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 <u>general nature</u>, contact one of the above persons. Phase I proposals must be received by 19 August 1998. All Phase I proposals and subsequent Phase II Appendicies A, B, and E must be submitted to:

Office of Naval Research
ATTN: NAVY SBIR PROGRAM, CODE 362
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 pertaining to the Department of Navy mission can be obtained by viewing various Navy World Wide Web sites at http://www.navy.mil. Additional information on the Office of Naval Research (ONR) and the Navy SBIR Program can be found on the ONR Home Page (http://www.onr.navy.mil).

NEW THIS YEAR:

1. The Navy is now requiring Appendix E, along with Appendix A and B, to be submitted in an electronic format.
2. All Phase I award winners must electronically submit a Phase I and Phase II Summary Report to the Navy at the end of the each effort. This requirement will also be included in contracts and is described in further detail below.
3. The Navy requires that all Phase II proposers simply submit the Internet form of Appendicies A, B & E to the Navy SBIR Program Office.
4. The time frames and requirements for Navy Fast Track submissions have been modified and are described below.

PROPOSAL SUBMISSION CHECKLIST:

SUBMIT YOUR PROPOSAL(S) WELL BEFORE THE DEADLINE.
DON'T WAIT UNTIL THE DEADLINE TO SUBMIT YOUR PROPOSAL.

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

1. **You must use the electronic format described in the section <u>Electronic Submission described below</u>. The Navy will not accept any proposals that do not have electronic forms of Appendix A, B, and E. The electronic appendices submitted must match the paper copies submitted via mail/express delivery.**

2. **An electronic version of Appendix E must be submitted with all proposals. Even if you have no Phase II or Phase III information to report.**

3. **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 Appendix A, 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 Appendices early, as computer traffic increases, computer speed slows down. <u>Do not wait until the last minut</u>e.**

ELECTRONIC SUBMISSION OF APPENDICES:

Submit your SBIR proposal to the Navy, using the online submission. **The Navy WILL NOT accept the Red or Black Forms in the rear of this book as valid proposal submission forms of the Appendix A, B and E, nor any other online Internet form from this or other SBIR solicitations.** Proposers must use the following procedures

A. Go to the ONR Homepage (address --http://www.onr.navy.mil), click on ABusiness Opportunities@, then click on ANavy SBIR Online submission interface.

B. Submit your Appendix A, B and E via the Online Submission option. Just fill out all the information requested, the screen format will look different than the forms in the solicitation. Once, you have filled in the data, follow the instructions to electronically submit appendices.

C. Follow instructions to print out and sign the Appendix A/B and E forms. The printed form may look different than forms in book and your signature may be on the second page.

D. Submit the signed Appendix A/B and E form along with one original and four copies of your entire proposal (the copies should include 4 copies of the signed Appendix A, B and E forms) to the Navy SBIR Program Office at the above address.

NOTE: The Navy is moving toward a system which will only accept on-line submission of Appendices A, B, & E in the future (when?..no date has been set). If you are not on the Internet, please contact your local library, a friend or other activity which has access to the Internet to establish how to access and use it.

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 summary of Phase I results, includes potential applications and benefits, and should 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 Database Webpage at: Ahttp://www.navysbir.brtrc.com@ and then click on ASubmission of Summary Reports and Success Stories@ If your company does not have access to the Internet on your computer consult your local library or local computer service store.

The Navy is initiating this new program to help increase the awareness and implementation of SBIR funded efforts. The goal is to increase the market potential and transition of SBIR projects by increasing the visibility and ease in accessing information about SBIR projects to DOD, government and DOD industry contacts. This should facilitate the transition of these projects into follow-on efforts and bring additional revenue to the SBIR Company.

To do this the Navy is asking companies to provide information on the status and benefits of their technology developments so that this information can be put into a media that others can easily access and review. The Navy plans to redistribute this information to a wide audience using such tools as the Navy Webpage, Accomplishment Book and a new interactive Navy SBIR Website. This will help provide parties with technical challenges or those with the need to implement new technology, with a user-friendly mechanism to access and identify SBIR companies that can provide them with solutions. This information should be **non-proprietary** yet detailed enough to provide the interested transition partner with enough knowledge to understand the potential use and benefit to their program.

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 and to the designated Contracting Officers Technical Monitor (the Technical Point of Contact (TPOC) for the contract and the appropriate Point of Contact at the end of this Introduction). The following dates and information are required by the company to qualify for the FAST TRACK program. All of the requirements listed in the Fast Track Section of the front of this solicitation must be met. The information provided below provides specific dates and some additional information that is required by the Navy SBIR Program Office.

Party/Days After Phase I Award	**Required Deliverables**
SBIR Company / 150 Days	- Fast Track Application and all supporting information. (See instructions in the

	DOD section of this Solicitation) - Phase II 5 Page Summary Proposal., as required of all Phase I Projects as described in Navy SBIR Website listed above. (It is strongly recommended that if you are contemplating the submittal of a Fast Track Application, you make your intention known to your technical point of contact (TPOC) and the SBIR SYSCOM Program Manager for that respective topic, as listed in this Navy section.)
SBIR Company /181 - 200 Days	- Phase II Proposal - Phase I Final Report
Navy / 201 - 215 Days	- Navy will formally Accept or Reject your Phase II proposal.
SBIR Company /45 Days after Acceptance	- Proof that Funding has been received by SBIR company.

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. 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 -- see Section 4.5). 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 Bulletin Board on the Internet or request the instructions from the Navy SBIR Program Office. All Phase I and Phase II proposals should be sent to the Navy SBIR Program Office (at the above address) for proper processing. If the Program Office is unaware of the proposals in the system, they can not be tracked. 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 Phases I and 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 maximum demonstration phase of the SBIR project (i.e. Phase II)(Phase II efforts are for two (2) years no more, no less....Phase II options are for an additional six (6) months...a waiver may be granted only from the NAVY SBIR Program Office); 2) a transition or marketing plan (formally called a "commercialization plan") describing how, to whom and at what stage you will market your technology to the government and private sector; 3) a Phase II Option ($150,000 maximum) 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. You must also submit your Phase II appendix A, B & E electronically to the Navy SBIR Program Office at the address above. 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 Science
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 MANGERS OR POINTS OF CONTACT FOR TOPICS

TOPIC NUMBERS	POINT OF CONTACT/ACTIVITY	PHONE
N98-129 to N98-144	Mr. Douglas Harry (ONR)	703-696-4286
N98-144 to N98-162	Ms. Carol VanWyk (NAVAIR)	301-342-0215
N98-163 to N98-168	Mr. William Degentesh (NAVSEA)	703-602-3005
N98-169	Mr. Frank Munozrovira (SSPO) Mr. Ron Vermillion (NSWC/DD/DAHL)	703-607-3440 540-653-8906
N98-170 to N98-172	Mr. Andy DelCollo (NAVFAC)	703-325-8533

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98.2 Solicitation

WORD/PHRASE **TOPIC NO.**

NAVY TOPIC LIST
98.2 Solicitation

OFFICE OF NAVAL RESEARCH

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N98-140	Advanced Poly(dimethylsiloxane) or Fluoropolymer Coatings for Inlet Side Heat Exchanger Fouling Release
N98-141	Ultra-Light Structural Steel Fabrication Technology
N98-142	Compact and Low Cost Airborne Laser Sensor with Recording
N98-143	Frozen Platelets
N98-144	Innovative Air and Surface Strike Weapons Technology

NAVAL AIR SYSTEMS COMMAND

N98-145	Innovative Heavy Fuel Compression Ignition Engine Designs
N98-146	Salt Bath Process Replacement
N98-147	Detonation Technology to Replace the Hard Chrome Plating
N98-148	Non-Hazardous Alternative Materials and/or Coatings to Replace Black Oxide
N98-149	Repair Of Ceramic Matrix Composites For Exhaust Washed Airframe Structures
N98-150	Development/Integration of Low Cost, Light Weight "See and Avoid" Capability for Unmanned Aerial Vehicles
N98-151	Short-Range Mobilizer for Transport and Complexing of Mobile Facilities
N98-152	Non-Hazardous Air Pollutants Rubber Cement
N98-153	Non-Hazardous Shipboard Adhesive Bond Pretreatment

N98-154 Control Display Navigation Unit (CDNU) Interface for Flight Simulators

N98-155 Night Vision Goggle Simulation/Stimulation

N98-156 Geographical Information System (GIS) Advancements for Mission Rehearsal

N98-157 Tools for Linking Training to Combat Readiness

N98-158 Software Tools to Create Bump-Mapped Texture

N98-159 Exploitation of Target Scattering in Airborne Active ASW Systems

N98-160 Instrumenting Embedded Software Behavior via Busses

N98-161 Application of Genetic Algorithm Technology to Route Planning

N98-162 High Temperature Valves for Weapons Systems

NAVAL SEA SYSTEMS COMMAND

N98-163 Standard Telemedicine System Architecture (STSA) for Shipboard Use

N98-164 Advanced Techniques for Combat System Training

N98-165 Fiber Optic Heading Sensor Technology for Towed Arrays

N98-166 Advanced Technologies for Automated Ship Meal Preparation and Delivery

N98-167 Integrated Fluid Dynamic Hydronumeric Ship Design Tools

N98-168 Design of High-Speed, High Endurance Mine Warfare Craft

STRATEGIC SYSTEMS PROGRAM OFFICE

N98-169 Low-Cost Carbon-Phenolic Composites for Reentry Body Heatshields

NAVAL FACILITIES ENGINEERING CENTER

N98-170 Tethered Aerostat Communication Link Application

N98-171 Engineering Modeling of Hockling in Ocean Cables

N98-172 FRP/Concrete Hybrid Structural Components for Waterfront Construction

NAVY TOPIC DESCRIPTIONS
98.2 Solicitation

OFFICE OF NAVAL RESEARCH

N98-129 TITLE: Improved Position Tracking for Virtual Reality

OBJECTIVE: Better enable decision makers, engineering designers, and other users of virtual reality systems to visualize and interact in non-head-mounted-display immersive 3D environments with complex, computer-generated geometrical scenes ranging from 3D terrain populated with entities to large-scale design systems.

DESCRIPTION: Immersive Rooms [1], such as the CAVE TM developed at the Univ. of Illinois/Chicago and Naval Research Laboratory's (NRL's) new GROTTO facility, offer revolutionary capabilities to explore and interact with 3D, computer-generated data. These spaces are large enough for users to walk around (approximately 10 foot square) examining multidimensional data sets, large scale designs, and complex urban environments. Even larger facilities are likely to emerge as technology limitations are overcome. One current limitation is the inability to perform accurate tracking of human movement at an accuracy of a centimeter or less using technology that does not tether the user (no wires or other hardware that links a person to stationary equipment in the room).

The National Research Council [2] identifies the need for position trackers that have adequate performance at reasonable cost. They note that AIdeally, one should be able to track a moving person in a sufficiently large space without loss of resolution or worries about obscuration. People should even be able to move from room to room in a building without loss of tracking.@

The system should allow the tracking of multiple parts of a person's body (head, torso, upper and lower arm segments, upper and lower leg segments, hands, and feet). It should allow for the tracking of multiple limb segments of several people moving about in the same general area, and should maintain the association of each body segment with each individual. The system should provide at least fifty samples of each coordinate per second, with a low latency. Six degree of freedom tracking (translational and rotational) is preferred, but three degree of freedom tracking (translational only) would be considered. The system must be able to work in the presence of the display system's visual and audio output, with a potentially high level of background noise. The tracking system must not interfere with the user's visual or auditory experience in the display facility.

It is highly desirable that the tracking system should retain its accuracy in environments that contain significant amounts of conductive and non-conductive metals and electrical power cables, as would be the case aboard a Navy ship. The system should track over a horizontal range of at least 7 meters (100 meters would be preferable) and vertical range of at least 3 meters (from floor to ceiling), while remaining accurate to one centimeter. It is desirable for the person being tracked to wear as little heavy or otherwise encumbering equipment as possible. It is highly desirable that the technology should be able to evolve into a cost effective system (less than $16K to track 12 points on a person's body).

PHASE I: Develop a prototype, non-tethered tracking system that can track at least three points on a user's body to 1 centimeter resolution over a range of 8 meters.

PHASE II: Extend the system to track several users over an extended range while accurately tracking detailed user movements to within 1 centimeter. Measurements for registering upper and lower body movements would be examples of the type of untethered, highly accurate tracking that is required.

PHASE III: Integrate the tracking system into a DoD virtual reality facility such as NRL=s GROTTO and demonstrate its effectiveness for use in design, command and control, and similar applications both in the military and civilian domain.

COMMERCIAL POTENTIAL: The system is applicable to work environments that use projective technology to achieve immersion in 3D, computer-generated spaces. Significant potential exists for commercialization in such diverse areas as situational awareness for disaster relief, engineering design, simulation of high risk environments for training, and military and civilian command and control. One could envision potential applications in the gaming market for multi-player games within large and complex virtual environments.

REFERENCES:
[1] Cruz-Neira, C., D. Sandin, T. DeFanti, "Surround-screen, projection-based virtual reality: The design and implementation of the CAVE," Computer Graphics (Proc. Siggraph 93), 135-142, July 1993.
[2] Virtual Reality: Scientific and Technical Challenges, National Academy Press, Washington, DC, 1994.

KEYWORDS: Virtual Reality, 3D, position tracking

N98-130 TITLE: Low Parasitic Heterojunction Bipolar Power Transistors

OBJECTIVE: This work seeks to combine and exploit recent basic research advances in wide bandgap semiconductors (WBS) and low parasitic Heterojunction Bipolar Microwave Power Transistors (HBTs) to provide the basis for highly linear, highly efficient, high power microwave amplifiers.

DESCRIPTION: This work will combine low parasitic (LP) (no collector under base contact) HBT technology with WBS to enable a highly linear (e.g. 3rd order intermodulation products 28 dB below fundamental), highly efficient (e.g. approaching 60% power added efficiency), broadband (e.g. 1-5 GHz), high power (e.g. 100 watt), class B, push-pull, solid state microwave amplifier. The effort is predicated on the ground breaking efforts of Prof. Mark Rodwell at the University of California at Santa Barbara who has developed a truly scalable HBT process that has produced an HBT with a maximum available gain (f_{max}) > 400 GHz and an amplifier operating from DC to 50 GHz with 10 dB of gain (1,2). In addition, significant advances have occurred in the material quality of the WBS GaN via lateral epitaxial overgrowth thereby reducing the dislocation density to well below 10^5 cm^{-2}. Noteworthy is the realization of the strong piezoelectric effect in the AlGaN/GaN material system that generates sheet electron and hole charges at interfaces that should enable fabrication of HBTs in this material system.

PHASE I: The contractor shall develop the process technology, device design, and device model for a LP-HBT for use in the related circuitry necessary to achieve the above objective in accordance with the description. The initial effort may be based on arsenide-,phosphide-, or nitride-based semiconductors.

PHASE II: The contractor shall develop and demonstrate a microwave power amplifier based on the approach described above and capable of meeting the specifications presented in the above description. If the technology developed in Phase I does not include a WBS, then WBS HBTs shall also be addressed in Phase II to increase the power handling capability.

PHASE III: The contractor should be able to compete for the supply of highly efficient, highly linear, broadband (e.g. 1-5 GHz and 5-25 Ghz) amplifiers for the Navy Advanced Multifunctional R F Systems (AMRFS) contemplated for DD-21, the common support aircraft (CSA), and the next generation aircraft carrier (CX).

COMMERCIAL POTENTIAL: This work is expected to engender a new class of combined radar/communication systems for the FAA, a new approach to civilian microwave ovens, a competitive marine radar, and a new class of microwave clothes dryers wherein woolens do not shrink.

REFERENCES:
1. R. Pullela, Q. Lee, B. Agarwal, D. Mensa, J. Guthrie, L. Samoska, amd M. Rodwell, AA > 400 GHz f_{max} transferred-substrate HBT integrated circuit technology,@ Device Research Conf. Tech. Dig., 1997, pp. IIIB_2.
2. B. Agarwal, D. Mensa, Q. Lee, R. Pullela, J. Guthrie, L. Samoska, and M. J. W. Rodwell, AA 50 GHz feedback amplifier with AlInAs/GaInAs transferredBsubstrate HBT,@ Tech. Digest IEDM, 1997, p. 743.
3. P. M. Enquist and D. B. Slater Jr., ASymmetric self-aligned processing,@ US patent # 5,318,916 (1994).

KEYWORDS: microwave: amplifier: semiconductor: linear: power: efficient

N98-131 TITLE: Flexible Ribbon Cables for Digital Signals

OBJECTIVE: To develop ribbon cables capable of transmitting large numbers of channels of digital data signals from a low (4 or 10 K) temperature environment to a moderate temperature environment (80-110 K) with low rf loss, cross-talk, and static heat load.

DESCRIPTION: Incorporation of newly developed, high performance superconducting components into rf systems is hindered by the heat load associated with getting the large dynamic range analog signals in and the 1-20 GHz digital signals out. This program will focus on the output problem using methods and materials that could later be generalized. At MHz frequencies, copper deposited on polyimide and patterned as stripeline channels on ribbon cable works well, but at GHz frequencies produces too much signal attenuation. Tapes of high temperature superconductor deposited on IBAD buffer layers is an attractive substitute for the Cu if the static heat load of the substrate can be reduced. (The ability of IBAD to produce a crystallographically oriented buffer layer is independent of the substrate.) Performance goals include physical length of at least 2 inches, more than 8 channels per cable, static heat loads less than 0.1 mW per channel when connected between 4 and 80 K, and more than 20 dB of cross-talk isolation. When driven with a 0.2 V rms signals in the 1 - 20 GHz range, the channels should have a 50 ohm impedance and an rf insertion loss below 1 dB. The flexibility goal is to withstand deformation around a 1 inch diameter rod without degradation.

PHASE I: In phase I the vendor should design and experimentally demonstrate a concept for how ribbon-like cable conductors can be fabricated which meet the above rf and heat load performance goals.

PHASE II: In phase II a prototype cable should be fabricated which meets all the above performance goals and provides a solution for the issue of easy to use, low loss/high isolation connectors at the ends. Work on longer cables and revised cable designs that increase the isolation between channels to above 100 dB should be instituted.

PHASE III: Such cables will be used to field high performance superconducting processors under development by ONR, NSA, DOE, and NASA in settings where cooler power must be economized. At ONR these include active aperture array receivers (AMRFS) where hundreds to a few thousand superconductive components operating at the multi-GHz carrier frequency may be utilized.

COMMERCIAL POTENTIAL: The civilian sectors which will most benefit from such cables include the satellite based communications industry and astrophysics (NASA) community, the extreme high end computer industry, DOE high energy physics community, and laboratory analytical equipment manufacturers. Each of these groups have need for massive quantities of real time computation that can currently be meet only by extremely low dissipative power superconductive electronics, for radiation hard processors, or for the extreme accuracy offered by the operative principle of SQUIDs. The cables will preserve the benefits of the superconductive processing when the signals are brought to the room while allowing the heat load to be small enough the refrigerator does not become unwieldy or excessive in its energy consumption.

REFERNCES:
(1) P. Grant, IEEE Trans on Appl Superc. 7, 112 (1997).
(2) R.M. Bradley, et al., J Vac Sci Tech, A5, 1792(1987).

KEYWORDS: Ribbon cable; flexible connectors; superconductive electronics; high temperature superconductors; cryogenic technologies; GHz digital logic

N98-132 TITLE: Millimeter Wave Radar Transmission Line and Rotary Joint

SCIENCE/TECHNOLOGY AREA: Electronics

OBJECTIVE: Design and build a 94 GHz transmission line and rotary joint for use in the NRL Radar Division high-power, coherent Millimeter Wave Radar currently under development (Project EW-32-1-12). The transmission line will carry up to 80 kilowatts peak and 10 kilowatts of average power from the Gyro-Klystron amplifier, concurrently being developed by the Vacuum Electronic Branch (Code 6840) at NRL, to the radar antenna.

DESCRIPTION: High power millimeter wave RF amplifiers, such as Gyro-Klystrons, are capable of producing tens of kilowatts of peak power. The current development effort by NRL/Litton/CPI of a high power Gyro-Klystron amplifier is expected to deliver 80 kilowatts peak and 10 kilowatts of average power over a bandwidth of 700 Mhz. Radar systems operating at 94 GHz. require a unique approach to transfer the energy from the transmitter to the antenna. Conventional waveguide is too lossy and will not handle the power and the transmitter is too heavy and bulky to be located on-mount as has often been done in the past. Corrugated waveguide, 90 degree miter bends, mode-converters, and corrugated horns represent the types of components most likely to result in an acceptable, low loss transmission line design

PHASE I: Design a transmission line with two rotary joints (azimuth and elevation) meeting the following requirements: Center frequency 94.0 GHz with 4 GHz bandwidth. Power handling to be at least 80 kilowatts peak, 10 kilowatts average. Insertion loss from end to end including two rotary joints and mode conversion adapters must be less than 0.5 dB. The transmission line is to be compatible with a WR-10 wave-guide output from a TWT at 5 kW peak or alternatively a TE01 output from the high-power Gyro-Klystron. The output of the transmission line will connect to a corrugated feed horn which will launch the quasi-optical beam into a duplexer located behind the antenna. Mode purity must meet the requirement of producing at least -20 dB antenna sidelobes in space.

PHASE II: Build the transmission line and rotary joint as designed in Phase I. Perform test to verify mode purity and system performance.

PHASE III: Small business will offer standard catalog items as developed in Phase II for use in military or commercial systems.

COMMERCIAL POTENTIAL: The technology developed in Phase II will have applications in commercial millimeter wave communication systems for both terrestrial and space systems and for scientific uses of millimeter waves to radars and transport of energy.

REFERENCES:
1. Principles and Applications of Millimeter-Wave Radar, edited by Nicholas C. Currie and Charles E. Brown, Artech House.
2. HE11 Miter Bends and Gaps in Circular Corrugated Waveguide, J.L. Doane and C.P. Moeller, General Atomics, 1997 Conference on Millimeter and Infrared Techniques
3. Mode converters for generating the HE11 (Gaussian-like) mode from TE01 in circular waveguide, J.L.Doane, General Atomics
4. A Quasi-optical resonant ring for high power millimeter-wave testing, T.S. Bigelow, Oak Ridge National Laboratory, 1997 Conference on Millimeter and Infrared Techniques

KEYWORDS: Radar; Millimeter wave; Transmission line; Rotary joint; Gyro-Klystron; Mode-converter;

N98-133 TITLE: TACAIR Networked Radar Warning

SCIENCE/TECHNOLOGY AREA: Electronic Warfare

OBJECTIVE: Provide capability for existing radar warning receivers (i.e. ALR-67) to process and transmit data over a distributed network.

DESCRIPTION: Radar warning receivers (RWR) are a integral, and essential element of the survivability of Navy Tactical Aircraft. The RWR performs its function based solely upon data received at the aircraft, provides processed data via a display to the pilot, and cues onboard countermeasures systems. As the Strike aircraft are the closest to the action, and most numerous of the combatants in a Strike package, extremely valuable data received by the RWR sensor is wasted. Data never passes beyond the confines of the aircraft. The proposed effort will explore and implement possible innovative methods for providing networked RWR data to other air platforms.

PHASE I: Develop a system concept for modifying the ALR-67 RWR to provide output of processed data over a high bandwidth distributed net similar to that used in the Navy's Cooperative Engagement Capability (CEC).

PHASE II: Fabricate brassboard prototype hardware and flight test demonstrate the concept.

PHASE III: Form-factor package the hardware into a functional ALR-67 system (GFE) and provide the RWR element of the networkcentric EW demonstrations planned under the Emitter Multi-Node Precision Geolocation and Identification ATD (FY00 Start) and transition technology to the Joint Emitter Targeting System (JETS) EMD Program (FY01).

COMMERCIAL POTENTIAL: Private sector application of the developed technology will be broad in application and will advance the state-of-the-art in distributed network information processing at high data rates and bandwidths.

KEYWORDS: Electronic Warfare, signal processing, automation, situational awareness, datalink, network

N98-134 TITLE: Compact Ocean Sensors for Diver and AUV Applications

OBJECTIVE: To develop innovative, low-cost, compact, low power, perhaps expendable ocean sensors that may easily be used by divers or deployed on small autonomous underwater vehicles. The sensors should accurately measure directly or derive from associated measurements ocean properties that can be used to 1) aid in underwater navigation or avoidance of obstacles and/or 2) characterize aspects of the ocean or it=s boundaries in order to validate shallow-water remote sensing algorithms or to initialize or update predictive coastal ocean models.

DESCRIPTION: Shallow water remote sensing algorithms and predictive coastal ocean models are presently under development within the Navy and a variety of other federal, state, and private laboratories. However, our ability to collect environmental data in shallow water to support these model development and algorithm validation efforts is extremely limited. Classical ship-board techniques to measure ocean properties are often inappropriate for coastal, shallow-water environments and data collections in hostile areas will require covert surveying techniques, e.g., divers and small autonomous underwater vehicles (AUV=s). Therefore, proposals are sought to develop sensors and associated on-board signal processing that will enable the covert navigation of submerged platforms (divers and small AUV=s) and the use of sensors on such platforms to characterize the shallow ocean and its boundaries. New, innovative approaches to developing the next generation of ocean sensors that are significantly lower in power consumption and more compact than existing sensors are encouraged.

PHASE I: Design and/or specify the components of an in situ environmental or navigation/obstacle avoidance sensor and associated on-board signal processing that may be used by a diver or fielded on a small AUV. This includes estimating power consumption, size, weight and cost, identifying expected sensor errors and calibration issues, addressing ergonomic issues in the case of diver operation, real time on-board processing of the signal to a useful and manageable output, and identifying data flow (e.g., storage and/or short- and long-range telemetry).

PHASE II: The contractor will build and field test a working prototype. This includes initial tests under controlled laboratory conditions and further testing in the field resulting in data adequate to address each aspect of the issues identified in Phase I. At the end of Phase II, the contractor should have in hand a working version of the sensor that may be deployed in a variety of environmental situations that conform to the intended platform and data that verify the performance of the sensor. Further testing to address scientific or applied objectives within existing ONR field projects prior to proceeding to Phase III is encouraged.

PHASE III: It is expected that the contractor will undertake the production and commercial sale of the successful sensor, the target market being the DOD and non-DOD research communities, components of the operational Navy that require the resulting data and have the means of fielding the resulting sensors (e.g. divers and AUVs), as well as private industry.

COMMERCIAL POTENTIAL: The applications in the private sector are abundant, including environmental monitoring and surveying where remote sensing products need to be validated. The civilian commercial and recreational diving industry will no doubt also make use of the resulting products as coastal habitats continue to be impacted by human activities and natural events such as El Nino and global warming.

KEYWORDS: Ocean environmental sensors, obstacle avoidance, low-power, compact, diver-operated, AUV compatible.

N98-135 TITLE: Advanced Signal Processing Algorithms to Overcome Pulse Distortion in Shallow Water

SCIENCE/TECHNOLOGY AREA: Modeling and Simulation

OBJECTIVE: Time stretching or distortion of a transmitted sonar pulse at a center frequency of several kilohertz can severely degrade anti-submarine warfare (ASW) sonar performance in shallow water. The objective of this effort is to overcome environmentally-induced degradation by developing advanced signal processing algorithms.

DESCRIPTION: A transmitted pulse is distorted, or time-stretched, in shallow water due to the many multipath/multimode arrivals, and due to interactions with inhomogeneities within the bottom sediment. The degradation in performance for a sonar using a matched filter or correlation processor can be significant (on the order of 10 dB) and is referred to as energy spreading loss (ESL). Understanding this problem should be demonstrated by referring to past modeling of the multipath/multimode time arrival structure in shallow water areas. Time domain models used in past analyses of ESL should be described, and new environmentally adaptive signal processing techniques to measure and overcome ESL should be proposed. Consideration should be given to approaches to incorporate these new signal processing algorithms together with environmental models, to provide an environmentally-adaptive prediction, measurement, and signal processing system. The use of inversion techniques in the signal processing algorithms should be described quantitatively.

PHASE I: Initial development of environmentally adaptive signal processing algorithms based on inversion techniques to overcome ESL. This development will be based on current sonar data, which will be provided by the government.

PHASE II: Develop environmentally adaptive signal processing algorithms. Build a COTS workstation-based processing system to augment a selected operational ASW sonar, and test performance of new algorithms using at-sea recorded data. Participate in a Navy-sponsored sea test to demonstrate at-sea performance.

PHASE III: Integrate algorithm(s), if successful, into processor for current active sonars.

COMMERCIAL POTENTIAL: Commercial acoustic imaging sonars suffer the same performance degradation in shallow water areas, and the results of this task could vastly improve fish-finding sonars, sub-bottom sediment classifying sonars, bathymetry swath sonars, buried object detection sonars, and harbor survey sonars.

REFERENCES:
1. Bell, T.G., APredicting and Dealing with Energy Spreading Loss,@ Proceedings Active Sonar Signal Processing Seminar, NUWC, NLON, 1989.
2. Tanaka, A., AAn Analysis of Energy Spreading Loss Associated with Tactical Active Sonar Performance in a Shallow Water Environment,@ Master=s Thesis, Naval Postgraduate School, June 1996.

KEYWORDS: Active sonar, Signal Processing, Environmentally Adaptive, Detection, Algorithms, Inversion, Dispersion.

N98-136 TITLE: Maritime Intelligence, Surveillance, Reconnaissance (ISR) and Space Exploitation

SCIENCE/TECHNOLOGY AREA: Command, Control and Communications/Physics

OBJECTIVE: Further the development of technology to automatically develop complete awareness of the littoral maritime situation long before, leading up to, during, and after military engagement.

DESCRIPTION: The focus of this SBIR topic is to stimulate bold new concepts for significantly increasing the performance of automated maritime ISR including use of space assets. The Century 21 Navy will need complete awareness of the subsurface, and surface situation within a wide area of interest. This SBIR focuses on the littoral situation which is complicated by the presence of many neutral surface ships of all sizes and purposes as well as friendly and enemy combatants, including mines. Awareness must extend seamlessly across time, beginning well before and extending through hostilities. Situation Awareness must be consistent among all involved. Situation Awareness will be expressed in the form of a complete picture of who is where as a function of time. This picture will be available to all Naval personnel at an appropriates level of resolution. This SBIR focuses on aspects of maritime ISR other then conventional ASW and MCM since these are covered by other SBIR topics. Novel means of exploiting existing sensors, including space sensors are of interest. Methods of detecting and classifying (or, in some cases, identifying) neutrals (commercial shipping, fishing and pleasure craft) and unusual threats such as small surface craft (i.e. 'Boghammers'2) 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 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. Methods of tracking entities of interest in the complex littoral environment are sought The littoral scene may contain many objects with crossing paths and unknown motion models. Methods of maintaining a consistent awareness of the situation among Navy personnel who are dispersed and intermittently in contact with each other are sought.

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: Waltz, Edward and James Llinas, AMultisensor Data Fusion,@ Artech House, 1990, Bar-Shalom, Y., ATracking Methods in a Multitarget Environment,@ IEEE Transactions on Automated Control, Vol. AC-R3, August 1978, pp. 618-626

KEY WORDS: Electromagnetic, Acoustic and Hydrodynamic signatures, multitarget tracking, state estimation, common tactical picture

N98-137 TITLE: Environmental Data Fusion for Mine Warfare

OBJECTIVE: Further the development of technology to apply environmental data to mine warfare. This includes the human/computer interface, knowledge discovery in databases (KDD), retrieval of knowledge and data from very large databases, and the interfacing and exchange of data between large databases.

DESCRIPTION: The focus of this SBIR topic is to stimulate bold new concepts for significantly improved application of environmental data to mine warfare. Current Naval doctrine calls for operations in the littoral regions of the oceans. Effective counter measures against enemy mines in the littoral requires knowledge of all aspects of the complicated undersea environment. Typical databases include: historical and recently acquired bathymetry and bottom composition, the spatial/temporal distribution of physical, chemical, and biological properties in the water column, and the locations of detected, classified and identified objects on the bottom and in the water column. Metadata which are descriptions of the basic data will be generated. These databases will be heterogeneous, comprised of maps, images, sets, lists and descriptions. The size and complexity of these data bases may prohibit storage as relational data bases and favor Object Oriented Data Bases (OODB). On the other hand, maps are usually stored as Geographical Information Systems (GIS). Methods of overcoming known difficulties with both OODB and GIS are of interest. These data bases must be interfaced for analysis. Methods of simultaneously working with OODB and GIS (i.e. the integration of spatial and non spatial data) are of interest. Analysis will require exchange of databases from one set of software to another. Analysis will create linked or integrated data systems from these multiple databases. Information and data must be retrieved from these databases on demand and as required by the analysis. Methods of data retrieval are of interest. The knowledge required for effective action must be extracted from these diverse data sets. The technologies of Knowledge Discovery in Databases (KDD), Data Mining, learning algorithms, and feature extraction are of interest. The extracted knowledge along with the supporting data must be presented to the human operator in a meaningful way. Innovative hardware and software for human/computer interaces are of interest. This includes technology for perceiving and interacting with the knowledge and data through multiple senses (i.e. visual, aural, tactile), three dimensional and temporal displays, and combining GIS display with an object oriented retrieval capability.

PHASE I: Develop a complete algorithm or detailed description of the proposed data fusion 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 underwater MCM reconnaissance systems or environmental tactical decision aids, such as MEDAL, to integrate the concept into future generations. Team with manufacturers of commercial environmental fusion systems, such as satellite remote sensing displays, to integrate the concept into these products.

COMMERCIAL POTENTIAL: There is a growing commercial market in environmental data fusion using satellite remote sensing and historical geographical data. Weather display is a well known application but also resource display has a significant application. There is a developing market fusing and displaying integrated social and natural science data. The technology developed in this SBIR may also be of use in the fields of medicine and gaming.

REFERENCES: Samet, Hanan, >Applications of Spatial Data Structures, Computer Graphics, Image Processing, and GIS@, Addison-Wesley, 1990; Fayyad, Piatetsky-Shapiro, Smyth, and Uthurusamy, eds. AAdvances in knowledge discovery and data mining@, AAAI Press, 1996

KEYWORDS: Object Oriented Databases (OODB), data mining, Knowledge Discovery in Databases (KDD), Geographic Information Systems (GIS), Database Exchange and Integration

N98-138 TITLE: Non-Magnetic Underwater Attachment System

SCIENCE/TECHNOLOGY AREA: Materials, Processes and Structures

OBJECTIVE: The objective is to provide the ability to attach objects quickly, quietly, reliably, and securely to remote underwater surfaces. The system should provide the ability to attach robustly to ill-prepared surfaces throughout environmental conditions found in oceans and rivers of the world.

DESCRIPTION: Attaching objects quickly and securely underwater is required for various underwater operations by Navy Divers. Present commercial adhesive technology is limited in ability to adhere quickly in cold temperatures, and to coated or fouled surfaces. The scope of this effort is to conduct research leading to the development of a prototype system, either adhesive or mechanical, for attaching objects underwater without modifying the attachment surface.

PHASE I: Conduct research and develop a prototype system suitable for a laboratory proof-of-concept evaluation. The system should demonstrate the ability to remain attached to an underwater surface down to 29.5^{o}F while experiencing sustained loads of 20 pounds in tensile and 20 pounds in shear.

PHASE II: Develop an improved non-magnetic system minimizing size, power requirements, and necessary surface preparation, in addition to maximizing attachment strength, operational life, and the range of materials and surfaces to which the system is capable of being attached. The system must not require surface support and should also be manageable and user friendly to a free-swimming diver. The system should demonstrate reliable and secure attachment to surfaces in varied states and conditions as would be to be found in sea, brackish, and fresh water.

PHASE III: Prepare diver-friendly, easily deployable underwater adhesives and application systems for use by military and civilian divers.

COMMERCIAL POTENTIAL: The system may be directly used or modified for commercial and recreational diving industries and ship/boat husbandry applications. Depending upon technology developed, the system may have above-water commercial application as an adhesive for use in moist/rainy conditions.

REFERNCES:
1. Hal F.Brinson, AEngineered Materials Handbook: Adhesives and Sealants@, Vol 3, 1990 (ISBN 0-87170-281-9)
2. Walter Penzias, M.W. Goodman. AMan Beneath the Sea, A Review of Underwater Ocean Engineering@, 1973 (ISBN 0-471-68018-4)
3. Ray E. Bolz, George L. Tuve. ACRC Handbook of tables for Applied Engineering Science@, 2nd edition, 1985 (ISBN 0-8493-0252-8)
4. Eugene A. Avallone, Theodore Baumeister, AMark's Standard Handbook for Mechanical Engineers@, 9th edition, 1987 (ISBN 0-07-004127-X)

KEYWORDS: Adhesive; Attachments; Underwater; Diving; Marine; Suction

N98-139 TITLE: Stream Reforming Catalyst/Scrubber System

SCIENCE/TECHNOLOGY AREA: Material, Process and Structures

OBJECTIVE: Develop innovative catalysts and scrubber system for reforming diesel fuel into a hydrogen-rich mixture for use in low temperature fuel cells.

DESCRIPTION: Fuel cells operating on logistic diesel fuels offer a viable means to provide distributed ship service power for future design platforms and electrical power for unmanned air and undersea vehicles. Direct oxidation of diesel and other organic fuels at a fuel cell anode is a complex problem which is highly dependent on the chosen fuel cell technology and operating conditions. Clean hydrogen fuel, on the other hand, is universally compatible with all current fuel cell technologies. This effort will produce clean hydrogen fuel (i.e., low carbon monoxide and sulfur content) at a continuous rate, with high efficiency, and in a manner that is compatible with current fuel cell technologies.

PHASE I: Identify catalysts and scrubber formulations that produce a clean hydrogen fuel stream from diesel fuel. Perform screening tests to demonstrate feasibility. Perform conceptual design of a total reformer system that is compatible with current fuel cell technologies.

PHASE II: Demonstrate that the selected catalysts and scrubber(s) have the potential for several thousand hour life by operating in a brass-board sub-scale reformer.

PHASE III: Transition the technology to commercial and military fuel cell applications.

COMMERCIAL POTENTIAL: The system will be applied to a variety of commercial fuel cell technologies, currently being applied to civilian applications and being evaluated for marine application.

REFERENCES:
1. Ahmed, S., Doshi, R., Lee, S. H. D., Kumar, R., Krumpelt, APartial Oxidation Reformer Development for Fuel Cell Vehicles,@ Proceedings of the 32nd Intersociety Energy Conversion Engineering Conference, Vol. 2, pp. 843-846, Jul 27-Aug. 1, 1997.
2. Fuller, T. F.AIs a Fuel Cell in YourFuture,@ The Electrochemical Society INTERFACE, Vol. 6, pp. 26-33, 1997.

KEYWORDS: Diesel fuel; reforming; hydrogen; fuel cells; catalysts; scrubbers.

N98-140 TITLE: Advanced Poly(dimethylsiloxane) or Fluoropolymer Coatings for Inlet Side Heat Exchanger Fouling Release

SCIENCE/TECHNOLOGY AREA: Materials, Processes and Structures; Environmental Science

OBJECTIVE: Demonstrate the preparation of silicone or fluorinated organic polymers as improved fouling release coatings for sea water inlet pipes and heat exchanger face plates; this application requires toughness and adhesion to substrates.

DESCRIPTION: In contrast to ship hulls, toxicant release coatings cannot be used for inlet side heat exchanger applications (sea chests, inlet pipes, face plates which hold heat exchanger tubes in place) as sea water is used for cooling and then pumped back into the environment. At the present time, fouling is controlled in heat exchangers by chlorination. Chlorination must be carefully controlled and requires a reducing agent to neutralize the unused portion of the charge. Although chlorination kills fouling organisms, hard fouling shells may remain and ultimately require removal by water jet. This cleaning process is time consuming, expensive, and can damage equipment and harm personnel. Hull coatings are under development that do not contain toxicants, but rely on surface properties that inhibit the attachment of fouling organisms or minimize the force needed to remove them. Thus far, the most effective coatings of this type have been based on silicones. This work seeks to extend the application of fouling release coatings to heat exchanger water inlet areas. Special properties called for include good fouling release without sacrifice of toughness and adhesion (preferablyprimerless).

PHASE I: Demonstrate the feasibility of novel chemical processes that can produce silicones or fluoropolymers with good fouling release without sacrifice of toughness and adhesion. Important targets include low surface wettability, measured by receding contact angle (immersion method), of at least 95 degrees and the demonstration of stability of low wettability and chemical stability in water over many months.

PHASE II: . Prepare polymers with optimized properties for fouling release coatings. Implement a plan for scaleup of synthesis and coatings tests. Correlate surface properties with fouling release. Show feasibility for large-scale applications.

PHASE III: In conjunction with a major shipyard and independently or with a major coatings manufacturer, develop a commercial process which is flexible enough to allow coating sea chests, inlet pipes, and face plates in new installations and during routine overhaul.

COMMERCIAL POTENTIAL: There is a large market for inlet-side heat exchanger coatings for commercial shipping, pleasure craft and electric generating stations, in addition to the Navy and Marine Corps market.

KEY WORDS: silicones, flexible, low surface energy coatings, fouling release, synthesis, surface characterization

N98-141 TITLE: Ultra-Light Structural Steel Fabrication Technology

SCIENCE/TECHNOLOGY AREA: Materials, Manufacturing Science

OBJECTIVE: Develop cost-effective fabrication technology for ultra-light steel structures.

DESCRIPTION: Ultra-light metals, materials with densities less than 50 % that of bulk alloys offer significant structural advantages in terms of compressive strength- and stiffness-to-weight ratios for both military and commercial structures. Such materials have also been found to offer excellent crash protection, flame retardation, vibration damping and blast protection. This effort would develop cost-effective fabrication/ manufacturing technology for ultra-light structural steel alloys which will find wide-spread applications in military and commercial structures.

PHASE I: Develop concepts for low cost fabrication/ manufacturing of ultra-light structural steel alloys with densities less than 50% that of the bulk alloy.

PHASE II: Develop material mechanical and physical property data base sufficient for engineering design studies. Demonstrate methods for joining ultra-light steel materials and fabricating engineering structures.

PHASE III: Scale-up process to produce sufficient quantity of ultra-light steels for technology demonstration. Conduct design trade-off studies to select, fabricate and evaluate ultra-light steel engineering structure.

COMMERCIALIZATION POTENTIAL: Commercial applications for such materials may include structural components for automobiles, construction studs for houses, pallets for storage, etc.

REFERENCES: Gibson, L.J. and Ashby, M.F., *Cellular Solids*, Pergamon Press (1988).

KEYWORDS: Ultra-light, Steel, Metal Foams, Fabrication, Joining, Ship Structural Elements

N98-142 TITLE: Compact and Low Cost Airborne Laser Sensor with Recording

SCIENCE/TECHNOLOGY AREA: Biomedical and Materials/Processes

OBJECTIVE: Develop a compact, low cost airborne sensor that can be used without aircraft modification to detect and record when and to what extent aircrew are illuminated by visible or near infrared pulsed or continuous laser light.

DESCRIPTION: The low cost and availability of lasers has led the defense intelligence community to predict that low- and medium-energy, portable lasers will be deployed by adversaries as cost-effective tactical weapons[1-4]. Recent incidence of purposeful and accidental exposure of military and civilian aircrews to hazardous levels of laser light confirm the capability of laser systems to illuminate aircraft at tactically significant ranges, and change behavior in the aircraft cockpit (e.g., hand off control to the co-pilot or increase pilot workload). Exposure to visible and infrared laser light can result in temporary, prolonged, or permanent changes in aircrew visual function. Additionally, some laser wavelengths can defeat aircraft and aircraft weapons sensors (e.g., NVGs, FLIRs). Accurate detection of the wavelength and duration of laser light incident on biological or electro-optical sensors is critical for predicting sensor effects, countermeasure requirements (e.g., laser eye protection), and battlefield laser proliferation. Existing commercially available airborne laser warning devices are either expensive and require tedious aircraft modification (e.g. the Laser Detecting Set AN/AVR-2A) or they are simply inadequate (e.g. aviators using the SLIPAR detector complain that its warning alarm only sounds during the illumination and is easily missed). None of the existing laser-warning devices possess the ability to record illumination events. As the threat of laser illumination of aircraft increases, aircrews need the protection of easily obtainable laser sensors that can record pertinent information about any illumination event for future medical and security evaluation. Research currently underway to address Navy science and technology requirements[5,6] by quantifying the laser threat to military personnel and mission objectives has been limited by the lack of laser sensors with onboard recording capabilities. The ideal airborne laser-warning device would include:

[1] one or two detectors to cover the visible to near infrared spectrum,

[2] the ability to distinguish laser light from incoherent sources,

[3] sufficient electronic processing and memory to record any laser illumination (including wavelength, intensity at the sensor, and duration of the sensor's exposure) over a six hour mission,

[4] the ability to match the data's time stamp to the aircraft's telemetry (i.e. at the time of illumination, the data recorded must include the aircraft's position and time, e.g. with its own GPS receiver or by synchronizing the sensor's internal clock to the aircraft's navigational aids),

[5] the ability to record continuous and pulsed laser events for pulses as short as 10 nanoseconds, and

[6] self-containment in a box small enough to be attached to the inside windscreen (e.g. via suction cup) without obscuring aircrew vision and be low cost (under $500 retail).

PHASE I: Design a laser warning sensor that posses all of the optical, electronic and recording requirements (1 through 5 above) and demonstrates the feasibility of miniaturization sufficient to meet the size requirement while remaining low-cost.

PHASE II: Deliver a miniaturized prototype. Airborne testing of this prototype sensor should at least be performed on board rotary wing-aircraft using a continuous laser source and if it can be safely done, also with a pulsed source. This prototype sensor must meet all of the other requirements including size and projected production cost.

PHASE III: Based on successful Phase II effort, expand the testing (including testing on board fixed wing) of the prototype sensor to include sensitivity and damage threshold across the useful spectrum for continuous and pulsed sources.

COMMERCIAL POTENTIAL: Both defense and commercial aviation would have an interest in a laser sensor that not only warns of hazardous illumination events, but also records laser illumination event data for use in assessing the biological impact, treatment, and countermeasure requirement/effectiveness. The recording capabilities should give this device particular appeal to the commercial aviation insurance industry. Its small size and affordability are essential to its mission for protecting the widest range of aviators and missions.

REFERENCES:

1. Defense Intelligence Agency/Armed Forces Medical Intelligence Center (1992). Biological effects of laser radiation: A tutorial (DST-1810R-16-92;PT-1810-02-01L). Fort Detrick, MD: Armed Forces Medical Intelligence Center

2. Defense Intelligence Reference Document (1995,Oct). Ground Combat Laser Weapons: Foreign (U). National Ground Intelligence Center, NGIC-1861-669-96

3. Defense Intelligence Reference Document (1996,Nov). Laser Threats to Air Force Special Operations Command Assets (U). National Air Intelligence Center, NAIC-1866-0273-96

4. Defense Intelligence Reference Document (1997,Jun). Integrated Air Defense System (U). National Air Intelligence Center, NAIC-1861-669-96.

5. Department of the Navy: Chief of Naval Operations; Director, Test and Evaluation and Technology Requirements N091 (1997, July). Science and Technology Requirements Guidance. Washington, DC.

6. Defense Technology Area Plan, Defense Technology Objective (1997). MD.08.J00 Laser Bioeffects Countermeasures.

KEY WORDS: laser, bioeffects, airborne, sensor, recording sensor, pulsed, continuous, directed energy

N98-143 TITLE: Frozen Platelets

SCIENCE/TECHNOLOGY AREA: Medicine

OBJECTIVE: Create an automated device and process for rapidly thawing and washing frozen platelets.

DESCRIPTION: Human platelets for transfusion are currently stored at 22°C for a maximum of five days. Platelets have been frozen with dimethylsulfoxide (DMSO) as permeant (1,2) or with hydroxyethyl starch (HES) as impermeant (2,3). Although in some instances thawed platelets have been transfused without removal of the cryoprotectants (4), the transfusion of DMSO is undesirable. Current methods for post-thaw washing are costly, time-consuming and result in product losses. Frozen platelets could be useful for both civilian and military use if a rapid, fully automated thaw/wash process were available. The thawed and washed platelets should be clinically useful following post-wash storage at 22°C for at least 24 hours.

PHASE I: Select a method for optimal platelet freezing, thawing, washing and storage for at least 24 hours using a transfusable wash solution. Design a fully automated thawing and washing device and process capable of processing, preferably in 5 minutes or less.

PHASE II: Construct an engineering prototype capable of completing the thaw/wash in five minutes or less. Maximize platelet recovery, function and shelf-life by optimizing the composition of the cryoprotective and washing solutions and the freezing and thawing rates.

PHASE III: Complete and test a fully automated prototype, conduct clinical trials and submit data for FDA licensure of both device and product.

COMMERCIAL POTENTIAL: Current 22°C storage suffers from risks of bacterial growth and decreasing product quality during storage. A 5-day shelf-life is insufficient for military use in the field. A fully automated, rapid thaw/wash procedure would make the use of frozen platelets feasible for both civilian and military use wherever storage in excess of 5 days is desired.

REFERENCES:

(1) van-Imhoff GW; Arnaud A; Postmus PE; Mulder NH; Das PC; Smit-Sabinga CT. Autologous cryopreserved platelets and prophylaxis of bleeding in autologous bone marrow transplantation. Blut. 1983 Oct; 47(4): 203-9

(2) Angelini A; Dragani A; Berardi A; Iacone A; Fioritoni G. Evaluation of four different methods for platelet freezing. In vitro and in vivo studies. Vox-Sang. 1992; 63(3): 146-51.

(3) Chaudhury C. Freeze preservation of platelets using hydroxyethyl starch (HES): a preliminary report. Cryobiology. 1978 Oct; 15(5): 493-501.
(4) Mulder PO; Maas A; de-Vries EG; Orie JL; Sleijfer DT; Smit-Sabinga CT; Willemse PH; Mulder NH. Bleeding prophylaxis in autologous bone marrow transplantation for solid tumors. Comparison of cryopreserved autologous and fresh allogeneic single-donor platelets.Haemostasis. 1989; 19(2): 120-4.

KEYWORDS: platelets, blood, transfusion, blood preservation

N98-144 TITLE: Innovative Air and Surface Strike Weapons Technology

OBJECTIVE: The objective of this SBIR topic is to develop and demonstrate innovative technologies in the areas of weapon guidance and control, weapon systems fire control, projectile aeromechanics, ordnance, propulsion, and Naval gun systems and launchers that will allow Naval Air and Surface weapon systems to maintain their capability edge in through the 21st century. The developed and demonstrated technologies must avoid requiring ADoD@ unique processes and materials.

DESCRIPTION: The Office of Naval Research (ONR), Naval Air Warfare Center, Weapons Division (NAWCWPNS), and Naval Surface Warfare Division, Dahlgren Division (NSWCDD), are interested in small business responses for the Naval Air and Surface Weapons Technology (NASWT) program. The vision of this time-phased goal oriented program is to maintain the Naval Air and Surface Weapons Technology edge through the 21st century. The desirable weapons capability attributes are: affordable, precise, mission adaptive, mission responsive, insensitive, safe, higher performance and higher effectiveness. Technologies that do not require unique processes and materials are highly desirable.

The Naval Air and Surface Weapons Technology (NASWT) program supports four operational Naval mission areas, air superiority, ship-based defense, naval surface fire support, and precision strike. Time-phased technology goals for the 2005, 2010, and 2015 time-frame have been established. The technologies developed and demonstrated to achieve these goals will allow for significantwarfighting payoffs in the four mission areas. These goals are available to interested offerors upon request.

Offerors interested in responding must submit their plan for achieving a goal or goals for a given mission area. These plans must show the following: (1) identification of which mission area goals will be achieved with this plan, (2) an estimate of the warfighter payoffs from achievement of these goals, (3) the path to achieve these goals, through identification of the technical objectives in the taxonomy areas of weapon system fire control, weapon guidance and control, projectile, aeromechanics, ordnance, propulsion, and Naval gun systems and launcher (4) identification of the technical challenges that must be overcome to meet the objectives (5) identification of the approach to be taken to overcome the challenges, and (6) identification of the proposed tasks that will overcome the technical challenges, meet the overall objectives to achieve the goals. Any proposed rocket propulsion efforts shall be consistent with the goals of the DoD/NASA/Industry Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program and any propulsion turbine engine work shall be consistent with the goals of the Integrated High Performance Turbine Engine Technology (IHPTET) program.

PHASE I: Concept development and conduct system level bench tests. Develop Phase II Plans and identify three (3) specific commercial transitions of technology for Phase III. Identify all manufacturing plant and facilities requirements.

PHASE II: Demonstration of capabilities through actual testing of prototype production samples. Prototypes should be tested in actual operating environments, or as closely matching operational requirements as physically possible with funding levels currently expected for Phase II effort. Development of a production and manufacturing plan for Phase III. Manufacturers capable of production quantities identified in commercialization plan, and appropriate license agreements exercised.

PHASE III: Transition technology and prototype systems into commercial production for Commercial off the shelf (COTS) application.

COMMERCIAL POTENTIAL: Affordable Commercial Off the Shelf (COTS) technologies and marketable items must be made available to industry and government alike at the end of the effort (phase III), and private sector applications and benefits must be inherent in the objective of the proposed effort. All of the technologies developed under this topic should have commercial potential and not develop technologies that would only be of benefit to the DOD. Technologies developed should have benefits to the commercial space, automotive, recreation and commercial navigation industry.

REFERENCES: Sections of the 1997 Science and Technology Requirements Guidance (STRG) relating to Air and Surface Strike Technology is available in Chapter 3, Air Warfare and Chapter 4, Surface Warfare, and is available on the Internet (http://www.hq.navy.mil/N091/STRGCOVR.HTM) and information on existing Navy Systems are available from the Navy Fact file Internet Site (http://www.chinfo.navy.mil/navpalib/factfile/ffiletop.html). Air and Surface Weapons Technology (ASWT) program briefing materials with additional expectations and technology focus areas are available by request of Mr. James Chew, ONR at the numbers provided below.

KEYWORDS: Conventional Weapons; Weapons; Missiles; Ammunition; Explosives; Munitions

NAVAL AIR SYSTEMS COMMAND

N98-145 TITLE: Innovative Heavy Fuel Compression Ignition Engine Designs

SCIENCE/TECHNOLOGY AREA: Aerospace Propulsion and Power

OBJECTIVE: To examine breakthrough, innovative, lightweight compression ignition heavy fuel engine designs to determine feasibility.

DESCRIPTION: The Navy desires to investigate lightweight state-of-the-art compression ignition engine designs in the 25 to 150 horsepower range. Current commercial compression ignition engine technology is too heavy (low power to weight ratio) to replace the gasoline engines currently used in unmanned air vehicles, firepumps, gensets, etc. Innovative designs shall focus on heavy fuel operation (JP-5, JP-8, and Diesel fuel), lightweight construction, and true compression ignition (compression ratios of 16:1 or higher). Engine designs shall have power to weight ratios of 1.0 lb/hp or better, brake specific fuel consumption not exceeding 0.4 lbs/hp-hr, and have a time between overhaul (TBO) exceeding 250 hours.

PHASE I: Conceptual designs shall be generated and validated through theory, analysis and subscale testing.

PHASE II: Fabrication of full scale design prototype and experimental verification of the concept.

PHASE III: Produce limited numbers of pre-production engines for field demonstrations and validation.

COMMERCIAL POTENTIAL: Commercial applications currently using gasoline engines will require lightweight diesel engines to meet increasing emissions requirements. This lightweight diesel technology will benefit the entire commercial market currently using gasoline engines. Replacement of gasoline engines with lightweight diesel engines will allow safer operation with lower emissions.

KEYWORDS: compression ignition, lightweight, heavy fuel, diesel engine, brake specific fuel consumption

N98-146 TITLE: Salt Bath Process Replacement

SCIENCE/TECHNOLOGY AREA: Manufacturing Technology /Materials, Processes, and Structures, Environmental Quality

OBJECTIVE: Elimination of the salt bath / stretch form process for making aircraft skin panels.

DESCRIPTION: Currently a hazardous manufacturing process is used for shaping the 6061-T6 aluminum skin panels for helicopters. The process involves heating the material in a bath of molten salt at 450^{o} F prior to shaping on a stretch form press. The material must be removed from the bath and stretch formed within 45 minutes in order to obtain the desired material properties. The salt bath itself, being very corrosive, is both hazardous to production personnel and creates a hard-to-handle effluent. This innovation effort develops either a replacement for the salt bath treatment prior to stretch forming or develops an entirely different process for achieving the desired shape and material properties.

PHASE I: Provide a feasibility study which develops alternative, safer methods of achieving the desired shape and material properties (strength, fatigue and corrosion resistance, weight, etc.) for aircraft skin panels. This study will also include alternative materials suited for the aircraft skin application if current materials are not amenable to the new methods.

PHASE II: Develop, test, and operationally demonstrate to cognizant and plant engineers a method which eliminates the salt bath operation. An optimal outcome would also eliminate the stretch form press operation, forming parts with the correct properties in a single or continuous operation.

PHASE III: Using the new method, produce an aircraft skin panel set for engineering testing. Prepare acquisition bid package of cost estimates, Statements of Work, Specifications, and layouts of the new process equipment. This will be the transition into the Navy.

COMMERCIAL POTENTIAL: The new method can also be used in industry for manufacturing aircraft skin panels.

KEYWORDS: Salt Bath; Aircraft; Skin; Forming

N98-147 TITLE: Detonation Technology to Replace the Hard Chrome Plating

SCIENCE/TECHNOLOGY AREA: Environmental quality, Materials

OBJECTIVE : To develop the new concept of detonation gas spraying aiming to replace the environmentally unfriendly Hard Chrome Plating with Detonation Coating Process.

DESCRIPTION: The Hard Chrome Plating and Anodizing of the heat treatable high strength aluminum is being widely used in the industry. The Navy currently requires corrosion protection anodizing for all high strength aluuminum applications. But it is environmentally unfriendly and needs to be replaced by the other methods. Detonation technology has several advantages over the Hard Chrome Plating and the coating methods. This technology was developed by former soviet Union and was widely used for thermal barrier and wear resistance coatings. It is environmentally friendly, and it has the highest bonding strength, lowest porosity, and low substrate temperature (below 150 degrees C) which allows to spray different powders (WC-Co, A1203, Cermets, etc.) on very thin (about 100 micron) aluminum substrate. Furthermore, it does not need the high pressure gas and it=s operating cost is very low compared to HVOF and other methods. Detonation technology can replace the existing Hard Chrome Plating successfully.

PHASE I: In Phase I, the contractor will develop a new concept of detonation gas spraying and evaluate spray parameters: including the interaction of two phase gas jet with the aluminum substrate, and develop the substrate cooling system to control the substrate temperature, and make the coatings on the heat treatable high strength Aluminum (7075-T6 and 7050-T7) substrate. The contractor will evaluate the microstructure, stresses, diffusion, physical and mechanical properties of substrate to decide the proper parameters, and optimize the process.

PHASE II: The contractor will select the aircraft parts and will develop the industrial technology and equipment. The contractor will perform the high cycle fatigue, corrosion, (salt and salt+ SO2),mechanical, stress testing for the complicated shaped parts, and optimize the process. The contractor will provide samples for the shipboard exposure testing.

PHASE III: The detonation coating process has enormous applications in Navy aircraft and the civilian aviation industry and will be commercialized.

COMMERCIAL POTENTIAL: Commercial aircraft utilized the hard chrome plating and anodizing. The development of hard chrome replacement coating has enormous commercial potential and its environmental impact is unmeasureable.

N98-148 TITLE: Non-Hazardous Alternative Materials and/or Coatings to Replace Black Oxide

SCIENCE/TECHNOLOGY AREA: Materials, Processes and Structures

OBJECTIVE: To develop a non-hazardous alternative material(s) and/or coating(s) to replace black oxide for target application(s). The alternative material(s) and/or coating(s) shall meet both current environmental laws/regulations and the performance requirements (corrosion resistance, lubricity, etc.) for target application(s).

DESCRIPTION: Currently, some bearing manufacture have ceased production of housing and bearing with black oxide coating due to the EPA and OSHA regulations concerning the toxicity of hazardous waste disposal products. Black oxide coating are generally use in bearing and gear applications in aircraft and propulsion system.

PHASE I: Develop a non-hazardous alternative material(s) and/or coating(s) to replace black oxide that meet current environmental laws/regulations and the performance requirements for its target application(s). Identify the new material(s) and/or coating(s) and potential applications. Conduct preliminary laboratory testing to demonstrate the feasibility of the new material(s) and/or coating(s) for its target applications. Black oxide shall be included as a baseline. The non-hazardous alternative material(s) and/or coating(s) shall consider the bearing and gear vendor requirements to implement the new technology.

PHASE II: Further develop the new product meeting the objectives of Phase I results. Conduct both laboratory testing and field testing using black oxide as a control. The above testing shall demonstrate that the new product meets all the performance requirements and environmental laws/regulations for target application(s). In addition, the bearing and gear vendor requirements to implement the new product shall demonstrated. Prototype the new technology in a manufacturing environment. If necessary, propose amendment to existing government or commercial specification or propose new government or commercial specification for this electrochemical system to cover the technology.

PHASE III: Produce the material(s) and/or coating(s) demonstrated in the Phase II effort for both the military and commercial market. If further development and/or field testing is required, aircraft programs funding will be pursued.

COMMERCIAL POTENTIAL: The non-hazardous alternative material(s) and/or coating(s) can be used on commercial aircraft as well as non aerospace applications for both the government and private sector. Therefore, this technology is directly transferable.

REFERENCES: AMS 2485 BLACK OXIDE COATINGS; MIL-HDBK-205

KEY WORDS: Black Oxide, Bearing, Gears, Non-hazardous Pollutant

N98-149 TITLE: Repair Of Ceramic Matrix Composites For Exhaust Washed Airframe Structures

SCIENCE/TECHNOLOGY AREA: Materials, Processes and Structures

OBJECTIVE: Develop supportable repair techniques for Blackglas™ ceramic matrix composite blast shield components which are being considered for the AV-8B Harrier aircraft.

DESCRIPTION: The Navy has an immediate need for an alternative to the metallic blast shield currently being utilized on the AV-8B Harrier aircraft. The blast shield protects the fuselage from the harsh exhaust environment, however, the existing component exhibits severe degradation due to the high thermal and acoustic loads. Blackglas™ Ceramic Matrix Composites (CMCs) have been identified as potential replacement materials for blast shield applications due to the ability of the material to withstand the severe exhaust environment. Significant effort has been expended in the development of a prototype CMC blastshield, including successful ground and flight testing to verify its capability. However, prior to fleet introduction, repair techniques applicable to this CMC component must be developed.

Very little development effort has been directed to the issue of repair of CMC systems, and the Navy cannot field CMC flight components until dependable and supportable repair techniques have been demonstrated. Potential damage mechanisms to the blast shield may include normal operational wear and abuse, as well as possible battle damage. Repair techniques should consider both field and depot level capabilities.

PHASE I: Demonstrate feasibility by designing, fabricating, and testing a repair of a Blackglas™ ceramic matrix composite sub element representative of the prototype CMC blast shield. Analytically show that the repair method restores the structural and durability characteristics of the blast shield component.

PHASE II: Address repair of the more complex geometric areas of the blast shield component. Consider damage mechanisms arising from normal wear and abuse as well as battle damage. Address supportability issues and requirements for field repair versus depot restoration. Establish repair versus replacement guidelines.

PHASE III: Transition the CMC repair technology to the fleet by expanding the techniques to other CMC material systems and other components including advanced structurally integrated exhaust washed airframe structures.

COMMERCIAL POTENTIAL: CMC repair techniques will be required for commercial components presently under development in the energy and chemical industries including hot gas filters, radiant burners, corrosive handling equipment, waste incinerators, and power turbines.

KEYWORDS: blast shields; ceramic matrix composites; repair; Blackglas™

N98-150 TITLE: Development/Integration of Low Cost, Light Weight "See and Avoid" Capability for Unmanned Aerial Vehicles

SCIENCE/TECHNOLOGY AREA: Sensors

OBJECTIVE: Provide the UAV with the means to Asee and avoid@ equal to that of manned aircraft while operating under Visual Flight Regulations (VFR)

DESCRIPTION: There exist a need to develop and integrate a Asee and avoid@ capability on current and future Unmanned Aerial Vehicles (UAVs) that is equivalent to manned systems. Currently, UAV autonomous operations are limited to restricted airspace. In order to operate outside these military limited areas, civil airspace control authorities require UAV systems to have a capability to deconflict their operations with other airspace users; preventing mid-air collisions is the prime focus. Collision avoidance is primarily provided today by manned escort aircraft or ground-based visual spotters, however, these techniques severely limit UAV system utility. Although the FAA-approved TCAS (Threat Collision Avoidance System) technology is adaptable for use in UAVs, it requires target aircraft to be ATC transponder equipped and its cost and size/weight/power needs restrict its use to the larger, more complex, UAV systems. In addition to being able to provide cueing for collision avoidance protection against other airborne vehicles, the system of interest should be expandable to other detect hazards to aerial navigationl: ground-based obstructions, undesirable weather, or other unmapped objects. The Asee and avoid@ system must be compatible with existing UAV surveillance sensors (visual, infrared, radar, etc.), able to cue/detect non-cooperative targets, and integatable into the tactical family of UAVs (Pioneer, Predator, Outrider) (integration into smaller UAVs is desired).

PHASE I: Conceive a low-cost, light-weight, sensor system which will provide UAVs an in-flight Asee and avoid@ capability against passive airborne targets (i.e, those not equipped with radar beacon transponders, strobe lights, or other active emitters). The system must be capable of providing the UAV both conflict cueing and automatically issuing the appropriate flight control commands needed to avoid collision. System should be adaptable to multiple platforms, be compatible with the UAV=s existing equipment, and have the potential for detecting other hazards to aerial navigation (including ground-based obstructions).

Sharing of existing UAV resources (sensors, processors, etc.) will be allowable provided their primary function is not negatively impacted. Risk-reduction testing on high-risk elements may be required.

PHASE II: Develop prototype system formulated under Phase I and test the equipment to demonstrate its potential to meet the system=s stated objectives. Integrate the system into a UAV and demonatrate it=s Asee and avoid@ capability in an operationally representative environment.

PHASE III: Refine the system based on the results of Phase II. Qualify and produce manufactured systems for use in military and commercial systems.

COMMERCIAL POTENTIAL: Small light weight UAVs have a possible usage for news coverage, traffic reporting, police surveillance. In addition, larger UAVs may provide commercial broadcasters and the telecommunication industry a Apseudo satellite@ capability for audio/video transmission and cellular telephone systems. This Asee and avoid@ system will allow UAVs to operate in public-use airspace without the major constraints now imposed by the Federal Aviation Administration and other civil aviation authorities.

REFERENCES: U.S. Department of Transportation, Federal Aviation Administration Draft Notice 7110.XXX, ASubj: Remotely Operated Aircraft (ROA) Operations in the National Airspace System (N@AS)

KEYWORDS: Autonomous, See and Avoid, Unmanned Aerial Vehicles, Collision Avoidance, Sensor Fusion

N98-151 TITLE: Short-Range Mobilizer for Transport and Complexing of Mobile Facilities

SCIENCE/TECHNOLOGY AREA: Logistics/Vehicles

OBJECTIVE: Develop a Short-Range Mobilizer to complex and transport Mobile Facilities (MFs) short distances over unimproved terrain. Innovative powered or unpowered alternatives as well as new material development/application would be explored to obtain weight reduction and meet the all terrain requirements.

DESCRIPTION: The desired equipment (mobilizer, running gear, wheel kits, etc.) will be used for transporting and complexing MFs, which resemble standard 8ftX8ftX20ft International Organization for Standardization (ISO) containers and weigh up to 20,000 pounds. It is desired that the equipment perform the following tasks: lift and support a MF a minimum of 18 inches above ground level utilizing ISO 1161 corner fittings and/or the three longitudinal skids on the MF underside; allow short distance transport over unimproved terrain; allow complexing (end to end, end to side, side to side) and allow stable, controlled towing/steering in the forward and reverse directions. The equipment should utilize a drawbar/towing assembly having a lunette eye conforming to Military Specification 51336.

PHASE I: Determine feasibility of alternatives for mobilizer exploring innovative powered or unpowered mechanisms and lightweight high strength materials or designs. Establish criteria to determine the leading candidate and select leading alternative. Develop preliminary design of the selected Short-Range Mobilizer alternative.

PHASE II: Design, fabricate and demonstrate a prototype Short-Range Mobilizer.

PHASE III: Transition prototype design into Marine Corps inventory.

COMMERCIAL POTENTIAL: Exists in commercial shipping/ISO container industries. Industry needs to move similar equipment.

KEYWORDS: mobilizer; ISO container running gear; wheel kits

N98-152 TITLE: Non-Hazardous Air Pollutants Rubber Cement

SCIENCE/TECHNOLOGY AREA: Materials

OBJECTIVE: To develop a rubber cement formulation that does not contain any substance listed under the Clean Air Act Amendment of 1990 Section 112, Hazardous Air Pollutants. The new rubber cement formulation shall meet the performance requirements of MMM-A-121, MMM-A-122, or MMM-A-1617.

DESCRIPTION: Currently, the rubber cement is used to bond rubber to metal, and rubber to rubber. These rubber cement contain high percentages of hazardous air pollutants including methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), and toluene. These materials are not used in large quantities, but they are required for elastomeric bonding applications.

PHASE I: Develop a non-hazardous air pollutant rubber cement formulation(s) that meet current environmental laws/regulations and the performance requirements for its target application(s). Identify new formulations and potential applications.

Conduct preliminary laboratory testing to demonstrate the feasibility of the new rubber cement formulation(s) for its target applications.

PHASE II: Further develop a new rubber cement system meeting the objectives of Phase I results. Conduct both laboratory testing and field testing. The above testing shall demonstrate that the new rubber cement meets all the performance requirements and environmental laws/regulations for target application(s). If necessary, propose amendment to existing government or commercial specification or propose new government or commercial specification for this rubber cement to cover the technology.

PHASE III: Produce the rubber cement demonstrated in the Phase II effort for both the military and commercial market.

COMMERCIAL POTENTIAL: The new rubber cement can be used on commercial aircraft as well as non aerospace applications for both the government and private sector. Therefore, this technology is directly transferable.

REFERNCES: MMM-A-121, MMM-A-122, MMM-A-1617

KEYWORDS: Rubber Cement, Adhesives, Non-hazardous Air Pollutant

N98-153 TITLE: <u>Non-Hazardous Shipboard Adhesive Bond Pretreatment</u>

SCIENCE/TECHNOLOGY AREA: Materials, Processes and Structures

OBJECTIVE: To develop an environmentally friendly bonding pretreatment for aluminum substrates to be used on shipboard repairs. This pretreatment shall not contain volatile organic compounds, chromates, and must have a relatively neutral pH. The elimination of toxic chromates from adhesive bond pretreatment processes will result in considerable cost savings due to the avoidance of the need for hard controls and toxic waste disposal. These hard controls are mandated by Federal, state and local agencies (EPA, OSHA, California=s South Coast Air Quality Management Districts (SCAQMD), etc.) through regulations such as the Clean Air and Water Acts, CERCLA and RCRA along with local EPA and AQMD rules. The new prebonding treatment shall meet the performance requirements of MIL-HDBK-337 chapter 5, MIL-HDBK-6918 chapter 5, and SAE-ARP-1575A.

DESCRIPTION: Currently, the processes that are used aboard a ship for the pretreatment of aluminum substrates prior to adhesive bonding contain large amounts of chromates and are extremely acidic in nature. These hazardous processes require large amounts of rinsing steps that create large amounts of waste. The process should provide a structural adhesive bond interphase that is not susceptible to hydration and degradation due to moisture absorption and exhibits thermo-oxidative stability for service up to 350EF.

PHASE I: Develop a non-hazardous adhesive pretreatment for bonding that can be used aboard a ship. This process should provide a stable surface that has physical properties required for a durable bonded joint. Demonstrate process feasibility on aerospace structural aluminum alloys. Characterize the chemical composition, morphology, thermodynamic stability, hydrolytic stability, corrosion resistance and bondability of the processed surface.

PHASE II: Optimize the process parameters to achieve the best balance of adhesive bonding and corrosion resistance in bonded joints. Conduct both laboratory and field testing.

PHASE III: Produce the process demonstrated in the Phase II effort for both the military and commercial market.

COMMERCIAL POTENTIAL: The new structural adhesive can be used on commercial aircraft as well as non aerospace applications for both the government and private sector. Therefore, this technology is directly transferable.

REFERNCES: MIL-HDBK-337 Chapter 5, MIL-HDBK-6918 Chapter 5, and SAE-ARP-1575A

KEYWORDS: Structural Adhesive Bonding, Bonding Pretreatment, Non-Chromated, Non-hazardous Materials

N98-154 TITLE: <u>Control Display Navigation Unit (CDNU) Interface for Flight Simulators</u>

SCIENCE/TECHNOLOGY AREA: Manpower, Personnel, and Training

OBJECTIVE: Develop an external interface that will allow a Control Display Navigation Unit (CDNU), loaded with an actual aircraft Operational Flight Program (OFP), to function properly in a Flight Simulator environment without sacrificing trainer unique functions such as initialization/reset, freeze, run, slew, snapshot recall and present position calculations.

DESCRIPTION: With Global Positioning System (GPS) navigation equipment required on DoD aircraft, the Navy is installing GPS controlled by the Rockwell Collins Control Display Navigation Unit (CDNU), via MIL-STD-1553B databus. This modification is now being installed on the Navy flight simulators, using the actual CDNU to take advantage of the processing capability of the

CDNU. Since the CDNU software was designed to operate in actual aircraft, there are several anomalies that occur when it is used in the flight simulator application. These trainer unique functions that the CDNU cannot adapt to are: Initialization/Reset, Freeze, Run, Slew, Snapshot Recall and Present Position Calculations. Each aircraft platform with the CDNU has aircraft specific software installed in that CDNU, called an Operational Flight Program (OFP). Currently, each OFP is being modified for each flight simulator, on a case by case basis, to address trainer unique functions. A ABlack Box@ interface, external to the CDNU, is required to address trainer unique functions for all CDNU applications in flight simulators. This will eliminate nonrecurring costs each time a platform installs CDNUs in its flight simulators. It will also eliminate the requirement to develop a trainer unique OFP each time the aircraft version of the OFP changes. This configuration will allow the aircraft OFP to be installed directly into its corresponding flight simulator.

PHASE I: Conduct in depth analysis and provide proof of concept that the CDNU trainer unique functions can be controlled externally to a CDNU loaded with an actual aircraft Operational Flight Program. The interface between the CDNU and the Host Simulation Computer must be external to both devices and perform at a reasonable speed.

PHASE II: In Phase II, the contractor will be required to continue with the concept developed in PHASEI, and develop a prototype interface. Demonstrate the operation of the prototype on multiple flight simulators to display its multi-platform capability.

PHASE III: Produce the CDNU Simulator Interface Units for use in the many flight simulators that have CDNUs installed. This will be the standard for Navy aircraft training systems modified with the CDNU.

COMMERCIAL POTENTIAL: Use of GPS is rapidly spreading throughout the aerospace industry. Potential exists outside DoD for use in NASA, FAA, General aviation, and Commercial aviation flight simulators. The commercial flight simulation industry will share the same cost saving benefits as DoD with the use of this interface.

REFERENCES:

1. MIL-STD-1553B (8 September 1986)
2. MIL-HDBK-1553A (1 November 1988)
3. DoD Minimum Avionics Requirements For Global Positioning System as Sole Means of Navigation. (1 September 1991)
4. GPS Integration Requirements for Navy, Marine Corps, and U.S. Coast Guard Aircraft. (1 December 1993)

KEYWORDS: CDNU; GPS; OFP; Host Simulation Computer

N98-155 TITLE: Night Vision Goggle Simulation/Stimulation

SCIENCE/TECHNOLOGY AREA: Modeling and Simulation; Manpower, Personnel and Training

OBJECTIVE: To extend the capabilities of Night Vision Goggle (NVG) training through development of a modified operational NVG optimized for a simulator display system=s illumination levels.

DESCRIPTION: Night Vision training technology currently involves either a stimulation approach (the pilot wears actual goggles in the trainer to view a display system in which color tables and gamma correction curves have been manipulated, as well as the use of neutral density filters), or a simulation approach (where an image generation channel is dedicated to driving an HMD or other display that simulates the NVG scene). The disadvantages to both approaches are that only a limited portion of the full dynamic range of illumination levels required to effectively simulate the night sky is achieved, and the peripheral scene is not correctly simulated. Image generator independent concepts are sought which will better reproduce the complete NVG operational experience in training systems. Simulation, stimulation, use of modified NVG=s, or a combination approach is acceptable.

PHASE I: Analyze existing NVG capabilities and deficiencies with respect to supporting development of Navy Aviation simulators. Identify a complete list of applicable goggle parameters and display system factors that would pertain to the design of stimulated/simulated goggles or other display devices. Determine the tests and analyses which need to be performed, and the data to be collected. This includes analysis of varying illumination levels in the night sky due to both of natural and man-made origin and varying environmental conditions. Identify a preliminary design and an implementation methodology.

PHASE II: Collect and analyze needed source data identified in PHASEI. Complete the design. Develop a prototype NVG simulator/stimulator. Test and validate the prototype performance and ease of use. Demonstrate and quantify improvements in fidelity and/or cost.

PHASE III: Package the developed system as a commercial which can be integrated with commercial visual systems suitable for use in law enforcement, military, or other NVG training systems.

COMMERCIAL POTENTIAL: NVG technology development has applications in law enforcement.

KEYWORDS: Night vision goggles; night training; simulation; stimulation.

N98-156 TITLE: Geographical Information System (GIS) Advancements for Mission Rehearsal

SCIENCE/TECHNOLOGY AREA: Modeling and Simulation.

OBJECTIVE: To promote cost-effective horizontal integration of interoperable mission rehearsal systems through advancement of open-architecture Geographical Information System tools.

DESCRIPTION: Open-architecture initiatives such as OpenGIS offer new opportunities for greater mission rehearsal system interoperability, database reuse, reduction in database development costs, and increased fidelity. The stated intent of OpenGIS is Aan Open System environment involving the interoperation of application resources in heterogeneous computer environments, and the portability of software and data resources over both operating systems and application platforms.@ The Federal Geospatial Information Infrastructure Integrated Product Team has endorsed Open GIS as a key strategy for fulfilling the Joint Vision 2010 goal of Ageospatial information and software tools to compose a common view of the mission space.@ Advanced GIS tools and features are sought which can be used Atransparently@ with other open-architecture database development tools to develop hardware-independent mission rehearsal applications. Examples of areas where new or advanced GIS features are sought include (but, are not limited to): direct and collateral bombing operation damage prediction and assessment, dynamic terrain blast effects, merging of data sources and OPFOR tactics to predict anti-aircraft and other threat locations in mission planning and rehearsal systems, anti-terrorism systems, multi-spectral image and geometry input/capture and manipulation for large area databases with scalable complexity, high resolution urban area databases, support for training scenario planning and real-time training scenario control, advanced texturing techniques, and correlated Computer Generated Force (CGF) databases.

PHASE I: Analyze existing GIS capabilities and deficiencies with respect to supporting development of key Navy Aviation Mission Planning and Rehearsal databases. Identify one or more new or advanced GIS features that will dramatically increase Naval Aviation Mission Planning and Rehearsal database fidelity, functionality, or reduce development costs for these systems. Determine the tests and analyses which need to be performed, and the data to be collected. Identify an implementation methodology and a preliminary design.

PHASE II: Collect and analyze needed source data identified in Phase I. Complete the design. Code the new/advanced feature(s) in software. Integrate new/advanced feature(s) with an existing GIS tool set. Develop a prototype database using the new/advanced GIS feature(s). Test and validate feature performance, ease of use, interoperability, and work flow with other open-architecture database development tools. Demonstrate and quantify improvements in fidelity and/or cost.

PHASE III: Refine and bundle the developed feature(s) as standard or optional features of an open-architecture GIS product suitable for use by commercial and military database developers.

COMMERCIAL POTENTIAL: GIS software technology has very broad application and mass-market potential for commercial database development, e.g., drug enforcement, police, anti-terrorism. Fire fighting, city planning, and fire fighting. Applicable to all systems usinggeospatial data bases to include.

REFERENCES: Geospatial Information IPT homepage: //164.214.2.57/ OpenGIS homepage: //www.opengis.org/ipt/

KEY WORDS: Geographic Information Systems, open-architecture, mission planning, mission rehearsal.

N98-157 TITLE: Tools for Linking Training to Combat Readiness

SCIENCE/TECHNOLOGY AREA: Manpower, Personnel and Training Systems

OBJECTIVE: Design and develop a "Measure of Performance" (MOP) process based training system.

DESCRIPTION: Historically, fleet training and readiness assessment systems have relied almost exclusively on "Measures of Effectiveness" (MOE) strategies which attempt to describe mission outcomes, end states and results in quantitative terms. MOEs are tools used by a diverse group of Department of Defense (DOD) decision-makers. While MOEs can offer a valuable global perspective, outcome-based analyses are unable to segregate operator performance deficiencies from systems or tactical doctrine deficiencies. MOEs do not yield appropriate diagnostic information on performance problems, and therefore, are ineffective in prescribing corrective training solutions. This is because MOEs identify the results of given actions, without regard to the methods used. Understanding AWHY@ a failure occurred is as important as identifying what failed. That is because hardware, performance and tactical deficiencies have dissimilar resolution strategies. MOEs focus on outcomes and MOPs focus on processes. The human performance aspect of individual and team mission metrics needs to be clearly defined. MOPs describe the knowledge, skills and abilities of individuals and/or teams. Performance is successful if the best decision was made and executed -- regardless of outcome. A process based MOP training system must aim for consistent, systematic, and quantifiable performance and training improvement.

For that reason, it must provide programmatic feedback to training programs in order to determine and maximize training effectiveness; and training resource commitments must be tied to combat readiness. If one can measure training effectiveness and link that metric to combat readiness, then for the first time a value-added approach can be applied to training investment. Establishing these links are critical to the process.

PHASE I: Phase I will be used to develop a functional ATeam@ MOP system model for the Naval aviation community focusing on Under Sea Warfare (USW) and Surface Warfare (SUW) missions. This model should provide a consistent systematic and quantifiable strategy for linking observed aircrew performance with training improvement initiatives and resources. This is the first step in the much larger goal of effectively linking training investments to combat readiness. This phase should include the development and automation of instructional support tools and performance assessment techniques to assess training effectiveness, diagnose performance shortfalls, correct deficiencies, and evaluate readiness. Envision this phase to include capturing the cutting edge research ongoing in laboratories such as the Naval Air Warfare Center Training Systems Division, Orlando, Florida and Armstrong Laboratory in Mesa, Arizona, and tactical school houses such as Sea-Based Weapons and Advanced Tactics School, Pacific in San Diego, California.

PHASE II: Phase II will culminate in a prototype assessment methodology for a current MOP training system model and will focus on model transfer to other warfare areas. Utilizing the results of the efforts of Phase I, this phase will develop a system for assessing job skills and knowledge of individual operators as their performance relates to individual and team skills. It will also begin to provide instructors with training aids that apply instructionally - valid techniques, strategies, and tools within an automated training support tool kit.

PHASE III: Phase III will result in the production of an automated aircrew MOP training system and assessment device(s), and the production of a system to standardize, obtain the maintain individual aircrew experience summary data. Additionally, development of a performance database management host-system for individual, teams and units will be provided to track combat readiness and to perform analysis on the impact of training or resources changes upon combat readiness.

COMMERCIAL POTENTIAL: Within a number of communities (e.g. commercial aviation and education) increased emphasis is being placed on the training of teams, not just individuals. This methodology will allow for the assessment of these training programs, provide feedback for their improvement, and link training investment (value-added) to product readiness, training resources required, school/class measurement standards and education effectiveness.

KEYWORDS: Measures of Performance, Measures of Effectiveness, training Systems, Combat readiness

N98-158 TITLE: Software Tools to Create Bump-Mapped Texture

SCIENCE/TECHNOLOGY AREA: Manpower, Personnel and Training systems

OBJECTIVE: To develop software tools to create bump-mapped texture data

DESCRIPTION: High performance Image Generators (IG) are beginning to transition to advanced phong shading and bump-mapped textures for greater fidelity simulation. Existing database development systems can not take advantage of this important technology improvement. Bump-maps modulate texture surface normal vectors on a pixel basis. The benefit is improved visual cues such as improved depiction of terrain roughness and glint from water & metal. For full sunlighting effects, shadows must be complimented with effective phong shading which require bump-mapped texture. However, cost effective implementation into Naval Air training simulation requires automated bump-mapped texture modeling tools which are currently not available. The task is to develop software tools to create bump-mapped textures from a wide variety of source data types such as IG databases, geospecific photo imagery, geotypical imagery, stereoscopic image disparity etc. Transition between levels of detail and into polygon models should be smooth.

PHASE I: Identify types of algorithms required to fully exploit bump-mapped texture to provide advanced cuing for Naval Aviation training simulation. Perform preliminary design to identify features desired in software tools which will allow developers of databases to create bump-map texture data. Verify acceptable levels of fidelity and automation of the algorithms will be attainable. PHASE II: De

PHASE III: Package the developed software tools as a commercial product or integrate tools into an existing product.

COMMERCIAL POTENTIAL: Real time high performance simulation such as commercial aviation flight trainers. The ability to create complex textures has wide commercial application for graphic arts and entertainment.

REFERENCES: Becker, Barry & Max, Nelson ASmooth Transitions between Bump Rendering Algorithms@ proceedings of SIGGRAPH 93

KEYWORDS: virtual; software; simulation; imaging; visual; database

N98-159 TITLE: Exploitation of Target Scattering in Airborne Active ASW Systems

SCIENCE/TECHNOLOGY AREA: Sensors

OBJECTIVE: Use advanced signal processing and system concepts to exploit target scattering phenomena inherent in Airborne Active ASW systems. Demonstrate existence of the phenomena and its practical utility in the context of existing and future Air ASW Systems.

DESCRIPTION: Airborne ASW Active systems historically have been based on collocated acoustic source and receivers as the primary detection mode. Recent systems use additional receivers displaced from the source in order to capitalize on acoustic reflections other than those directed back at the collocated source/receiver. The system design, from signal processing to tactics, is based upon assumptions of target scattering characteristics. This SBIR topic will address how to best exploit the acoustic scattering phenomena of targets, including identification of unique properties and how they may be used to improve ASW system effectiveness.

PHASE I: Identify target scattering phenomena which have potential to add value to existing and future Airborne ASW active systems. Define the system concepts which may be used to capitalize on the phenomena and identify the signal processing which will be required. The concepts and signal processing must be feasible in airborne ASW systems.

PHASE II: Develop a prototype system which demonstrates the system concepts formulated under the PHASEI effort. The prototype system must be capable of processing actual sea data provided by the Government, and demonstrating that a target may be detected using the scattering phenomenon and associated processing. The prototype must also demonstrate that the concepts can be realized in an airborne system.

PHASE III: Develop a full system capability in a Navy ASW platform configuration. The system development will include all aspects of acoustic processing, display, OMI, and interfaces to the platform tactical computer required to provide an integrated capability.

COMMERCIAL APPLICATION: The acoustic phenomenon and system developed under this SBIR would have application to commercial sonar systems with distributed sensing.

KEYWORDS: Anti-Submarine Warfare, Sonar, Signal Processing, Acoustics

N98-160 TITLE: Instrumenting Embedded Software Behavior via Busses

SCIENCE/TECHNOLOGY AREA: Computer, Software

OBJECTIVE: Significantly improve real time software quality and significantly reduce software debug and integration time and cost by development of an instrumentation system for COTS processors.

DESCRIPTION: In the past the Navy has procured avionics mission computers with monitoring ports, designed in, to extract real time software behavior data for debugging and integration. For example, the AYK-14(v) family members have all been so instrumented. New systems will use COTS based processors. High performance processors, designed for desktop workstations, do not provide monitoring signals. Given the rapid move to multiple processor COTS avionics systems, a new form of instrumentation system is badly needed. One approach is to infer software behavior based on observed inputs and outputs from processors via the memory and I/O busses. Other approaches may also be possible. This project is targeted at the development of an instrumentation system for COTS based multi-processors which will satisfy software debug and integration needs. Such a system should be applicable to both commercial and military system development.

PHASE I: Demonstrate the feasibility of a software instrumentation system by analysis, modeling, simulation, or other means. If a method other than monitoring of external busses and signals is chosen, show how the chosen method is superior. The proposed method must address multiple processors with one and two level caches on-board the processor chip. The approach should stress use of open systems interfaces.

PHASE II: Develop, test and demonstrate a multi-processor (at least two processors) prototype software instrumentation system based on the method addressed in PHASEI. This demonstration shall be with a laboratory based processor system typical of advanced avionics such as JSF. Address comparable commercial markets that the prototype would be used within, such as embedded processors in health, transportation or telecommunications industries. Develop production feasibility plans, including applicability to distributed processors within avionics.

PHASE III: Develop a commercial tool incorporating the concepts demonstrated during PHASEI and II, correcting any difficulties encountered during those phases. Address economic aspects to assure acceptability to commercial markets.

COMMERCIAL POTENTIAL: Embedded high performance computing is emerging as a key development area in medical, transportation and communications markets. All of these markets are high risk where real time software problems have a large economic impact. Software instrumentation systems for debug and integration are equally applicable to these commercial systems as they are for military systems.

REFERNCES: Debugging Parallel Programs with Instant Replay, IEEE Transactions on Computers, Vol C-36 No. 4, April 1987, pp 471-482.

KEYWORDS: Software Testing, Validation, Debugging, Integration

N98-161 TITLE: Application of Genetic Algorithm Technology to Route Planning

SCIENCE/TECHNOLOGY AREA: Precision Guided Munitions, Command and Control, Software

OBJECTIVE: To increase the speed of route planning for multiple missiles or aircraft against multiple targets (M on N).

DESCRIPTION: The Navy is increasingly reliant on automation for planning missions for missiles and aircraft. The complexity of mission planning is also increasing as missiles and aircraft missile systems become more sophisticated in their capabilities. When this increased complexity is coupled with the increased scope of mission planning dictated by the trend towards "jointness" the responsiveness of conventional mission planning systems becomes inadequate to operational needs. This topic is aimed at exploring an alternative to traditional route planning through the use of genetic algorithm technology (GAT). GAT is an alternative mathematical approach to the linear programming traditionally used in route planning. The name comes from the fact that it uses a form of natural selection to arrive at the solution to a specified problem.

PHASE I: Provide a feasibility assessment, concept of operations, and plan of action and milestones for a GAT based automatic route planner for the Tomahawk Land Attack cruise missile.

PHASE II: Develop, test, and demonstrate an operationally representative GAT based automatic route planner based on the results of phase I.

PHASE III: Produce a GAT based automatic route planning engine for incorporation in the Tomahawk Weapons System (TWS). This implementation will be consistent with IT21.

COMMERCIAL POTENTIAL: This has potential in any area of route planning, e.g., aircraft planning, product distribution, wide area network topological assessment, shipping, etc..

KEYWORDS: GAT, route planning, autorouting, and autorouter

N98-162 TITLE: High Temperature Valves for Weapons Systems

SCIENCE/TECHNOLOGY AREA: Aerospace Propulsion and Power

OBJECTIVE: To develop valves which meet the requirements of metering endothermic fuels (JP-8, JP-8+100 & JP-10) in high temperature operating environments associated with high speed flight.

DESCRIPTION: The use of endothermic fuels for engine and airframe cooling has been investigated in recent years. The development of valves which that are capable of metering a high temperature liquid fuel would extend the use of airframes and engines to higher Mach numbers. The fuel may be saturated or fully vaporized. The increased flight speed will reduce the weapons time to target for the warfighter.

PHASE I: Development of valve requirements for high speed airbreathing engines (ramjet, scramjet or pulse detonation engine (PDE)). Create valve design options and evaluate the valve designs for compliance with the established requirements. The two most promising concepts are to be developed into prototype designs.

PHASE II: Preliminary drawing packages are to be created for valve designs produced in PHASE I. Prototypes shall be produced from these drawing packages for proof-of-concept testing with endothermic fuels. The valves shall be tested to verify performance in stand alone configurations by the contractor. Important parameters are expected to be maximum operating temperature, fuel flow capacity, pressure drop across the valve and linearity of fuel flow to valve position or operating frequency. Down-select to one concept will be made based on the results of these tests. A complete engineering drawing package shall be created for limited production of five units. Integration with an engine test bed to demonstrate operability is to be included as an option.

PHASE III: Successful completion of Phase II would result in an engineering drawing package to be transitioned to High Speed Strike and HiSabre Programs.

COMMERCIAL POTENTIAL: Processing or power plants, liquid rocket motors for space based systems and turbine engine industries may benefit from this product.

KEYWORDS: valve; fuel; liquid; high temperature; hypersonic

NAVAL SEA SYSTEMS COMMAND

N98-163 TITLE: Standard Telemedicine System Architecture (STSA) for Shipboard Use

SCIENCE/TECHNOLOGY AREA: Communications

OBJECTIVE: To develop a standard telemedicine system (voice, audio, video, image, and data communications) for distributed medical care delivery. The area of distribution will span from within the department and ship, to across ships and shore. The system must be capable of integrating diagnostic technologies, medical information management resources, and telecommunications into a consolidated system for employment aboard all Navy ships. The goal is to develop a standard system capable of cost effectively supporting a hierarchy of appropriate Atelemedicine@ applications/capabilities on ALL afloat units with the ultimate result of providing increased access to quality care while reducing lost time and expensive medical evacuation costs to fleet units.

DESCRIPTION: Telemedicine is generally defined as the use of telecommunications and computer technologies with medical expertise to facilitate delivery of remote health care. (Remote is not synonymous with distance; rather it refers to the relationship between the patient and the expert medical professional/facility). The availability of bandwidth within the current shipboard environment is an important consideration when developing distributed medical capability. The connectivity supporting the distributed medical capability will span the local and wide area. The system must include a communications infrastructure that provides seamless interfacing from the local to wide area networks. The STSA must be fully compatible with planned shipboard communications and networking capabilities (open architecture based) and able to function over the shipboard wide area network (SWAN), a local task force wide area network (WAN), and the shore-based worldwide communications network being developed by the Department of Defense.

The principle concern in developing the communications infrastructure will be to optimize the use of limited communications resources. This will include minimizing bandwidth requirements, optimizing circuit utilization, and interfacing seamlessly with current Navy communications systems. Key research and development areas would be audio/visual compression technologies, reduction in interrupt response times, use of SHF and EHF bandwidth, use of commercial satellite communications (SATCOM) in the 500 MHz and 1000 MHz at C/Ku and Ka frequencies.

Although the US Army is conducting telemedicine R&D efforts, their efforts are almost solely limited to shore-based telemedicine support. The solutions being developed do not consider the limited bandwidth environment applicable to sea-based telemedicine. As such, the approaches developed will not support the Navy=s efforts to enhance access to care, increase the quality of care, and reduce the overall expense of providing such care in the maritime environment.

PHASE I: Develop engineering information and a conceptual design for a shipboard telemedicine system including specifications and requirements, for current and emerging shipboard telemedicine communications support requirements. Identify specific architecture and technology areas requiring investigation to minimize bandwidth requirements, optimize circuit utilization, and standardize interfaces to current Navy communications systems. Formulate the data, specifications, requirements, and conceptual design into a report providing the foundation for the STSA.

PHASE II: Develop schematics and requirements for the STSA. Ensure system architecture is compatible with the Medical Information Management System (MIMS) being developed by NAVSEA/BUMED. Configure the necessary modules/components, and integrate them as necessary. Develop, test, and demonstrate a working prototype of the STSA. Demonstrations will be required, including shipboard, ship to ship, and ship to shore STSA communications.

PHASE III: Pilot System Implementation and Evaluation. Further refine the working prototype and interface with the MIMS. Transition the prototype for shipboard use. Potential cost savings and accrued benefits include improved shipboard health and readiness, superior utilization of limited shipboard spaces and compartments, and reduced operating costs for shipboard medical facilities.

COMMERCIAL POTENTIAL: The successful development and implementation of STSA would also be directly applicable to non-military ships around the world, including both industrial and large pleasure liners. Additionally, the application of a low bandwidth standard system would have direct application to remote care in isolated areas, home health care, medical response to major disasters, both domestic and worldwide. All of which increase access to and enhance quality of care over current communication infrastructure.

KEYWORDS: Telemedicine, STSA, standardized telemedicine system architecture, and MIMS.

N98-164 TITLE: Advanced Techniques for Combat System Training

SCIENCE/TECHNOLOGY AREA: Manpower, Personnel, and Training

OBJECTIVE: Identify and develop innovative techniques which will allow effective Training Methodologies to be utilized in the training of Surface Ship Combat Systems.

DESCRIPTION: The techniques should utilize the application of advanced training theory to on-board Naval Training Systems, specifically, to enhance and maintain personnel readiness relative to Network Centric Combat Systems. Advances in cognitive science have discovered and identified the structure of procedural knowledge in human memory. That is, the form in which knowledge is represented in human memory as a result of learning procedural type tasks has been reliably described. What this means for instruction is that curriculum can be engineered and structured in a manner which is most compatible with the way in which the human information processing system structures knowledge in memory.

PHASE I: Perform the research and concept development leading to a prototype training system based upon methodologies in advanced training, simulation and modeling. The prototype architecture will implement the training control strategy and present portions of interactive courseware for Operator and Maintenance Training. Interfaces with the Battle Force Tactical Training (BFTT) will be evaluated. Incorporation of the Training Architecture into a Modeling and Simulation for Naval battle group operating in large network will also be evaluated.

PHASE II: Advance the training system to on-board Naval training. Develop a prototype trainer to implement a training string. This trainer will be able to operate in stand alone configuration, or interface in a modeling and simulation based environment with other real or emulated stations. Analysis will be performed to document the advances in cognition and instruction that will reduce the required length and cost of traditional instruction.

PHASE III: Develop a complete curriculum for both operation, maintenance and delivery of trainers for schoolhouse, shipboard, and modeling and simulation use. Potential cost savings and accrued benefits include improved shipboard readiness, adaptation of limited training schedules to shipboard time available, and reduced training costs for shipboard personnel.

COMMERCIAL POTENTIAL: Techniques and technology developed under this SBIR will have broad application in primary and secondary education, industrial training, and job training programs.

KEYWORDS: Advanced Training Techniques, Modeling and Simulation, Cognitive Theory, and Interactive Courseware.

N98-165 TITLE: Fiber Optic Heading Sensor Technology for Towed Arrays

SCIENCE/TECHNOLOGY AREA: Sensors, Surface/Undersurface Vehicles

OBJECTIVE: Investigate and develop fiber optic heading sensor technology to reduce the costs of towed sonar arrays.

DESCRIPTION: Explore fiber optic technologies for heading sensors to be utilized in all-optical towed arrays that may permit a significant reduction in heading sensor cost without sacrificing reliability or accuracy, and with minimal power consumption. An accuracy of 0.1 degree at the earth's equator is desired in a pressure proof package not greater than 0.75 inches in diameter and 4.0 inches in length, and capable of operating at 1,000 psi of hydrostatic pressure and surviving at 2,500 psi. Heading accuracy should be maintained through 360 degrees of continuous roll and +20 to -20 degrees of pitch.

PHASE I: Investigate and provide a conceptual design of a feasible optical heading sensor. Design, develop, and fabricate sensor elements and interface to demonstrate the proposed concept by tests in a laboratory.

PHASE II: Design, develop, fabricate and test several prototypes of a miniaturized heading sensor suitable in form, fit and function for at sea demonstration in a thin line towed array using the sensor elements and interface of Phase I.

PHASE III: Produce high performance, fiber optic heading sensors for full evaluation of suitability and for use in Navy production towed arrays. Potential cost savings and accrued benefits include improved sonar array effectiveness, and reduced maintenance costs for sonar arrays.

COMMERCIAL POTENTIAL: A high performance, fiber optic heading sensor would find immediate application in seismic streamers used for oil exploration; this commercial application alone could easily exceed the military market by an order of magnitude. There would also be high potential for adapting the technology to numerous recreational and commercial applications, e.g., boats, airplanes, etc., where high performance, fiber optic compasses are required.

KEYWORDS: Fiber Optic Heading Sensor; All-optical Towed Arrays; Sensor; Sonar; Acoustic; Minimal Power Consumption

N98-166 TITLE: Advanced Technologies for Automated Ship Meal Preparation and Delivery

SCIENCE/TECHNOLOGY AREA: Manpower and Personnel

OBJECTIVE: Define innovative concepts using advanced technologies, such as robotics, for preparation and automated delivery of meals to deployed ships' crews to reduce shipboard galley manpower requirements.

DESCRIPTION: The Navy seeks innovative ways to reduce the cost of operating and supporting ships as the preferred alternative to reducing the number of ships. The typical shipboard organization dedicates 5% to 10% of total manpower to food preparation and delivery. Development of futuristic concepts for automated delivery and service of prepared meals to crews of deployed ships can reduce shipboard manpower requirements and significantly reduce life cycle costs. New technology for food preparation can offer opportunities for the production of prepared meals at a centralized shore-based facility. These new methods for food preparation and for shipboard dispensing of meals must be defined and a transition strategy for implementing the new technology must be developed.

PHASE I: Define the new automated production concepts. Identify procedures and methods for the production and dispensing of meals to crews of deployed ships, and develop an implementation strategy.

PHASE II: Demonstrate the new concepts and prototype equipment on a shore based prototype.

PHASE III: Demonstrate the new concepts and equipment on a selected ship.

COMMERCIAL POTENTIAL: Any commercial office or factory food service facility can apply the new dispensing methods. The technology should also have applicability in the automatic dispensing/routing of material such as circuit cards, hardware (bolts, nuts, screws, fittings, connectors, etc.) and packages.

REFERENCES: General articles on Robotics; Food Industry Publications such as: Encyclopedia of Food Science and Technology, Y. H. Hui, ed., John Wiley and Sons, New York; Journal of Food Engineering; Journal of Food Science

KEYWORDS: Robotics; Food Preparation; Dispensing Systems; Factory Automation; Automated Material Handling; Automated Warehouse

N98-167 TITLE: Integrated Fluid Dynamic Hydronumeric Ship Design Tools

SCIENCE/TECHNOLOGY AREA: Fluid Dynamics and Hydromechanics Modeling and Simulation

OBJECTIVE: This topic describes a dual use technology development and migration effort which will provide for the development, validation, accreditation, and integration of fluid dynamic and hydronumeric design ship tools made available to all government and qualifying (US) industry at a common on line site.

DESCRIPTION: It is proposed that a small business with proven expertise in ship design hydronumeric software development and integration evaluate and integrate design tools that can be applied to commercial industry and government ship and small boat design contracts. The design tools will allow for the up front and early modeling and simulation of innovative ship sub system solutions. The integrated software package will provide for analyses such as hull form development, appendage and propulsor integration, topside fluid flow modeling, and motions related human factors and mission related performance.

The small business entity will leverage work which has been completed in basic research (6.1 & 6.2) and will benefit from work performed by the Government. Data and computer code developed by Government entities will be made available for integration into the design system. Model test and computer model data will also be made available for validating the hydronumeric modeling capabilities of the system.

The software will be migrated to an industry or government site accessible by all US business entities. Standards for future software development and integration will be prepared.

PHASE I: Concept Exploration - Selection of software and determination of interfaces between programs and the determination of the best common site for the promoting and use of the integrate software system. Candidate software packages that will provide for the modeling of the aerodynamic, and hydrodynamic behavior of surface and subsurface ships operating near or at the free surface (air-water interface) will be evaluated. Alternative integration schemes will be investigated. The proper level for the common interface between programs will be determined. Metrics for successful software integration will be developed in this Phase. Exit criteria for moving onto Phase II as well as Phase II exit Criteria will be established.

PHASE II: Program Development and Risk Reduction - Determine the range of accredited application of the software packages determined in Phase I. Develop a prototype common interface that is exercised for each program independently.

PHASE III: Migrate integrated hydrodynamic design and evaluation system to ship design and building industry to support future surface ship programs. This should include the training and validation of design solutions developed by other industry entities.

REFERENCES: SC-21 Risk Management, ONR S&T Development Plan

COMMERCIALIZATION: Open systems architecture approach will permit other applications to be integrated as they reach maturity. Developing the software and interfaces at a common site accessible to all US industry entities will provide incentive to future design tool developers to adhere to the common interface. This will provide a central focus for hydronumeric and fluid dynamic models that support the tenets of scalability and upgradabilty.

KEYWORDS: Fluid Dynamics, Hydronumeric, Software, CAD, Modeling, Computer Architecture

N98-168 TITLE: Design of High-Speed, High Endurance Mine Warfare Craft

SCIENCE/TECHNOLOGY AREA: Structures, Surface Vehicles

OBJECTIVE: Develop innovative design(s) for new mine warfare craft, capable of supporting in-stride, organic mine warfare missions in a sea state of at least five, with emphasis on a capability to precede the Battle Group (BG) arrival as well as remaining behind the BG to conduct continued MIW operations. Both manned and autonomous craft are of interest. Autonomous craft will operate within the mine-field to conduct counter-mine operations such as: Mine hunting, mine clearance, and ship signature emulation. Manned craft must have a range up to 6,000 nmi at the maximum endurance speed and shipboard provisions for over 45 days of operations in on-board stores and lockers. Both manned and autonomous craft must have maximum endurance speeds in the range of 30-50 knots and must possess appropriate magnetic and acoustic signatures and resistance to the effects of underwater explosions. Closed loop degaussing or some other method may be utilized to reduce the magnetic signature. Material characteristics should be considered to reduce initial/maintenance costs and increase reliability. The manned craft must accomplish its mission outside of the minefield, and deploy MIW systems that enter the minefield; definition and selection of those deployed systems is required in the context of the manned craft design.

DESCRIPTION: Innovative hull forms and hull technology are encouraged, including (but not limited to) Surface Effect Ship, Catamaran, Small WaterPlane Area Ship, Hydrofoil, and Planing and displacement hulls. Include both Hydrodynamic modeling and finite-element structural modeling in all design phases. Offerors are encouraged to utilize innovative approaches to achieve autonomous operation or minimum manning, and minimize maintenance and operational costs. The new class MIW craft should include:

a) A sophisticated C4I system for manned or autonomous operation
b) A shock factor of 0.3-0.4
c) Minimal draft

Mine warfare systems to be considered should include: mine-hunting sonar(s); mine neutralization vehicle(s); Remote Minehunting System(s); sweep capability, Synthetic Aperture Sonar (SAS), laser line scan system for high-speed bottom survey and mine laying capability.

PHASE I: Develop a design concept showing layout of the craft and principle systems. Address the items specified in the Objective and Description, with estimated performance using modeling calculations where appropriate. Include stability calculations and power available curves. Provide ROM cost estimates, conceptual arrangements and weight breakdowns.

PHASE II: Develop a Preliminary Design to meet the prescribed performance levels. Complete drawings suitable for detail design of the vessel in Phase-III. Provide a preliminary design package and specifications and other documentation, disclosing arrangement of compartments and spaces and interior arrangements of any manned or occupied spaces and system, equipment and machinery areas. The preliminary design package shall be suitable for Phase III utilization and shall be based upon motion and structural analysis conducted by the Contractor utilizing the NSWC/DD ship motion program or equivalent, and shall be submitted for acceptance by the Government. Expand on any discussions covered in Phase I submittal.

PHASE III: Conduct a detail design of the new class MIW vessel, in support of an Advanced Concept Technology Demonstration (ACTD) or a New Construction Program. Potential cost savings and accrued benefits include improved deployment rates and readiness, superior utilization of limited MIW assets and personnel, and reduced operating costs for an organic, in stride ocean-going MIW capability.

COMMERCIAL POTENTIAL: New hull forms for maritime, trade, and commercial purposes have a ready commercial market, particularly if concurrent reductions in maintenance and operational costs are available. The vessel design proposed herein will combine reduced maintenance and operational costs and requires exceptional sea-keeping and low specific fuel consumption to meet the operational characteristics, and is very capable of commercial service requiring open-ocean exposure such as for fishing, passenger ferry, inter-island (pacific) shipping routes, hunting and salvage operations of lost ships and downed aircraft, along with providing the oil industry with a system to do a seismic survey of the ocean floor as well as ferrying supplies and personnel to off- shore oil rigs in high seas.

REFERENCES: Potential offerors requiring additional technical information or guidance may inquire through the SBIR Interactive Technical Information System (SITIS) at Web-Site 'http://www.dticam.dtic.mil.sbir/'

KEYWORDS: Mine Countermeasures; SMCM; Mine Warfare; Mine Sweeping; Autonomous Craft; Remote Control; High Performance Craft

STRATEGIC SYSTEMS PROGRAM OFFICE

N98-169 TITLE: Low-Cost Carbon-Phenolic Composites for Reentry Body Heatshields

SCIENCE/TECHNOLOGY AREA: Materials and Structures, Aerospace Vehicles

OBJECTIVE: Identify and quantify payoff of processing variations which reduce cost of carbon-phenolic reentry body heatshields.

DESCRIPTION: Reentry body heatshields, made of tape-wrapped, rayon-based carbon fibers-phenolic matrix (TWCP), utilize a fabrication process largely unchanged since the 1970s. The carbon-phenolic material system and the particular construction configuration was selected to meet the requirements of relatively high strength, low alkali contaminants, and minimum change in wall thickness with good thermal insulation capability under the extremely severe thermal and areodynamic shear environment of reentry. Presently, rayon cloth undergoes purification before and after carbonization, is prepregged, and then cut into strips. The strips are sewn together to make a tape which is then wrapped on a conical mandrel at a particular angle to the surface (shingle angle). Finally the wrapped part is cured in a hydroclave and machined. It is desired to revisit the fabrication process and, drawing from recent technological advances (automation, smart processing, etc.), identify processing changes which reduce heatshield cost. Other processes besides tape wrapping could be considered if significant cost reduction appears possible. Since aerospace grade rayon fibers are no longer available, other low thermal conductivity carbon fibers (such as PAN-based systems) will have to be utilized in this investigation for future heatshield applications.

PHASE I: Review existing process for heatshield fabrication and become familiar with the material requirements for the reentry application. Identify process variations or changes in process which potentially reduce fabrication cost. Quantify (via estimation or experimentation) and prioritize cost reduction associated with proposed process variations. Prepare a plan to evaluate cost reduction steps in Phase II.

PHASE II: Evaluate cost reduction process variations identified in Phase I. Depending on specific processes proposed, development of a process may be required. Other elements of this phase of work include sample hardware fabrication to provide data to support cost estimates, hardware fabrication, test and evaluation to verify required properties (mechanical, thermal, etc.), and the estimation of cost savings for heatshield production.

PHASE III: Additional carbon-phenolic heatshield material shall be produced to complete the property database on the most promising concept for potential system application.

COMMERCIAL POTENTIAL: Polymer matrix composites, which includes carbon-phenolic materials, are widely used in commercial (sporting goods) and DoD (aircraft aerosurfaces) applications. The development of lower cost fabrication techniques could be useful for cost reduction in all application areas - the cost reduction technology could have very broad applicability. Cost reduction of commercial and DoD products could improve market sales of U.S. products in foreign markets.

REFERENCES:
Reference Data Bases: (1) Automated processing of polymer matrix composites; (2) Smart processing of polymer matrix composites.
No releaseable reports available, contact POC for more specific details.

KEYWORDS: polymer matrix composites, fabrication techniques, cost reduction, automated processing, smart processing

NAVAL FACILITIES ENGINEERING CENTER

N98-170 TITLE: Tethered Aerostat Communication Link Application

SCIENCE/TECHNOLOGY AREA: Aerospace Vehicles

OBJECTIVE: Enable U.S. Navy ships in a logistics support mode to communicate with shore forces via a high volume, secure, reliable fiber optic communication link. The communication link must be lightweight, low-cost, and rapidly deployable.

DESCRIPTION: The concept is a fiber optic cable link that extends from shore-based operations to over-the-horizon sea-based operations. A component of this communication link will be aerostat relay stations, placed at the ends of the communication link. Forces afloat and ashore access the trunk cable via line-of-sight microwave transmission. The shore site(s) and sea-based vessels use the communication=s link to form a Wide Area Network between their Local Area Networks.

The aerostat relay station will be the platform providing the communication link between the ships= UHF communications and the fiber optic cable backbone from the sea-base to the shore. The payload for the aerostat should be minimized; this will minimize the aerostat=s size, making for ease of shipment and deployment, and potentially increasing survivability red lines. The communication package payload component is estimated to be relatively small, on the order of 100 to 200 lbs. The line-of-sight requirement for the aerostats is 50 to 100 km. The tether will moor the aerostat on the seafloor and house the communication link to the seafloor backbone.

PHASE I: Identify and explore concepts for a sea-based (moored) aerostat telecommunications relay station. Identify the system components, the integration of the components, and the sizing requirements for a moored, tethered aerostat. Consider how the tethered aerostat will be deployed from a ship and placed in the moor. Investigate how to make the connection between the tether=s mooring platform and the submarine cable. Address the trade-offs between utilizing a powered tether and having the system=s power package (i.e. batteries or on-board generator) as part of the aerostat=s payload. The environmental red lines for operation and survivability must be established. Assess reliability, determine operational limits and how they might possibly be expanded, and discuss survivability assurance. Determine the performance parameters with particular attention to the air-sea interface.

PHASE II: Develop and implement the Phase I approach, producing a prototype tethered aerostat communication link system. This system must be demonstrated via testing to be effective for the intended seabase application. The validation testing would not only include testing the communication platform capability, but it would include testing of the mooring system and the deployment and recovery methodologies. Documentation on operation, maintenance, and survivability issues will accompany the prototype.

PHASE III: Conduct any necessary revisions to the prototype system after the validation testing and transition to a production and assembly mode for the sea-base application.

COMMERCIAL POTENTIAL: Similar concepts are being applied in commercial telecommunications systems. Coastal festooning using lightweight, unrepeated fiber optic cable has proven to be an economical method for linking cities along a continent or island chain. Another concept, ARing Around Africa@ is an international telecommunications project where an offshore fiber optic ring will be laid on the continental shelf, and spokes will be routed to shore where needed. Lastly, potential dual-use applications exist in seaport commercial cargo load/off-load planning through high speed networking prior to port entry.

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KEYWORDS: aerostats; lighter-than-air vehicles; airships; blimps; powered tether; mooring

N98-171 TITLE: <u>Engineering Modeling of Hockling in Ocean Cables</u>

SCIENCE/TECHNOLOGY AREA: Modeling and Simulation

OBJECTIVE: Develop an engineering model of hockling behavior of cables used in US Navy applications in the ocean.

DESCRIPTION: The US Navy needs an engineering analysis and design tool to predict the likelihood of hockling in a cable. The cables may be electo-mechanical-optical, synthetic materials or wire rope. The hockling behavior is the looping of the cable as a result of tension variations and induced torque. The cables may be part of a tether system such as used in remote operated vehicles or fiber optic cable deployed from towed bodies in the ocean.

PHASE I: Document all existing engineering models to predict hockling behavior in cables. The models may be for land based and ocean based cable applications. With present modeling capabilities the investigator may be required to modify existing programs or develop a new engineering tool to model hockling behavior of cables in the ocean. Propose an improved modeling tool and describe its theoretical basis and resulting analytical equations.

PHASE II: Based on results of Phase 1,. The analytical equations shall be implemented into a computer program that provides identification of the hockling behavior and location along the cable. Input would probably be tension and torque along with motions of the cable ends and ocean currents and ocean wave load computations. Output would probably consist of coordinates, tensions and torque along the cable at discrete nodes such that a post process program may perform plots and statistics of the cable behavior. Verify model with experimental cable behavior under tension and torque. A possible experiment might be to suspend a tether cable with an S shape (inverted catenary) and imposed tension variations and torque at the ends of the cable while moving it in a wave or current model test tank.

PHASE III: The tool developed or acquired from Phase 1 and 2 will need to be rigorously tested and compared to varied experimental cases. Transition the development to the Navy=s ASW Program.

COMMERCIAL POTENTIAL: The commercial sector will benefit from this tool for prediction of cable behavior in oceanographic remote operated vehicles, electrical power cables, mooring systems, other cable structures. Larger ocean engineering structures are being designed both by the Navy and the ocean industry necessitating greater reliance on underwater cabling systems.

KEYWORDS: cablehockling; cable twist; cable torque; cable looping; cables under combined tension and torque; tethers;

N98-172 TITLE: FRP/Concrete Hybrid Structural Components for Waterfront Construction

SCIENCE/TECHNOLOGY AREA: Materials and Structures

OBJECTIVE: Develop cost competitive, long lived, lightweight, and modular structural components for Navy pier construction having a zero maintenance requirement for 75 years in a severe marine environment. The modularity will facilitate modification of a structure to meet changes in mission requirements over its service life.

DESCRIPTION: The Navy has a need to develop modular, prefabricated structural components to provide a new capability to reconfigure its waterfront infrastructure to meet changes in ship characteristics, force realignments, and rapid buildup of infrastructure in forward areas for either strategic basing or contingency response. Concepts will be developed and feasibility demonstrated for construction of waterfront pier and wharf structures using high performance concrete and Fiber Reinforced Polymer(FRP) composite materials. Concepts will maximize maintenance free service life while providing a competitive initial cost with conventional construction. Concepts will meet all operational requirements specified in MILHDBK 1025/1 including support for operation of 140-ton mobile cranes and for berthing of major combatants. The concept will evaluate performance trade-offs and will marry discrete state-of-the-art technologies such as high strength lightweight concrete, FRP reinforcement systems, large-scale FRP composite pultrusion technology, and fault diagnostics. Emphasis will be placed on exploiting the performance characteristics of the constituent materials without mimicking traditional construction technology.

Finite element modeling will be used to analyze the load response performance of concepts for subsystems. Laboratory tests to determine material constitutive relationships and to benchmark subsystem performance will be used to refine and validate the computer codes. Constructability and load performance of an optimized pier/wharf system will be analyzed and the concept refined. A one-half scale pier model will be tested. Tests will include component and substructure load performance including lateral load response, vertical load response (static, creep), and structural monitoring system performance.

PHASE I: Develop architectural concepts and characteristics. Develop structural computer models to demonstrate structural performance.

PHASE II: Use computer models to develop pier/wharf Models. Conduct laboratory tests to integrate qualitative diagnostics.

PHASE III. Construct and install pier and initiate performance tests at half scale side. Transition to NAVFAC=s modular Hybrid Pier Program and Naval Facilities Improvement Program. The final concept will be tested for constructability, load response and service monitoring at the Naval Facilities Engineering Service Center=s Advanced Waterfront Technology Test Site.

COMMERCIAL POTENTIAL: This research encompasses component structural elements, structural shapes, materials, innovative structural geometries and integrated sensor systems. In addition to commercial ports this technology base is applicable to the nation=s highway bridges in need of modernization. With the applications of advanced composites to civil engineering structures and the infrastructure, this technology offers to extend the industrial base for exotic aerospace materials during an era of reduced defense spending. This technology base will present a fertile mix of innovative materials, techniques and systems that will reduce the time and cost of developing a low maintenance pier concept and will present opportunities for technical exchanges and coordinated efforts.

REFERNCES: MILHDBK 1025/1

KEYWORDS: Composites; modular structures; FRP/Concrete hybrids; modeling; piers; material constitutive relationships