborne data terminal (ADT). The DACT/ADT will communicate in variable message format (VMF) and be interoperable with all communications and fire support systems to include the advanced field artillery tactical data system (AFATDS). Functional operations of the laser devices will be performed via remote control from a ground control station (GCS). The integrated system will be compatible with the tactical control system (TCS) and the future tactical common data link (TCDL).

PHASE I: Design and develop an LD prototype with emphasis on weight, dimensions, capability of identifying and designating standard NATO target at the required slant range, data and electrical interface, and operational remote control. Conduct and provide design trade studies such as: pump means, gain medium configuration, etc. to validate the design and to provide the lowest risk possible for LD development. The pump means will affect electrical efficiency, weight and power of electronics and cooling subsystem, and system reliability. The gain medium configuration will affect cooling and heat removal/dissipation. The design criteria considerations should also include laser energy, beam retention, divergence, operational time, warm up time, electro-optical switching, cooling system method, and maintenance method to achieve system maximum performance and reliability.

PHASE II: Produce LD prototype. Prepare and develop a controller and software as driver to control, demonstrate, and verify the LD operation via the LD data interface ports. Provide the actual LD design and output parameter measurements. Demonstrate the physical prototype as well as its functionality & capability. Verify and show that the LD prototype meets the operational requirements. The LD software source code and interface control document (ICD) along with the LD hardware module will be delivered to the government in Phase III, if selected, for use in the integrated system.

PHASE III: Transition the compact LD technology to a production capable item. This item will be integrated with a compact eye-safe LRF into an existing EO IR/visible payload. The system integration into an UAV platform will include hardware modifications and software upgrades on the existing EO payload, interface, data terminals, and control stations. It will include the integrated system developmental testing (DT) and operational testing (OT), flight and live fire testing. Expand the applicability of the compact LD to other EO IR/visible payload programs and platforms as well as commercial applications.

COMMERCIAL POTENTIAL: Eye-safe LRFs can be used in ceilometry at large and small commercial airports to measure the vertical height of the cloud ceiling; they can also be used by commercial aircraft for search and rescue; etc. LDs can be used for materials, medicine, and inspection.

REFERENCES:
1. Target Location, Designation and Hand-off System (TLDHS), http://sill-www.army.mil/tngcmd/usmc/tldhs.htm
2. Operational Requirements Document for the Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV), prepared by VTUAV/PMA-263, http://uav.navair.navy.mil/
3. Performance Specification for the Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV), N00019-99-R-1591, PRFSPEC-263-01,Version 1.0, prepared by VTUAV/PMA-263, dated 30AUG99, http://uav.navair.navy.mil/
4. IR/EO Systems Handbook, Volume 3 and Volume 6, published by ERIM at the University of Michigan, 1993
5. Advanced Laser Systems Technology (ALST), Inc., http://www.alst.com/6860/index2.htm
6. Eloptro, http://www.eloptro.com/; http://www.army-technology.com/contractors/fire/
7. PMA-263 Draft of Functional Requirements Document for TCS and Pioneer Integration Version 2.0 (REVISION 4) July, 1998, Revised 11 January, 1999, http://uav.navair.navy.mil/

KEYWORDS: UAV; Laser Designator (LD); Eye-Safe; Laser Rangefinder (LRF); Compact; EO Payload

N00-105 TITLE: Processor Technology Insertion Recertification

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-257 (AV-8B, Open Systems Core Avionics), PMA-265 (F/A-18)

OBJECTIVE: Develop a methodology to recertify the upgraded commercial off-the-shelf (COTS) hardware with a degree of confidence to eliminate or reduce the need to recertify operational application software in avionic systems. Establish a formal process/criteria that can fully characterize a real time computing system at the Application Program Interface (API) level such that changes to any hardware or software component below this level will be transparent to the application software that uses this interface. In essence, a formal process to characterize an operating system and its underlying processor. Once this characterization has been done, develop a process to generate test cases that can formally validate the API without being forced to exhaustively run every possible input and/or output to a service and every permutation of calling sequences.

DESCRIPTION: COTS based open architecture avionic systems are being fielded that are directly tied to the underlying microprocessor technology upgrades. The typical technology updates range from six to eighteen months. To avoid obsolescence over a twenty- to thirty-year military platform life cycle, the open system processor will need to be upgraded several times. The challenge is develop/evaluate cost-effective methods to verify behavioral integrity of a COTS-based real-time processing system as it transitions through its technology roadmap.

PHASE I: Design a process for identifying discrepancies in the functionality between two versions of commercial processor (i.e., 300 MHz versus 400MHz). Additionally, identify key performance metrics to enable evaluation of the effects on the operational application software.

PHASE II: Provide documentation of the functionality tested and the performance measurements used to verify the capability of identifying system discrepancies without the use of application software.

PHASE III: Demonstrate the above process in an avionic environment. Transition the methodology and tools to commercial and DoD processor applications. This would include support of a wide base of processor technologies including power PCs and pentium architectures.

COMMERCIAL POTENTIAL: Both commercial and DoD software developers would benefit from the ability to identify potential problems when upgrading processor technologies for obsolescence or performance needs. The largest benefits are for those systems and developers whose software is developed for a limited market, such as avionics, and where the cost of software development and reengineering cannot be spread over a large quantity of end-users.

KEYWORDS: Software Re-Use; COTS; Avionics; Processor; Certification; Upgrade

N00-106 TITLE: Towbody Towlines

TECHNOLOGY AREAS: Materials/Processes, Sensors, Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-272 (E-2A)

OBJECTIVE: Develop small-diameter towlines capable of having a break strength to 500lb+, withstanding temperatures to 2000 degrees F for multiple short duration cycles, having a line diameter of less than 0.1", and capable of withstanding extreme environmental abuse in airborne and shipboard military and commercial applications.

DESCRIPTION: The towline must be capable of withstanding a tight bend radius for long-term storage and captive carry and must exhibit low radar cross sections for gigahertz range radar. The towline must also withstand operating environments that include pyrotechnic byproducts, high vibration, and extreme temperature variations over the useful life of the product.

PHASE I: Develop requirements that include a break strength to 500lb+, up to 2000 degrees F tolerance for multiple short duration cycles, line diameter of less than 0.1", and survival in extreme environmental abuse such as airborne and shipboard military and commercial applications. A paper design showing the feasibility of the towline will be expected.

PHASE II: Assemble an engineering design line wound on a spool and develop a prototype product that meets the requirements developed in Phase I. Expand the design to include environmental requirements.

PHASE III: Field test the prototype developed in Phase II and transition the prototype into further production and integration into current airborne and shipboard systems.

COMMERCIAL POTENTIAL: Commercial miniature towline for weather balloon tethering and instrumentation; trip wires for security systems; miniature high-strength cable for a variety of commercial and industrial uses.

KEYWORDS: Towline; Miniature; High Strength Cable; Decoy; Towed Bodies; Countermeasures

N00-107 TITLE: Automatic Wake Detection Algorithms

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-299 (CH-60), PMA-264 (Air ASW)

OBJECTIVE: Develop a suite of automated wake detection algorithms for application to electro-optical/infrared (EO/IR) sensors.

DESCRIPTION: Image-based detection algorithms have concentrated on detecting the actual vehicle rather than a disturbance in the medium through which it passes. Larger, more diffuse signatures such as those generated by naval vessels can be easily detected by highly sensitive infrared (IR) and electro-optical (EO) systems and skilled operators. However, this surveillance represents a high workload for the operator and is highly dependent on training. Automated detection of this class of EO/IR signature will significantly improve operational capability for Navy EO/IR systems.

Development of this type of capability is high risk due to the high clutter environment typical of ocean background, signature variations caused by environment, and a large set of signature generation mechanisms.

The following areas shall be addressed during this development:
- Quantify and model observable EO/IR target signature sources
- Characterize and model background surface clutter and develop clutter suppression/rejection techniques
- Develop and demonstrate feasibility of automatic target detection in presence of background clutter.
- Quantify performance of algorithms as probability-of-detection versus probability-of-false-alarm on a given data set.
- Determine processing requirements for realtime implementation of the algorithms into prototype hardware.

PHASE I: Analyze and model target and clutter sources. Demonstrate feasibility of developing algorithms to automatically detect ocean surface wakes in the presence of ocean surface clutter. Target and background clutter data will be provided as government furnished information (GFI) image data collected during the test and evaluation state-of-the-art third generation medium-wave infrared and E/O systems. The algorithms must be robust enough to accommodate the expected variety of wake signature intensities, ocean surface environmental conditions, viewing geometries from nadir through low grazing angle, and ocean background clutter.

PHASE II: Develop optimized algorithm suite of wake detection algorithms. The algorithms will use developed target and clutter feature models to generate an algorithm chain which will maximize target-to-clutter signal-to-noise ratio prior to a thresholding and target detection and declaration to the operator. Possible features for exploitation are spatial linearity, spatial orientations, spatial intensity distribution, and frequency domain detection of Kelvin wake features.

PHASE III: Transition the algorithm suite to a sensor platform to demonstrate performance.

COMMERCIAL POTENTIAL: This capability will aid counter drug efforts by non-military agencies by providing a wake detection capability for commercial infrared systems.

KEYWORDS: Forward Looking Infrared (FLIR); Surveillance; Littoral Warfare; Software; Workload Reduction; Wake Detection

N00-108 TITLE: Real-Time Automatic Enhancement of Corrupted Video

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-258 (Standoff Land Attack Missile)

OBJECTIVE: Design and demonstrate real-time automatic video enhancement techniques that substantially mitigate the corrupting effects of turbulence, multipath, rain, low signal-to-noise, restricted bandwidth, electromagnetic interference, countermeasures, and/or other degrading phenomena on transmitted or hard-lined video.

DESCRIPTION: Commercial and military communication systems are faced with the need to perform critical tasks based on the use of transmitted (or hard-lined) video. Military examples include the use of video to perform stand-off targeting, autonomous target recognition (ATR), and operator-assisted terminal guidance of a missile. Commercial examples include video-based border patrolling, airport and other security systems, and medical testing such as X-ray interpretation. In each of these cases, autonomous corrections are preferred. In many applications, real-time, autonomous corrections are necessary.

Intentional video disruption (countermeasures) by an adversary is one possible cause of video degradation. This possibility should be addressed in responses to this solicitation. Electronic countermeasures might be performed at specific frequencies, or they might be random. Corrupting influences include multipath, atmospheric turbulence, white noise, 60-cycle and 400-cycle interference, nearby radio frequency (RF) transmitters, and other electromagnetic interference (EMI) sources. Some corruptive influences such as atmospheric turbulence of the scene radiation may not be totally correctable without the use of adaptive optics. Corrections that require adaptive optics should not be considered here. Some of the most important applications such as the operator-assisted or autonomous terminal guidance of a missile take place in real time.

The proposed solutions might involve hardware, firmware, software, or some combination of the three. Firmware and software techniques might include the design of a video card or application specific integrated circuit (ASIC) that autonomously performs the video corrections. The most important aspects of video enhancers, for purposes of this solicitation, are the corrective algorithms that are used to enhance the imagery.

For design purposes, it can be assumed that the video to be corrected is in a standard RS-170 format. The corrected video should also be in a RS-170 format. However, the data frame rate might be reduced to as low as 10 Hz. Implementation costs and processor requirements are very important considerations. The final product must be marketable to as many potential users as possible.

PHASE I: Design, develop, and document the enhancement techniques. Be able to perform initial demonstrations of the enhancement techniques at a level sufficient to demonstrate probability of success in Phase II. The Government may provide degraded RS-170 imagery to demonstrate the effectiveness of the approach.

PHASE II: Develop a prototype video corrector. Conduct performance tests of the video corrector using imagery with known sources of degradation. Conduct performance tests of video with unknown sources of degradation. Demonstrate significant video improvement. Parallel testing may be conducted by the Government. Provide design/development/production plans and schedules. Provide cost trade-off analyses.

PHASE III: Work with Government and/or commercial partners to develop video correctors specific to each individual need. Apply the successful technologies to the transmitted video of existing or new data link systems (or to hard-lined video) to improve video quality. The fixes might apply to airborne or earth mounted systems. Develop video enhancers that permit military and commercial users to perform tasks under video-degrading conditions, which heretofore prevented the performance of those tasks

COMMERCIAL POTENTIAL: The use of video data to perform critical tasks is mushrooming. Video is used in police work, entertainment, sports, communications such as the Internet, medical field, etc. Much has been done in some areas such as data compression. However, degraded imagery still occurs in all the above fields and is very costly in terms of task repeats, incorrect action taken, or task failures. The algorithms produced in this SBIR will reduce the costly effects of image degradation.

REFERENCES:
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4. “Image Edge Detection and Enhancement by an Inversion Operation,” D. Nath and S. Mukhopadhyay, Applied Optics, Vol. 37, No. 35, pp. 8254-8257, Dec 1998.
5. “Restoration and Frequency Analysis of Smeared CCD Images,” K. Powell, et. al., Applied Optics, Vol. 38, No. 8, pp. 1343-1347, March 1999.

6. “Reconstruction of an Object from its Noisy Fourier Modulus,” H. Takajo, et. al., Applied Optics, Vol. 38, No. 28, pp. 5568-5576, Sept. 1999.
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8. “An Enhanced NAS-RIF Algorithm for Blind Image Deconvolution,” Chin Ann Ong and J. A. Chambers, IEEE Transactions on Image Processing, Vol. 8, No. 7, pp. 988-992, July 1999.
9. “Estimation of Image Noise Variance,” K. Rank, et. al., IEEE Proceedings, online no. 19990238, June 1999.

KEYWORDS: Video; Imagery; Degraded Video; Video Corrections, Video Enhancement, Imagery Enhancement

N00-109 TITLE: Avionic Schematics on Demand

TECHNOLOGY AREAS: Air Platform, Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-299 (SH-60R)

OBJECTIVE: Develop a tool set and methodology to produce correct and visually useful avionic schematic drawings on demand from a database of components and interconnectivity.

DESCRIPTION: Avionic technicians require correct and visually useful schematics for trouble shooting and repair of avionics and the associated training. The avionic maintenance and training environment relies on computer based viewing of schematics and associated technical data. The authoring and maintenance of schematic drawings for this environment typically involve a multi-step, labor intensive work flow process between the schematic technical illustrator or graphic artist, the schematic interconnectivity database engineer, and the avionic technician. The products of this authoring environment are often late and not synchronized with each other, forcing the avionic technician to rely on schematic information of marginal use. This effort will fund the development of innovative approaches for authoring, maintaining, and deploying correct and useful schematic drawings from a single database of components, interconnections, and other essential information in the avionic computer based maintenance and training environment.

The application of schematics on demand facilitates the continued effort to digitize technical data. Current digital schematic technology fails to provide adequate information to trace single elements throughout a system, since an element cannot be tagged as on-screen presentations are shifted. Expanding this application to mechanical systems is anticipated when fuel and hydraulic lines become equally difficult to trace as wiring and electronic components in a virtual schematic.

PHASE I: Determine the technical merit and feasibility of a schematics-on-demand authoring and deployment environment. Provide a requirements document and a preliminary design document along with a working prototype useful for demonstrating the schematics-on-demand process and as a rapid development environment.

PHASE II: Provide a detailed design document for the schematics-on-demand process. Provide a tool set that can be used to test the schematics-on-demand process with selected naval aviation avionic contractor's schematics and field-tested by operational maintenance and training command.

PHASE III: Provide/license a commercial grade tool set with avionic schematic drawings to naval aviation contractors, operational maintenance, and training commands. Tool set could also benefit private sector maintenance crews using schematics.

COMMERCIAL POTENTIAL: This innovation will have wide use in schematic environments in general aviation, heavy machinery, utilities, the process industry and other industries where owner/operators use schematics for maintenance and training.

REFERENCES:
1. Sample Schematics are available. Call Carol Van Wyk 301 342-0215

KEYWORDS: Schematics; Avionics; Maintenance; Repair; Training; Interactive Electronic Technical Manual

N00-110 TITLE: Multiple Small ‘Smart’ Weapons Carriage

TECHNOLOGY AREAS: Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: Joint Strike Fighter (JSF)

OBJECTIVE: Develop a multiple small smart weapons carriage system for projected naval aviation platforms. This weapons carriage system will be universal without adaptation and capable of internal and external weapons carriage and release.

DESCRIPTION: Since Operation Desert Storm, there has been an overall trend within DoD toward smaller, smarter weapons that are low cost, have a reduced logistics tail, and are effective in all weather conditions. Innovative technologies are desired that will address the integration of small, smart weapons for both internal and external carriage on Navy and Marine Corps aircraft. The desired systems will improve communications between aircraft and weapon and allow for the carriage of multiple (minimum of four) small, smart weapons on one MIL-STD-1760 aircraft station interface. The envisioned system will improve weapon circular error probability and allow for independent targeting and release of individual weapons to facilitate multiple missions per sortie. The carriage system must be able to handle the loads and accelerations during catapult launches and arrested recoveries. Suitability for sea-based operational environments, storage, and maintenance aboard aircraft carriers and amphibious assault ships will be a central consideration throughout this development.

PHASE I: Provide a final design concept, including Level 1 drawings, which would be prototyped and demonstrated during Phase II. Deliver a mockup of the design. The significant research efforts in this phase include evaluating nonpyrotechnic ejection force generators, which will be cleaner and "greener," and performing fluid dynamic analysis of concepts for ejecting relatively small stores out of weapon bays through the shear flow boundary. Identify improvements to the naval aviation attack mission emanating from the proposed design concept, in particular higher aircraft speeds during ejection as well as shortened periods of aircraft vulnerability during launch. Develop system performance requirements and evaluate alternate system design concepts for the selected aircraft. The Navy will identify candidate aircraft and specific internal and external weapon stations for each selected aircraft. Cost per kill and total cost of ownership will be critical metrics for the overall system.

PHASE II: Design, fabricate, and demonstrate the proposed system. Conduct system form, fit, and function tests on candidate naval aircraft. Conduct system laboratory performance tests in preparation for flight tests in Phase III to assess design compatibility in naval shipboard and mission environments.

PHASE III: Produce five systems using the initial Level 3 (MIL-STD-100) production data package with the proposed production methods. Conduct ground-based aircraft and system flutter analysis. Conduct aircraft/weapon/system first flight. Conduct laboratory qualification tests.

COMMERCIAL POTENTIAL: The aircraft prime contractors of the selected aircraft, weapon developers, and foreign military all have high potential as customers of the resulting product. Foreign military sales are, of course, the most obvious commercial benefit. However, there is some interest in the aerial fire-fighting capabilities that such an advanced launch system could provide. The ability to disperse smaller "water bombs" over wide areas of forest fires, such as those that occurred last year in Florida, would enhance the effectiveness of fire fighting over multiple target areas and reduce the cycle time between reloading and mission assignment. The system will also have the potential for nonmilitary applications where smart system control of electromechanical systems is required in a demanding industrial environment.

REFERENCES:
1. MIL-STD-1553
2. MIL-STD-1760B
3. Meyer, R. Cenko, A. and Yaros, S. "An Influence Function Method for Predicting Aerodynamic Characteristics during Weapon Separation", 12th Navy Symposium on Aeroballistics, May 1981
4. Keen, K.S. "Inexpensive Calibrations for the Influence Function Method using the Interference Distributed Loads Code" J. Aircraft, Jan. 85, pp. 85-87
5. Cenko, A. et al. "NADC Approach to Air Launch Certification" AIAA paper 92-2900, Aug 91.
6. Welterlen, T.J. and Leone, C., "Application of Viscous, Cartesian CFD to Aircraft Stores Carriage and Separation Simulation." AIAA paper 96-2453, June 96

KEYWORDS: Precision Attack; Command, Control, Communications, and Computers; Air Warfare; Aircraft Systems; Smart Weapons; Weapons Carriage

N00-111 TITLE: Integrated Missile Seeker Signal-Processor Development and Implementation

TECHNOLOGY AREAS: Information Systems, Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMA-280 (Tomahawk)

OBJECTIVE: Develop an integrated missile seeker signal-processing and navigation aiding system capable of improving the accuracy of a global positioning system/inertial navigation system (GPS/INS) guided missile. Current GPS/INS guided missiles have no capability for correcting aimpoint errors in the terminal area caused by target location errors (TLE) or navigation system errors. Integration of a low cost seeker with signal processing, automatic target recognition and navigation aiding logic could provide aimpoint updates to the missile and improve the accuracy of the impact point. Such a missile integration would be done so the missile could be employed with or without the use of the seeker depending on missile planning parameters and target information available.

DESCRIPTION: A missile guidance system which includes a seeker that provides a method of updating the aimpoint to aid the terminal guidance system in locating and targeting both fixed and mobile targets is desired. Signal processing systems for such an advanced missile guidance architecture must perform required signal/image processing operations at a high bandwidth within size, power consumption, and manufacturing cost limitations. While there is much research and development going in the area of improving sensor signal processing and integrating sensor data with GPS data (USAF Advanced Guidance Division, Cooperative Research Center for Sensor Signal and Information Processing and the US Army Research Laboratory, for example) this has not been applied to missiles such as the Tomahawk. The goal is to design an integrated missile seeker signal-processing system tightly coupled to the existing GPS/INS guidance system designed to improve the terminal impact point accuracy while at the same time implementing a sensor/processor interface that will allow sensor interchangeability and enhance system modularity.

PHASE I: The contractor shall create an architecture incorporating signal/image preprocessing, automatic target recognition, target discrimination, tracking, reacquisition, and missile guidance aiding algorithms. Tne contractor shall analyze the front-end and back-end signal-processing requirements for advanced missile seekers and identify practical methodologies for implementing the missile seeker and guidance aiding. The implementation must be capable of processing rates consistent with next-generation seeker imagers. The identified implementation methodology must be compatible with the power and packaging requirements of the missile seeker.

PHASE II: Fabricate and demonstrate the Phase I design.

PHASE III: The developed technology will be an integral part of advance missiles and missile upgrades. The small business will participate in the production of the seeker as a supplier of the signal processing technology.

COMMERCIAL POTENTIAL: The developed technologies will be applicable to vision systems used in many applications including manufacturing, surveillance, and autonomous vehicle control. Examples include robotic vision and position location, UAV based survey systems and precision material delivery systems (UAV delivered forest fire suppression chemicals, for example).

KEYWORDS: Missile Seeker; Signal Processor; Real-Time Processing; Automatic Target Recognition; Autonomous Guidance; Imagers

Office of Naval Research

N00-112 TITLE: MCM Technologies for Detection, Classification, and Identification/Localization of Sea Mines and Submarines

TECHNOLOGY AREAS: Electronics, Weapons

OBJECTIVE: Enable airborne and sea platforms to rapidly detect, classify, and identify (D/C/I) sea mines and other objects of similar size and of submarine size.

DESCRIPTION: Sensors used for D/C/I of mines have dramatically improved in recent years. These include airborne LIDAR, underwater laser systems, high resolution sonars, and magnetic sensors. This effort will develop, fabricate, and test sensor system improvements which overcome some of the severe performance limitations of existing sensors due to adverse environmental factors, such as sonar surface and bottom reverberation, especially in shallow waters less than 60 feet and when searching for potentially buried objects. Underwater laser systems are limited by water clarity problems which result in blur, glow, and absorption. Airborne LIDAR systems suffer from water surface reflections which must be gated out, reducing the sensors' capability to detect surfaced objects. These optical systems also suffer from reduced target contrast in bright daylight conditions.

ASW sonar systems are on the verge of increased capability in littoral wasters. Current designs are performance limited by severe multi-path propagation and reverberation/clutter. Greater computing power in today’s signal processsors allow the possibility of sorting out the multi-path arrivals and de-cluttering the received signal. The development of wide frequency band systems, sources and receivers, will allow waveform designs not now available.

The proposed effort will develop technologies which can ameliorate one or more of today's sensor technology limitations.

PHASE I: Develop a technology design for overcoming underwater object sensing limitation(s). One or more designs addressing the same or different limitations is required. In addition, a document clearly explaining the theory of operation and predicted performance enhancement is required for each design.

PHASE II: Fabricate and test a breadboard (experimental) prototype of the sensor enhancement(s) and provide clear and complete documentation of the prototype's final design, functionality, and testing conducted to demonstrate performance improvement(s).

PHASE III: Design, fabricate and test advanced developmental prototype(s) with interfaces to existing and/or new technology sensors or sensor systems.

COMMERCIAL POTENTIAL: The technologies developed will have multiple commercial applications. Airborne LIDAR improvements will enhance the performance of air search and rescue sensors. Underwater technologies will enhance sensors used by commercial diving and salvage companies and the oil industry which uses sensors for oil pipe and cable relocation and inspection.

REFERENCES:
1. Sea Technology (ISSN 0093-3651) published by Compass Publications, Inc., 1117 North 19th Street, Arlington, VA 22209
2. P. T. Gough and D. W. Hawkins, "Imaging Algorithms for a Strip-Map Synthetic Aperture Sonar: Minimizing the Effects of Aperture Errors and Aperture Undersampling", IEEE J. Oceanic Eng., vol. 22, pp. 27-39, Jan 1997.
3. T. Rastello, et al, "Spatial Undersampling for Synthetic Aperture Ultrasonic Imaging via Digital Spotlight Technique", IEEE Trans. Image Processing, Vol8, No.9, Sept, 1999
4. Deak, J.G., Miklich, A.H., Slonczewski, J., and Koch, R.H., "A Low-Noise Single-Domain Fluxgate Sensor," Applied Physics Letters, vol. 69, p. 1157 (1996).
5. Miller, L.M., Podesek, J.A., Kruglick, E., Kenny, T.W., Kovacich, J.A., and Kaiser, W.J., "A :-Magnetometer Based on Electron Tunneling," Proceedings of IEEE 9th Annual International Workshop on Micro-Electro Mechanical Systems (Feb 11-15 1996), San Diego, CA.
6. Lonnie K. Calmes, James T. Murray, William L. Austin, and Richard C. Powell, "Marine Raman image amplification," SPIE Conference on Airborne and In-Water Imaging, to be published (1999).

KEYWORDS: Mines; countermeasures; sonar; LIDAR; environment; optics

N00-113 TITLE: Maritime Intelligence, Surveillance, Reconnaissance (ISR) and Space Exploitation

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Development of new technologies, sensors and algorithms to provide improved and long-term situational awareness within the maritime littoral region.

DESCRIPTION: The focus of this SBIR topic is to stimulate innovative new concepts to improve the performance of automated maritime ISR including use of space assets. Future Naval needs include complete awareness of the subsurface, and surface environment with particular emphasis on littoral areas. The littoral regions contain a complicated mix of neutral surface ships with a range of sizes and purposes mixed in with a variety of friendly and enemy combatants and mines. Specification of environmental and situational awareness must extend seamlessly across time, beginning well before and extending through hostilities. Innovative techniques to provide improved environmental specification simultaneously with situational awareness of non-environmental activity for prolonged periods of time are desired. This SBIR focuses on aspects of maritime ISR,(other than conventional ASW and MCM which are covered by other SBIR topics), and space exploitation. Novel means of exploiting or improving existing sensors, including space sensors are of interest. Natural environments of interest include ocean, atmosphere and space. Methods of detecting, identifying and classifying neutrals (commercial shipping, fishing and pleasure craft) and unusual threats such as small surface craft and small submarines (mini-submarines) are of interest. Examples include but are not limited to: 1) surface ship surveillance exploiting ship acoustic, electromagnetic, or hydrodynamic signatures or, of particular interest, use of GPS signals or low resolution space based radar to illuminate the ocean surface; 2) undersea surveillance via fusing of multistatic active acoustic sensing or novel matched field methods for autonomous deployed sensors. New techniques for environmental remote sensing from airborne or spaceborne platforms are encouraged. Improved methods for tracking objects of interest in the complex littoral environment are sought. The littoral scene may contain many objects with crossing paths and unknown motion models.

PHASE I: Develop a complete algorithm or detailed description of the proposed ISR concept. If the concept involves hardware produce a design. This algorithm, description, or design and supporting documentation should be sufficient to convince qualified engineers that the proposed concept is technically feasible.

PHASE II: Produce and demonstrate performance of a computer program based on the algorithm or description of the concept. If the concept involves hardware, produce and demonstrate performance of an exploratory Development Model (XDM). Demonstrate performance in such a way as to convince qualified engineers that the proposed concept is capable of meeting requirements in an operational environment.

PHASE III: Team with the manufacturer of one of the Navy's ASW or MIW ISR systems to integrate the concept into future generations. Team with manufacturers of commercial fusion systems, such as air traffic or harbor control, to integrate the concept into these products.

COMMERCIAL POTENTIAL: There is a commercial market for ISR concepts applied to air traffic and harbor control. There is a growing commercial market in tracking littoral traffic for law enforcement (smuggling and illegal fishing).

REFERENCES:
1. Waltz, Edward and James Llinas, "Multisensor Data Fusion",Artech House, 1990

2. Bar-Shalom, Y., "Tracking Methods in a Multitarget Environment," IEEE Transactions on Automated Control, Vol. AC-R3, August 1978, pp. 618-626

KEYWORDS: Electromagnetic, Remote Sensing, Acoustic and Hydrodynamic signatures, multitarget tracking, state estimation, common tactical picture

N00-114 TITLE: RF Transparent, Optically Tailorable Appliqué

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Electronics

OBJECTIVE: Develop an appliqué material whose visual and infrared reflectance can be independently tailored over a wide spectral range and is transparent to microwave radiation. The goal of this task is to develop affordable, durable, RF transparent, spectrally tailored appliqués that minimize life cycle costs and demonstrate their use.

DESCRIPTION: The majority of the work done to develop low IR emissive surface treatments that are compatible with radar absorbers (RAM & RAS) has focused on low-emissive paints. Low emissive paint, while being a good solution for emissivity control, is not the optimum solution because once the paint has left the spray gun or paintbrush, orientation control of the IR reflective and colorant pigments is lost. This severely limits the ability to tailor coating's spectral properties for high, moderate or low reflectance is certain segments of the visible through far-infrared region of the spectrum. Specific optical reflectance goals are detailed in the Joint Requirements Oversight Council ‘s (JROC) DD-21 Operational Requirements Document (ORD) of 16 October 1997.

The visible through far-infrared spectral characteristics, as well as the bidirectional reflectance properties, of an appliqué can be tailored to virtually whatever is desired dependant on operational scenario and expected threats. Appliqués offer additional benefits, especially when constructing RAS. The appliqué can be incorporated into the front face of the RAS during manufacture. This eliminates the need for painting, along with all the environmental, health and safety problems associated with painting, and allows increased control of how the signature control material is applied.

PHASE I: Develop a plan detailing how to construct a RF transparent, spectrally tailorable appliqué with an emphasis on developing a flexible technology that allows manipulation the spectral response of individual spectral bands independent of the spectral response of the other bands while maintaining RF transparency, maximizing manufactured volume and minimizing life cycle costs. The reflectance requirement for each spectral band is different (visible (400-700 nm), NIR (0.9-2 m), MWIR (3-5 m), and LWIR (8-12 m)) and will be fixed for individual bands between 10% and 90%.

PHASE II: Implement the approach defined in Phase I. Develop a production methods and equipment that enables manufacture of prototype materials. Test the spectral response, RF properties, and mechanical and environmental durability of each prototype. Define the limitations of the manufacturing process. Develop material application and repair procedures. Develop a detailed acquisition and life cycle cost estimate.

PHASE III: Scale up production to enable the manufacture several thousand square feet of material per shift.

COMMERCIAL POTENTIAL: Infrared reflective appliqué offer major performance gains for commercial applications areas in the automotive industry and the commercial coatings industry. Both industries are striving to minimize volatile organic compounds (VOCs) emitted during painting processes.

Appliqué use will virtually eliminate VOC emission while offering superior durability and offering the added benefit of reducing solar loading of a building, automobile, or whatever structure is being coated. Reducing the solar loading of a structure translates into increased habitability and significantly lower interior cooling costs and energy demands.

KEYWORDS: Infrared, Appliqué, Signature

N00-115 TITLE: High-g Micro Electro Mechanical Systems Inertial Measurement Unit (High-g MEMS MU)

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PMS-429, Naval Surface Fire Support

OBJECTIVE: Develop innovative concepts and approaches for low cost, precision tactical navigation grade Micro Sensor IMU suitable for insertion into multiple defense tactical missile, sensor, and projectile systems.

DESCRIPTION: Innovative and novel approaches are sought for a Micro Sensor IMU (1-10o/hr bias stability) that can provide accurate rotation and linear acceleration measurements in thermal conditions from –40oC to +125oC, vibration condition of > 30g rms, acceleration condition > 10g, and able to withstand 17,000g's. No know micro-electro-machanical-systems (MEMS) IMU technology can meet these requirements. Current surface machined MEMS fashioned from a thin film of polysilicon are typically limited to 2-6 mm thickness processing. This imposes serious constraints that reduces IMU resolution below tactical grade, severely limits IMU operating temperature range, and exhibit IMU failure during high-g accelerations and shock. Deep reactive ion etchhing and ion implantation technologies overcome the limitations of thin film surface micro machining and opens the door to new and novel IMU approaches employing meso scale micro machining on silicon-on-insulator, novel quantum tunnel in single crystal silicon, and integrated optics. Synergistic commercial Micro Sensor IMU applications include costly oil drilling and exploration, tunnel boring equipment, heavy machinery, and gun launched sensors. A very important factor is how the proposed effort will impact the projected Micro Sensor IMU unit cost across combined military/ commercial volumes. Proposers need to show close alignment of military and commercial business strategies, and how military IMU products will benefit from commercial production volume, commercial pricing and continuous technology improvements. Proposals also should include a description of the Micro Sensor IMU concept of operation, address assembly/ testing and reliability issues, predict operational specification limits, and have identified commercial and military application areas or demonstration candidates.

PHASE I: Develop, model and simulate tactical grade Micro Sensor IMU concepts that meet severe environmental conditions. Develop testing methodologies for Micro Sensor IMU's.

PHASE II: Develop and test a candidate Micro Sensor IMU.

PHASE III: Integrate the Micro Sensor IMU into a Navy missile, sensor, and/or precision guided munitions programs.

COMMERCIAL POTENTIAL: Commercial high-g MEMS IMU applications include costly oil drilling and exploration, tunnel boring equipment, heavy machinery, and gun launched sensors.

REFERENCES:
1. A number of silicon foundries offer deep reactive ion etching, including Kionix (http://www.kionix.com).

KEYWORDS: MESO; MEMS; IMU; INU; gyro; accelerometer; navigation.

N00-116 TITLE: Modular 100 kW Wave Powered Electric Generator

TECHNOLOGY AREAS: Materials/Processes, Sensors, Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Expeditionary Logistics

OBJECTIVE: Develop an ocean wave powered electrical generating system with a capacity of approximately 100 kW that can be operated alone or in groups for higher power levels.

DESCRIPTION: Ocean wave powered electric generation units with power capacities of up to 25 kW are becoming available. A unit that is modular and deployed off-shore can provide electric power on site for AUVs or sensing and communication applications. The power can also be sent to shore through a submarine cable to support manned or unmanned operations. It would be advantageous if the capacity of a single unit could be increased to 100 kW to power larger applications, and a group of 10 units could then generate a megawatt. Technology is needed to combine the output of multiple units and provide the power at a single point. A reasonably efficient 25 kW unit is large, heavy, and produces significant mechanical force and motion prior to its conversion to electric power. A 100 kW unit requires the solutions of a wide range of problems including: a new design approach such as a segmented structure to be assembled on-site, lighter weight marine materials, improved impedance matching of the electrical generation system with the massive mechanical system, transportation techniques for land and sea, deployment and assembly techniques, an economic mooring approach and design, attractive system economics, and most importantly maintaining or improving the efficiency of energy conversion from the waves over a wide range of wave conditions.

PHASE I: Develop innovative concept design(s), and conduct a trade-off study. Complete the preliminary design of a 100 kW unit for a specified operational site with its wave climate, sea bottom configuration, and interface to the power consuming application.

PHASE II: Complete the system design and power user interface, fabricate a scale model and verify its performance in controlled tests, and fabricate a full-scale prototype unit. Deploy the unit at a specified Navy operational site and put it into operation. Report the system's performance.

PHASE III: Develop the necessary business relationships for efficient manufacture and commissioning of production systems as well as their maintenance. Contract with Navy and commercial organizations for the installation of power generating systems.

COMMERCIAL POTENTIAL: Products developed under this topic have use in providing electric power for remote communities that located near useful wave action. This includes islands and coastal areas, and particularly those not connected to a main power grid. Wave power in general is available for a higher percentage of time than solar or wind power, and does not have the logistic burden of diesel-generator sets.

REFERENCES:

1. Ocean Power Technology's Wave Power System Institute of Mechanical Engineers November 30, 1999 Symposium U.K. Department of Trade and Industry, London Conference
2. DOE web site http://www.nrel.gov

KEYWORDS: Remote power, renewable power, wave power

N00-117 TITLE: Submarine Forward Escape Trunk Cofferdam

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

OBJECTIVE: Design, develop, test, evaluate and transition a watertight enclosure for the submarine forward escape trunk hatch.

DESCRIPTION: Submarine personnel transfers are frequently conducted at sea rather than pier-side. During a brief stop for personnel (BSP), the submarine is surfaced and personnel enter through the forward escape trunk hatch. Even under moderate sea states, waves come over the hull and can deposit large quantities of water down the hatch. At present, a make-shift enclosure is hung inside the forward escape trunk during BSPs in an attempt to minimize the extent over which the sea water can spread once it comes down the hatch. (The attached figures provide photos of this "bathtub" hanging in the forward escape trunk). The disruption caused by a large quantity of sea water coming down the hatch and the sailor workload required to clean it up are significant. Submarine force leadership has identified improving this situation through the innovative application of science and technology as a high-priority sailor workload-reduction issue. The technology solution must provide an external watertight enclosure that can fit down the hatch and be stored internal to the submarine. The desire for compact storage makes an inflatable solution attractive. The external enclosure must securely attach to the hull and have a raised rim extending two or more feet above the hatch to prevent sea water from entering the hatch. A built-in step is desired to allow easy personnel entrance to the hatch.

PHASE I: Develop a system concept for a stowable watertight enclosure for the submarine forward escape trunk hatch. Assess concept feasibility via system design and the development of design drawings. Should time and funding permit, begin work on a system prototype in anticipation of a Phase II award.

PHASE II: Develop a system prototype and demonstrate the prototype first in a laboratory environment and secondly on-board a submarine in a realistic environment during local operations including a brief stop for personnel

PHASE III: Address any conceptual or design issues raised by the Phase II prototype demonstration, develop the product and conduct NAVSEA testing and SHIPALT package preparation as required to transition the system to an acquisition program.

COMMERCIAL POTENTIAL: This technology could be commercialized for use by foreign navies and recreational industries conducting similar brief stops for personnel.

REFERENCES:
Specific measurements of the hatch are available from NAVSEA. NAVSEA can also provide a photograph of the forward escape trunk and the make-shift enclosure that is currently hung during BSPs in an attempt to limit the spread of water that comes down the hatch.

KEYWORDS: workload; submarine; hatch, trunk; personnel; BSP

N00-118 TITLE: <u>Liquid Fuel Atomizer</u>

TECHNOLOGY AREAS: Air Platform, Materials/Processes

OBJECTIVE: To provide a low-volume, low-weight, pulsating, liquid hydrocarbon fuel atomizer that will produce Sauter-mean diameters less than 10 microns without large power requirements or pressure drop.

DESCRIPTION: The performance of liquid-fueled ramjets, scramjets, pulse-detonation engines (PDE) and gas turbines can depend upon the size distribution of the fuel droplets which are produced by the combustion chamber atomizer. Large droplets do not follow the air flow and can result in poor fuel distribution/mixing and increased combustor length requirements. In addition, they can produce undesired soot when they pass through hot zones. In the PDE large particles may limit the wave speed and thrust and cause excessive wall heat release. PDEs also require rapid pulsing of the atomizer and zero-leak between pulses when the engine is purged. Current atomizers that produce small droplets of kerosene type fuels either require large pressure drops, have very low flow rates and/or are not robust enough to withstand the PDE environment. There is considerable technical risk. A technique that delivers the required atomization characteristics has not appeared in the literature and will require innovative application of scientific and engineering principles.

PHASE I: Review and compare to the required specifications all current liquid atomization techniques with emphasis on flow rates, pressure drops, power requirements, drop sizes produced and cost. Develop an atomizer concept and design that will provide (1) Sauter-mean diameter < 10 m for JP-10 with fuel temperatures from 0-500 F, (2) <50 psi pressure drop, (3) flow rates of > 0.5 lbm/s when open, (4) a total weight of <4 lbm, (5) a volume < 3x3x6 inches, (6) >100 Hz on-off pulsing with zero-drip at closure, (7) no failure for >600 sec of continuous operation and (8) no failure with high back pressure (>300 psi) pulses (~ 1 ms) during the closed mode.

PHASE II: Construct and demonstrate a prototype unit; measure drop size distribution and demonstrate that specifications can be met. One unit will be delivered for evaluation to determine if the specifications have been met.

PHASE III: Deliver 4 units for testing in a PDE. Make the atomizer available to government and industry for both propulsion and other commercial applications.

COMMERCIAL POTENTIAL: In addition to the military need for missile and gas turbine engine applications the device would have immediate utilization in the commercial gas turbine engine industry and in other spray-based processes (diesel engines, paint spraying, coatings, etc.).

REFERENCES:

1. Lefebvre, A.H., Atomization and Sprays, Hemisphere Publishing Corp., 1989;
2. Roy, G. and Anderson, S.L., Proceedings of the Twelfth ONR Propulsion Program Review 1999, Office of Naval Research and the University of Utah.

KEYWORDS: Atomization, liquid fuels, pulse-detonation, ramjets, scramjets, gas-turbines

N00-119 TITLE: Power Generation During Buoy Operations

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Sensors, Electronics, Battlespace

OBJECTIVE: To have power generation and storage system that would enable long-term (5-6 months) operation of instrumented buoys with power load of 35 watts.

DESCRIPTION: Generation and storage of electrical power is required on instrumented buoys because of longer-term usage and power demand of newly deployed sensors, acquisition and distribution components. Estimated requirements for present and planned sensors/components are power loads of 30-35 watts. The buoy types for the system would be similar to the discus (~3-meter) or spherical (1~2 meters) hulls now in use for several applications. They have nominal platform loading of 2,000 lbs and displacements of 3600 lbs. The solution to long-term moderate loads seems to be an economical generation/storage system for installation on the buoys. The system cannot disturb or block the airflow or ocean surface measurements nor exceed weight limitations. Generation and storage of electrical power will occur for 6 or more months. The generation could be based on a combination of solar, wind, wave energy availability, and/or sea-water conductivity properties.

PHASE I: Provide design characteristics of system to include size, weight, power generation and storage estimates taking into account atmosphere and ocean conditions including solar radiation, temperatures, winds and waves.

PHASE II: Build and demonstrate laboratory prototype with simulated required forcing, sensing non-interference and size/weight constraints.

PHASE III: Merge power generation/storage system with sensor (instrument), acquisition and transmission components and mount on buoy. Demonstrate performance both in laboratory and at sea in varying temperature climate. Both laboratory and at-sea test will be for 6 month periods. The system will be further tested for duration within marine regime and tested on operational NOAA and research buoys.

COMMERCIAL POTENTIAL: Technology would meet any private sector requirement for power load of 30-35 watts in remote location.

REFERENCES:
1. Anctil, Francois, Mark. A. Donelan, Wiilaim m. Drennan, and Hans C. Graber 1994: Eddy-Correlation Measurements of Air-Sea Fluxes from a Discus Buoy. Journal of Atmospheric and Oceanic Technology, vol 11.
2. Hosum, D., R. Weller, R. Payne, and K. Prada, 1995: The IMET (Improved METeorollogy) Ship and Buoy Systems. Journal of Atmospheric and Oceanic Technology, vol 12.

KEYWORDS: Generation; Battery; Buoy; Oceanography; Meteorology; Sensors

Naval Sea Systems Command

N00-120 TITLE: Electronic Warfare Adaptive Spatial/Spectral Cancellation

TECHNOLOGY AREAS: Electronics, Weapons

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Theater Air Defense and Surface Combatants

OBJECTIVE: Develop and demonstrate approaches to place spatial nulls in the directions of interfering own-ship RF sources for high-resolution interferometer antennas used in shipboard electronic warfare systems as a means of maintaining high system performance within complex, dense RF tactical environments.

DESCRIPTION: The next generation of ship electronic warfare systems is to provide the fleet with significantly enhanced tactical capabilities including high angular resolution for improved battle fleet passive situational awareness and a major increase in system sensitivity. These EW systems are designed to ameliorate the effects of strong own-ship RF sources and will work well with current and near term radar and communications systems. However, when looking forward in the future, network-centric requirements are driving the use of increasing communication link bandwidths and power levels. This effort is intended to evaluate and demonstrate the use of sidelobe cancellation techniques to adaptively place spatial and spectral nulls on own-ship emitters so as to reduce their effect on EW performance. Successful implementation and transition to the fleet of this capability will greatly ease ship topside arrangement constraints as well as reduce installation costs.

PHASE I: Develop candidate design alternatives and define selection criteria for the candidate approaches; perform tradeoffs between system parameters and interfering source characteristics to select best design alternatives. Evaluate performance characteristics including projected signal levels and modulation types such as spread spectrum pn-coded and frequency diversity waveforms; analyze and model system RF/IF/digital performance and timeline behavior; provide a plan with cost and schedule for the prototype /demonstration.

PHASE II: Design, build and evaluate prototype/brassboard RF/IF/digital processing hardware and software using applicable EW interferometer design parameters which demonstrates the adaptive spatial/spectral nulling approach; perform lab tests and support field tests on an antenna range to validate modeled performance; determine the system-level capabilities and limitations; perform risk management evaluations for this effort as well as supporting the technology transition for the next phase; provide cost data and planning schedules to aid in the transition.

PHASE III: Develop a system production mod kit providing this enhanced EW capability – design, build, validate/test; produce and install in the fleet.

COMMERCIAL POTENTIAL: Wideband Telecommunications

REFERENCES:

1. Brennan, L.E., and Reed, L.S., "Theory of Adaptive Radar", IEEE Transactions on Aerospace and Electronic Systems, Vol. AES-9, No. 2, pp 237-252, March 1973.
2. Gabriel, W.F., "Adaptive Arrays - An Introduction", Proceedings of the IEEE, Vol. 64, No. 2, pp 239-272, February 1976.
3. Applebaum, S.P., "Adaptive Arrays", IEEE Transactions on Antennas and Propagation, Vol. AP-4, No. 5, pp 585-598, September 1976.
4. Chapman, D. J., " Adaptive Arrays and Sidelobe Cancellers; A Perspective", Microwave Journal, Aug 1977.
5. Yuen, S., "Algorithmic, Architectural and Beam Pattern Issues of Sidelobe Cancellation", IEEE Transactions an Aerospace and Electronics Systems, Vol. 25, No. 4, pp 459-471, July 1989.

KEYWORDS: electronic warfare; system sensitivity; adaptive signal processing; sidelobe cancellation; wideband interferometer; electromagnetic interference

N00-121 TITLE: Galley Food Waste Disposal

TECHNOLOGY AREAS: Materials/Processes, Human Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Expeditionary Warfare

OBJECTIVE: Develop innovative shipboard equipment for the treatment of galley food waste. The discharge will be environmentally benign and acceptable for shipboard discharge worldwide. See references.

DESCRIPTION: Recent developments in sewage and gray water processing and treatment systems have addressed numerous shipboard applications; however, the galley waste stream has not benefited. The design for new ships includes Marine Sanitation Devices, which will have difficulty processing galley food waste; therefore an alternate technology is required.

This technology will treat the galley food waste stream prior to overboard discharge. Galley food waste is defined as food waste such as that generated in a typical restaurant kitchen including incidental water. This SBIR seeks improvements in processing the galley food waste stream and preparing it for environmentally acceptable overboard discharge.

Currently, the galley food waste is discharged directly overboard when the ship is greater than 3 nautical miles from shore; and within the 3 nautical mile limit; the ship must retain in holding tanks all galley food waste. This galley food waste contributes to the overloading of the holding tank capacity. This holding tank fluid is then offloaded to a barge (which is expensive) or discharged outside the 3 nautical mile limit (which limits the time the ship can stay in port). Since naval ships vary greatly in crew size, this development will produce equipment to service a single galley. A single galley will be defined as serving 400 persons. For larger naval ships, multiple units will be used to meet serving needs. This will allow one standard size equipment for the navy. Multiple units for larger vessels will also increase the reliability and maintainability of the processing system. The developed equipment will be installed in the galley, the waste generation site.

PHASE I: Develop a promising technology (or technologies) and demonstrate proof of concept. The final product will be a detailed report describing how this equipment will solve the existing problem of shipboard galley food waste disposal.

PHASE II: Design a full-scale prototype unit. Develop a test & evaluation plan including pass/fail criteria. The test plan will include shock and vibration requirements. This test plan will be submitted to and approved by the Navy prior to actual testing. Build the prototype unit and perform land based testing according to test plan. Provide a final report evaluating the prototype unit based on the test plan criteria. Recommend further development and production if warranted.

PHASE III: Correct any test deficiencies and finalize design as necessary. Build unit for navy testing onboard an operational ship. Assist in installation and testing and prepare a final report of shipboard test and evaluation.

COMMERCIAL POTENTIAL: The equipment for shipboard galley waste processing would be applicable to Army and Air Force vessels, to the commercial cruise line industry, the pleasure boating industry, recreational vehicle industry, commercial restaurant industry and possibly home/residential industry.

REFERENCES:
1. OPNAV INST 5090.1,
2. MIL SPEC MIL-S-901C & MIL-STD-167-1

KEYWORDS: Galley, food waste, environmental, shipboard, gray water

N00-122 TITLE: Smart Circuit Breakers and Switches

TECHNOLOGY AREAS: Electronics, Battlespace

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Expeditionary Warfare

OBJECTIVE: Develop an improved performance electric circuit breaker and switch, especially eliminating contact chatter, transient opening, and premature tripping in heavy vibration and shock environments. Apply smart materials, inclusive of magnetostrictive and electrostrictive magnetorheological and electrorheological techniques to and other innovative technology to meet this development objective. Provide for an electro-mechanical analog of the presently used polymer current limiter.

DESCRIPTION: Circuit breakers and switches have proven particularly susceptible to shock-induced tripping and to contact chatter under acceleration loads, which can disable key shipboard components. For example, presently used polymer current limiters are not infinitely reusable and have a finite electrical resistance. A typical DDG has a circuit breaker count of approximately 4,346, varying in amperage from 50 amps up to 4,000 amps. A significant number of these breakers have been used as switches rather than for their intended purpose.

Many of these breakers/switches have been known to open prematurely during the rigors of mechanical shock trials and testing, such as could occur during combat or deployment. Such "failures" will seriously reduce the operational effectiveness of our warships and potentially put them at a severe disadvantage in harm's way. The contradictory requirements of a circuit breaker, to hold tightly closed when not under electrical overload conditions, and yet trip quickly under electrical overload and be insensitive to other environmental conditions, suggest the application of one or more of the following smart materials to provide the needed response characteristics. Examples evidencing this potential include: magnetostrictive actuators utilizing a solid magneto-elastic element to directly convert electromagnetic energy into motion and thus act as a circuit breaker under the correct design parameters; Piezoelectric materials (and other electrostrictive) configured to perform circuit interruption; Electro-rheologic and magneto-rheologic technology providing electrical control of the viscosity of a fluid, permitting rapid adjustment of the mechanical properties of a circuit breaker or switch.

PHASE I: Develop an innovative Switch or Circuit Breaker design that provides insensitivity to shock, vibration, and other adverse shipboard environmental factors, and select design points (current capacity, tripping speed, form factor) based on the design and smart material chosen to augment performance. These design points should be based on current shipboard circuit breakers and switches, with the intention of replacing the circuit breakers and switches one-for-one. The design points chosen should particular address the power needs of shipboard weapon systems (guns, launchers, radars, and computers). The innovative design should also be coordinated with the power electronics building Blocks program, and should not duplicate the solid-state circuit breakers being developed in that program. Within those constraints, design smart, rapid response, infinite lifetime circuit breakers and switches.

PHASE II: Fabricate circuit breakers and switches based on the Phase I design, updating the Phase I design to reflect fabrication and test experience, and demonstrate the electrical and mechanical performance of the fabricated items under shock loads. Provide for rapid control and re-configuration of a power distribution system.

PHASE III: Produce circuit breakers and switches to replace those currently installed on ships.

COMMERCIAL POTENTIAL: These improved circuit breakers and switches will be applicable to any power distribution system that must function under high shock and vibration loads. Particular applications include rail transportation, improved earthquake resistance for power plants, industrial facilities, apartment buildings, and electric vehicles. More generally, smart material adjustment to electro-mechanical systems will bring improvements in actuators such as solenoids, robotics, and machinery.

KEYWORDS: Rheology; circuit breaker; switch; shock; vibration; survivability; magnetostrictive; electrostrictive, piezoelectric, polymer current limiter

N00-123 TITLE: Ship Mission Readiness Measurement System

TECHNOLOGY AREAS: Information Systems, Battlespace, Human Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Expeditionary Warfare

OBJECTIVE: Develop a new technology for measuring a ship's readiness to conduct assigned missions.

DESCRIPTION: The U.S. Navy has undertaken several initiatives to develop and deploy automated combat training systems aboard its ships. The trend is toward increased use of modeling and simulation based systems which (1) stimulate the ship's combat system elements or (2) simulate the tactical environment in a training mode of the combat system, or (3) a combination of these. In each case, the combat operators interact with the synthetic environment through their operational consoles and displays. They observe and interpret displayed information representing the environment. They then execute tasks as appropriate to neutralize simulated threats, coordinate actions with simulated friendly forces, and allocate sensor and weapon resources.
Current training systems typically collect ground truth and performance data during such training events, and they compile this data into after-action debrief products. Specific data collected is typically a function of the particular training system used to create the synthetic environment. The drawback of current and emerging training systems is that they collect and process data items that are sometimes unrelated and often uncorrelated with overall mission effectiveness. No measurement system exists which can operate independently of the source of the synthetic environment and which can collect and process mission effectiveness data in a consistent way across training events and training systems.

PHASE I: Research the cognitive tasks and team behaviors associated with combat operations at sea, and develop an initial set of measurable parameters that reflect a ship's mission readiness. Parameters may be measured at the individual or combat team level. Parameters should encompass individual and team combat skills, combat system material readiness, and casualties. Demonstrate the feasibility of a measurement system and develop a software prototype that can collect and analyze data to support the initial set of parameters to be measured. Assess the feasibility of automatically collecting data in a shipboard environment, across various training events, and aggregating the results to assess total ship readiness.

PHASE II: Develop, test and demonstrate a prototype readiness measurement system by installing it in conjunction with at least two dissimilar training systems. Individual and team skills parameters should be collected automatically from training systems or through the use of passive taps on tactical system interfaces. The system should accept casualty status and other combat system material readiness information via combat system interfaces. Readiness data should be collected and analyzed for a series of training events. The demonstration should show the ability to measure improvements in mission readiness over time. The system should provide diagnostic information in the form of remedial maintenance recommendations and/or individual and team learning objectives for subsequent training events. A producibility analysis should be performed and an initial design of a production unit should be accomplished. A manning analysis should be performed that demonstrates the ability to measure and assess readiness, on demand, with no increase in shipboard manning or workload.

PHASE III: Develop a production ship readiness measurement system that can be installed and used in conjunction with existing and planned Navy shipboard readiness training systems.

COMMERCIAL POTENTIAL: A readiness measurement capability is needed in a variety of military training environments, as well as in many non-military environments where large investments are being made in readiness training. Examples are medical and paramedic teams, law enforcement, disaster assistance and crisis management.

REFERENCES:
1. Joint Vision 2010

KEYWORDS: Training, Readiness, Assessment, Performance, Measurement, Testing

N00-124 TITLE: Aerosol Can Voiding Device

TECHNOLOGY AREAS: Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Expeditionary Warfare

OBJECTIVE: Investigate and develop a shipboard system to void aerosol cans, collecting fluid contents without causing emissions onboard ship.

DESCRIPTION: Ships generate a large amount of waste in the form of partly empty aerosol cans. These aerosol cans when not totally empty or evacuated have to be containerized and disposed of as Excess Hazardous Material. The Navy has a need for equipment that reduces the amount of hazardous waste generated and stored aboard ships, and handled and disposed by shore activities. The waste from aerosol cans has to be handled in an environmentally friendly and safe manner onboard the ships. When the ship is underway this equipment will enable existing shipboard solid waste equipment (metal/glass shredders) to shred the empty metal aerosol cans and dispose overboard as solid waste. Pierside, it will enable the ships to dispose of as solid waste vice Excess Hazardous Material. The equipment needed has to void the metal can of its liquid and/or gaseous propellant and contain that mixture for further disposal ashore. The aerosol container voiding device should fit securely to a containment device (e.g.: 55gal drum) readily available for shipboard use and not produce hazardous effluents/emissions of any kind. The aerosol voiding device shall be able to evacuate a wide range of mediums; personal hygiene, paints, cleaners and any other aerosols that can be brought onboard by the crew or purchased from the stock system.

PHASE I: Develop the initial concept and design of a shipboard voiding device and subsequent containment of voided material, including measures of safety and environmental performance. The design shall include means to accomplish both the voiding operation and the subsequent handling and containment of voided material and propellant shipboard and ashore until disposal is accomplished. Prepare Test plans to demonstrate the feasibility of the concept and design.

PHASE II: Develop, fabricate, test and demonstrate a prototype shipboard voiding device and related containment based upon the Phase I design. Test and demonstration data should be collected and analyzed for compliance with applicable performance parameters and environmental regulations. Demonstrate the ability of shipboard personnel to operate the device and containment, and their ability to measure device and containment performance including cost and emissions over a ship deployment. Based upon the demonstration, complete an initial design of a production unit for Navy acceptance, submitting a manufacturability analysis and a design disclosure for Navy acceptance.

PHASE III: Fabricate, install and test shipboard production prototype devices as required, and fabricate subsequent production units as may be required. Include and clearly identify and describe the expected transition of the device, containment, and process within the government in consequence of the Phase II effort.

COMMERCIAL POTENTIAL: Processing equipment for discharging and containing shipboard aerosol can contents would be applicable to the commercial cruise line industry, any company utilizing large amounts of aerosol generated products, and possibly the home/residential industry (public waste collection facilities).

KEYWORDS: aerosol; cans; environmental; waste; shipboard; containment

N00-125 TITLE: Low Hydrodynamic Drag Cable for Mine Countermeasures

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Mine Warfare

OBJECTIVE: Develop and demonstrate an in-water tow cable with a lower hydrodynamic drag coefficient than current tow cables of the same diameter.

DESCRIPTION: Existing and programmed future air mine countermeasure sensors are towed through the water using a tow cable attached to a helicopter. The Remote Minehunting System (RMS) will also tow a variable depth sensor from a semi-submersible vehicle. In each case the length of cable released from the winch regulates the sensor's depth. Tow cable hydrodynamic drag is the primary system drag component effecting system tow requirements and hence overall system size and weight. As such, it limits the system’s depth capabilities and on-station endurance. Currently the systems employ typical wound cable with a circular cross sectional geometry. Past efforts have demonstrated that a drag reduction of greater than 25% can be achieved using faring and or streamers flowing from the cable. Both of these techniques are difficult to employ without increasing the size of the existing winch assemblies. It would be useful to design a cable with self-orientating drag reduction shape(s) designed in and or applied to it which will not require a larger winch assembly. For example, consider faring components fabricated from a durable compressible material that simply compresses as it is taken up by the winch. When reeled out into the water the faring resumes its' drag reduction shape and orientation. The example may or may not be feasible, but new innovative concepts are solicited that will reduce cable drag by at least 25% compared to bare cable of the same diameter.

PHASE I: Develop a cable design(s) that reduces drag without reducing strength, without reducing the internal volume allocated to system communications (wires and/or fiber optic) and without significantly increasing cable cost. Estimate the drag reduction to be achieved with each design and the strength & cost differential per linear foot. Document the phase I efforts and results.

PHASE II: Develop and test one or more designs from the phase one study using the AN/WLD-1 Advanced Development Model. Testing must include winch stowage, payout and retrieval as well as strength, drag reduction and integrity of communications. Document the results of this phase.

PHASE III: Develop two complete cable subsystems for either RMS or one of the air MCM systems for testing by the Navy. Develop production drawings, interface requirements, sensor additions, and other technical documentation necessary to enable the Navy to procure production systems.

COMMERCIAL POTENTIAL: Cable drag is a major consideration in the fishing industry, the oil industry and other commercial interests which tow object through the water. Low drag cables would apply to any of these efforts.

KEYWORDS: cable; hydrodynamic drag; mine countermeasures; towing.

N00-126 TITLE: <u>High Strength Fiber Optic Sensor Grating Arrays</u>

TECHNOLOGY AREAS: Materials/Processes, Electronics

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: PEO, Undersea Warfare

OBJECTIVE: Develop high strength fiber optic gratings to support Navy fiber optic towed array applications.

DESCRIPTION: Future Navy fiber optic sensor systems plan to utilize arrays of fiber optic Bragg gratings as interferometric sensors. The arrays will incorporate multiple gratings separated by fiber spans of tens of meters. The goal of this topic is to demonstrate the feasibility of manufacturing grating arrays, meeting Navy requirements, without removing the fiber coating. This will allow high strength, higher production yields, and minimize changes to grating characteristics upon winding. A longer term objective is to demonstrate fabricating the grating after the fiber is wound on an 11 mm diameter mandrel. This will enable integration of the grating fabrication and sensor array manufacturing for added production efficiencies.

Navy grating requirements are as follows. Gratings will be at multiple wavelengths on the ITU grid in the window from 1530 to 1565 nm. Several gratings will operate at the same wavelength and must be well matched in spectral response. Required reflectivities are 5% typical; all gratings shall match within + 0.5 %. The grating array will use low bend loss Fibercore Limited, Type SM1500H fiber, which will be proof tested to a minimum of 300 kpsi prior to, and after, writing of the gratings. Desired wavelength accuracy is + 0.1 nm; desired bandwidth (FWHM) is 0.8 nm + 0.1 nm. All sidebands more than 2 nm from the center shall be down by 30 dB. Excess loss shall be less than 0.1 dB. Fiber lengths between gratings shall be accurate to + 5 cm. It is desired that there be no splices, consistent with yield and producability. The gratings and fiber will be wound at small diameter, necessitating high strength.

PHASE I: Develop and demonstrate the ability to write gratings through the coating with adequate specifications. Develop theoretical model for grating written on fiber wound in place in the sensor.

PHASE II: Develop grating fabrication after the fiber is wound onto sensors. Produce full grating arrays. Demonstrate test equipment to monitor and test grating arrays without straining gratings.

PHASE III: Transition grating array production to the hydrophone array manufacturer, supporting Navy tactical array and commercial seismic array production.

COMMERCIAL POTENTIAL: The product has direct application to low cost fabrication of commercial seismic streamers for oil/gas exploration and well field monitoring.

KEYWORDS: gratings; sensors; Bragg; fiber optics; hydrophone; array