NAVY
Proposal Submission

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. Inquiries of a general nature may be brought to the Navy SBIR Program Manager's attention and should be addressed to:

Office of Naval Research
ATTN: Mr. Vincent D. Schaper
ONR 362 SBIR
800 North Quincy Street
Arlington, VA 22217-5660
(703) 696-8528

The Navy's SBIR program is a mission-oriented program which integrates the needs and requirements of the Navy primarily through science and technology dual-use, critical technology topics. A total of 31 Science and Technology (S&T) areas has been identified (see Table 1). While all of these areas may not be funded equally during the annual DOD SBIR solicitations in which the Navy participates, topics will be funded according to a priority it has established to meet its mission goals and responsibilities.

PROPOSAL SUBMISSION:

The Navy WILL NOT ACCEPT THE RED FORMS in the rear of the book as valid proposal submission. There are only two ways of submitting your SBIR proposals to the Navy. You may send a disk to the Navy SBIR Program Office at the above with a single hard copy of the exact proposal that is on the disk; or you may access the Navy SBIR Bulletin Board and submit your proposal via the Internet and send a single hard copy of the exact proposal that you send via the Internet.

FOR PC with WINDOWS:
SUBMITTING a DISK and ONE HARD SIGNED COPY OF YOUR PROPOSAL:
The Navy's part of the solicitation which is readable and retrievable from the INTERNET under the ONR Homepage (address--http://www.onr.navy.mil) contains topics which permit small businesses to submit their solutions to Navy requirements. We are providing proposers the opportunity to send proposals on diskette or via the Internet for this solicitation. From the ONR Homepage on the INTERNET you may gain access to the Navy SBIR Bulletin Board by clicking on BUSINESS OPPORTUNITIES and then on Navy SBIR Bulletin Board or by accessing it directly at address -http://web.fie.com/web/fed/onr/down/onrdn.013.htm. Once on the Bulletin Board go to 96.2 Solicitation and down load the text, forms and compression files into your computer. Make sure you READ the "readme" file. This informs you about submitting your proposal to the Navy using your PC computer with WINDOWS capability and for filling out your SBIR proposal on disk (Appendix A, B, C, and proposal text) which can be mailed to the above address together with a single signed hard copy. All proposals sent on disk should be written using one of the following software packages: WordPerfect 5.1, 5.2, 6.0; WordStar 2000 1.0, 2000 2.0, 2000 3.0, 3.3, 3.4, 4.0, 5.0, 6.0, 7.0; MultiMate 4.0; MS Word for Windows 1.0 or 2.0; MS Word 4.0, 5.0 or 6.0; or Display Write 4.0 or 5.0. You may ask technical questions through the SBIR Interactive Topic Information System (SITIS), see Section 7.2 of this solicitation. A listing of companies selected for award negotiations for this Navy SBIR solicitation will be listed on the INTERNET on the Navy SBIR Bulletin Board. If you do not have Internet capability, the same information can be obtained by sending a request letter for a Navy SBIR disk together with a

typed self addressed adhesive label and then submitting your proposal on disk with a signed hard copy of your proposal.

FOR WINDOWS AND MAC USERS:
SUBMITTING YOUR PROPOSAL VIA INTERNET with ONE HARD SIGNED COPY;
S*ubmitting your proposal via Internet is the proposers responsibility....THERE IS A RISK OF INTERCEPTION* . However, it affords you the opportunity to submit your proposal if you were not aware of the solicitation and had only limited time to make a submission or had a Macintosh Computer and had no ability to use or rent a PC with Windows capability. This mechanism for submission will be closed exactly at 2:00 Eastern Standard Time on the date noted in section 6.2 of the front portion (DOD section) of this solicitation.
To submit your proposal via the Internet follow the instructions on the Navy SBIR Bulletin Board (address noted above) under the section entitled "Submit your Navy SBIR Proposal". You will send your proposal using a file named with the three initials of the principal investigator (your first, middle and sur name.....if you don't have a middle initial use "Z"), your month and day of birth and numeral representing the number of that proposal which is being submitted for that topic. For example, Mary Jane Jones is submitting her second proposal under topic N96-100 and she was born on 10/18/68. The proposal she would send would have the file name MJJ10182.
If you are using Windows you may use any of the software packages noted above. If you are using a Macintosh you must use a Microsoft Word that can be converted into the PC version.
Once you have sent your proposal using the Internet you must send to the address noted above .....A ***SINGLE HARD COPY OF THE EXACT PROPOSAL YOU SENT ON THE INTERNET AND IT MUST BE RECEIVED WITHIN FOUR (4) WORKING DAYS AFTER THE OFFICIAL CLOSING DATE NOTED IN PARAGRAPH 6.2 OF THE DOD SECTION OF THE SOLICITATION.***

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 successful Phase I effort will be eligible to participate for a Phase II award. If you have been invited to submit a Phase II proposal by the Navy TPOC get a copy of the Phase II Instructions from the Navy SBIR Bulletin Board on the Internet. All Phase I and Phase II proposals should be sent to the Navy SBIR Program Office (at the above address) for proper processing. 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 & 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. <u>The Navy will not award Phase I contracts in excess of $70,000 (exclusive of the Phase I option).</u> The Phase I Option should be the initiation of the demonstration 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); 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 <u>and</u> 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. 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. The transition plan should be in a separate document.

Evaluation of proposals to the Navy will be accomplished using scientific review criteria. Evaluation and selection of Phase I proposals will be 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	SCIENCE
Aerospace Propulsion and Power	Computer Sciences
Aerospace Vehicles	Mathematics
Chemical and Biological Defense	Cognitive and Neural Sciences
Command, Control, and Communications	Biology and Medicine
Computers	Terrestrial Sciences
Conventional Weapons	Atmospheric and Space Science
Electron Devices	Ocean Science
Electronic Warfare	Chemistry
Environmental Quality and Civil Engineering	Physics
Human-System Interfaces	Electronics
Manpower and Personnel	Materials
Materials and Structures	Mechanics
Medical	Environmental Science
Sensors	Manufacturing Science
Surface/Undersurface Vehicles	
Software	
Training Systems	

NAVY SBIR PROGRAM MANAGERS OR POINTS OF CONTACT FOR TOPICS

TOPIC NUMBERS	POINT OF CONTACT	PHONE
144-176, 289	Mr. Douglas Harry	703-696-4286
177-186	Mr. Joseph Johnson	703-784-4801
187, 194 208-210, 215, 216, 222, 226-228, 232, 234, 238	Ms. Cathy Nodgaard	703-604-2437 x6309
190-193, 195, 196, 199-207, 211-213, 229	Ms. Carol Van Wyk	215-441-2375
188, 189,197, 218-221, 230	Mr. Walt Kahl	301-826-7870
198, 217	Mr. Chuck Sullivan	317-306-7998
223-225	Mr. Peter (Pete) O'Donnell	908-323-7566
239-244, 284	Mr. Eugene (Gene) Patno	805-989-9209
214, 231, 233	Ms. Janet Wisenford	407-380-8276
246-247, 249-259	Ms. Betty Geesey	703-602-6901
282	Ms. Patricia Schaefer	703-767-6263
235-237, 263, 264, 280, 283	Mr. Donald Wilson	301-394-1279
248	Ms. Louise Goodman	619-553-2104
245, 285, 288	Mr. Jack Griffin	203-440-4116
260-262, 265-279, 281, 286, 287	Mr. Bill Degentesh	703-602-3005

DEPARTMENT of NAVY
Small Business Innovation Research (SBIR) Program
96.2 Solicitation Topic Titles

OFFICE of NAVAL RESEARCH

N96-144TITLE:Engineering Technologies for Large Complex Systems

N96-145TITLE:System Engineering of Human Resources and Cognitive Task Analysis in Complex Navy Systems

N96-146TITLE:Vertical-Cavity Surface-Emitting Laser

N96-147TITLE:Dielectric Materials for Use with Wide Bandgap Semiconductors

N96-148TITLE:Photonic Technology for RF, Microwave, and mmW Antennas

N96-149TITLE:Ultra-High Isolation Circulator/Duplexer for Surveillance and Communication

N96-150TITLE:Four Dimensional (4-D) Atmospheric and Oceanographic Instrumentation

N96-151TITLE:Radar and Electro-optical Analysis Tool

N96-152TITLE:Low-Cost, Covert, Moored Environmental Monitoring Package

N96-153TITLE:Acoustic Clutter Discrimination and Classification

N96-154TITLE:Fuel Cells for Underwater Vehicle Propulsion

N96-155TITLE:Thin Film Thermoelectric Device Science & Technology

N96-156TITLE:Advanced Polymer Optical Fibers

N96-157TITLE:Flame Resistant Organic Composites

N96-158TITLE:Alternative Curing Technology For Composites and Adhesive Bond Processing

N96-159TITLE:Improved method for the production of difluoramine energetics

N96-160TITLE:Production of Strained Liquid Hydrocarbon Fuels

N96-161TITLE:Quiet, Compact, Efficient Variable Ballast (VB) System for Small Undersea Vehicles

N96-162TITLE:Micro-Actuators and -Sensors based on Terfenol-D Film

N96-163TITLE:Nonlinear Dynamics Control of Advanced Electrical Power Systems

N96-164TITLE:Expert System for Underwater Vehicle Maneuvering Control

N96-165TITLE:Low Profile Motion Sensor

N96-166TITLE:Laser Scanning Three Dimensional Surface Velocity Vibrometer

N96-167 TITLE:Container for Storing and Processing Injectable Carbon Dioxide-Containing Fluids and Freeze-Dried Blood Components

N96-168TITLE:Biological Neural Network Software Toolkit

N96-169TITLE:Smart Analog Vision Chip with Spatio-temporal Filtering

N96-170TITLE:Novelty Detection for Condition-based Maintenance of Mechanical Systems Using Neural Networks

N96-171TITLE:Operation Evaluation of Advanced Integrated Air Vehicle Suites

N96-172TITLE:Incorporation of Gap Effects in the Design of High Performance Missile Control Fins

N96-173TITLE:Superconductor Applications to Aircraft Electric Systems

N96-174TITLE:Model Development for Shock-Induced Reactions in Non-Explosive Materials

N96-175TITLE:Microscopic Investigation of Rocket Propellant Processing Parameters on Cure Shrinking

N96-176TITLE:Rapid Positioners for Precision Manufacturing

MARINE CORP SYSTEMS COMMAND

N96-177TITLE:Composite Mine Vehicle Survivability Kit

N96-178TITLE:Anti-Personnel Obstacle (APOBS) Breaching System Manufacturing Technology

N96-179TITLE:Battlefield Information Warfare

N96-180TITLE:Deployable Power Distribution System

N96-181TITLE:Multipurpose Lifting/Excavating Arm

N96-182TITLE:TRSS Air Delivered Target Acquisition Sensors

N96-183TITLE:Knowledge-based System

N96-184TITLE:Ultra-WideBand Antenna

N96-185TITLE:Detection of Unexploded Ordnance (UXO)

N96-186TITLE:State of Charge Monitoring for Hybrid Electric Vehicles

NAVAL AIR SYSTEMS TEAM

N96-187TITLE:Fretting and Wear Resistant Blade/Vane Coatings

N96-188TITLE:Multivariable Integrator Windup Protection for Aircraft Fight Control System using Model Predictive Controller

N96-189TITLE:Development of a High Power Air-Cooled Clutch

N96-190TITLE:Viscous Cartesian Unstructured Grid Generation

N96-191TITLE:High Lift Aerodynamics Shear Layer Transition Modeling

N96-192TITLE:Aircraft Weapon Bay Turbulent Flow Simulation Model

N96-193 TITLE:SYSTEMS ENGINEERING ENVIRONMENT: Methods and Tools for Collaborative Systems Engineering at Geographically Distributed Sites

N96-194TITLE:Innovative Control Design Impact for Aircraft

N96-195TITLE:Escape System Data Recorder

N96-196TITLE:Hot Film Sensing of Vortex Shedding and Structural Dynamics

N96-197TITLE:Advanced Scanning Interferometer System for Characterization of Moving Surfaces.

N96-198TITLE:Wire Bonding Interconnects for High Temperature Silicon Carbide Electronics

N96-199TITLE:System and Algorithm Concepts for Automatic Detection and Classification of Non-Traditional Acoustic Signals

N96-200TITLE:Integrated Flight Performance Model for Various Aircraft Platforms

N96-201TITLE:Using Multi-media for embedded Training within Application Software

N96-202TITLE:A POSIX Interface for the F-22 Common Integrated Processor Avionics Operating System

N96-203TITLE:Incremental Modernization of Legacy Software Systems(IMLSS)

N96-204TITLE:Transitioning Embedded Avionics Software from Ada 83 to Ada 95

N96-205TITLE:Adaptive Optics for Advanced Laser Systems

N96-206TITLE:Laser Beamrider Detection

N96-207TITLE:High Brightness, Wavelength Selectable, Pulsed Solid-State Laser Sources.

N96-208 TITLE:Unmanned Aerial Vehicle(UAV) Low Probability of Intercept (LPI) Communications Relay and Interrogator for the Search and Rescue Beacon Transponder

N96-209 TITLE:Unmanned Aerial Vehicle(UAV) Based Magnetic Anomaly Detection (MAD) for Small Submarine Hunting in Shallow Water and Over-the-Land Reconnaissance

N96-210TITLE:Optical Beam Forming Network

N96-211TITLE:Ytterbium Yttrium Orth-Vanadate (Yb^{3+}:YVO_4) Laser Crystals

N96-212TITLE:Corrected Fiber Optic Laser Beam Delivery

N96-213TITLE:Engineered Infrared Nonlinear Optical Materials

N96-214TITLE:Image Matrix Merger

N96-215TITLE:Innovative Methods for Minimization Glass Bead Abrasive Blasting Hazardous Waste Stream

N96-216TITLE:Single Component Sealant for Watertight Integrity and Corrosion Control

N96-217TITLE:Optical Time Domain Reflectometer Development

N96-218TITLE:Fiber Optic Microwave Transmission System

N96-219TITLE:High Frequency Lossy Line Extension

N96-220TITLE:Faster High Intensity Radiated Fields (HIRF) Testing from 10 Khz to 40 Ghz

N96-221TITLE:Electronic Maintenance of Equipment Identification and Configuration Data

N96-222TITLE:Advance Model-Based Reasoning

N96-223TITLE:Improved Visual Landing Aids on Air Capable Ships

N96-224TITLE:Piloted Approach Decision Aid Logic (PADAL) System

N96-225TITLE:Hydrogen Fuel Cell for Powering Aviation Support Equipment.

N96-226TITLE:Fuel Bladder Cell Failure Identification

N96-227TITLE:Determine the State of State of Stress in Non-Ferromagnetic Metals and Composite Structures.

N96-228TITLE:Comprehensive Electrical Evaluation of Polyalphaolefin Dielectric Coolant

N96-229TITLE:Open Systems to Legacy Systems Communications Bridge

N96-230TITLE:Design Assistant for Application of System Identification and Adaptive Control to Aircraft Flight Systems

N96-231TITLE:Image Generator Frame to Frame Update Post Processor

N96-232TITLE:Enhanced/Operator Machine Interface

N96-233TITLE:Trade-Off Techniques for Training Using Multimedia

N96-234TITLE:Improved Missile Positioning, Attitude Sensing and Targeting (IMPAST) Using the Global Positioning System (GPS)

N96-235TITLE:Optimal Resource Allocation in a Distributed Computing Environment.

N96-236TITLE:Enhanced Target Movement Prediction.

N96-237TITLE:Object Recognition and Tracking at Video Rates

N96-238TITLE:More Effective Employment of Precision Guided Missiles (PGMs) with the inclusion of Weather Data

N96-239TITLE:New Polymeric Material for Propulsion Systems

N96-240TITLE:GPS Based Formation Control

N96-241TITLE:Interdigital Deposition of Highly Conducting Polymers for Electrochromic Window Application

N96-242TITLE:Ability to Predict Scene Based Algorithm/System Performance

N96-243TITLE:Improve Thermal Shock Resistance of Sapphire

N96-244TITLE:Nanometer Metal Powder Production

SPACE and NAVAL WARFARE SYSTEMS COMMAND

N96-245TITLE:UHF-SHF Flat Panel (Planar) Antenna Arrays

N96-246TITLE:Electro-Optics Window for Shipboard Application

N96-247TITLE:Enchanced Infrared Images of Pop-up Targets

N96-248TITLE:All-Software Global Positioning System (GPS) Receiver

N96-249TITLE:High Resolution Time-Frequency Representations

N96-250TITLE:Automatic Feature Combined Track-Detect-Localize Technique

N96-251TITLE:Passive Acoustic Transient Detection and Analysis of Mine Operations

N96-252TITLE:Development of Performance and Traffic Adaptive Management Tool for High Performance Communications Networks

N96-253TITLE:Requirements Management Assistant

N96-254TITLE:Image Information Preserving Compression for LOFARGRAMs

N96-255TITLE:Image Compression for LOFARGRAMs

N96-256TITLE:A Mission Planning Trainer Module for IUSS Deployable Systems

N96-257TITLE:Adaptive Beamforming for Littoral Waters

N96-258TITLE:Robust Coding Scheme for Satellites (ROCSS)

N96-259TITLE:Dynamic Selection of Reallocated Timeslots

NAVAL SEA SYSTEMS COMMAND

N96-260TITLE:Virtual Prototyping

N96-261TITLE:Oceanic Environmental Control

N96-262TITLE:Advanced Technology Information Interconnectivity

N96-263TITLE:Fast Room Temperature Cure Adhesives for Fiber Optic Connectors

N96-264TITLE:Develop Techniques for Use of Open System Architectures for Commercial Off-the-Shelf-Components

N96-265TITLE:Three Dimensional Target Location from Video Images

N96-266TITLE:Develop Uplink Channels Within Military GPS Receivers

N96-267TITLE:Electronically Stabilized and Deblurred Camera

N96-268TITLE:Innovative Gun, Chamber, Breech Designs

N96-269TITLE:Very Low Structure Borne Noise Unit Enclosure for COTS Modules

N96-270TITLE:Generic Electronic Card Chassis & Power Supply Enclosure

N96-271TITLE:Core Based ASIC Signal Processor

N96-272TITLE:Expanded Data Link Throughput for Submarines

N96-273TITLE:Interactive Acoustic Analysis Processor

N96-274TITLE:Signal Processing Platform-Independent Code Generation from Software Specifications

N96-275TITLE:Mine Localization and Registration

N96-276TITLE:Plastic/Elastomeric Sensor Outer Heads/Housings

N96-277TITLE:Advanced Spatial Filtering

N96-278TITLE:Technology Infusion Methodology for COTS-based Systems

N96-279TITLE:Low Light Level Color Imaging with Image Processing (readvertised)

N96-280TITLE:Integrated Fuzzy Control Systems for Missiles

N96-281TITLE:A High Doppler IR Target

N96-282TITLE:Electronic Support (ES)-Radar Track Correlation

N96-283TITLE:Thin Cell Thermal Battery

N96-284TITLE:Advanced Hot Gas Valve and Manifold Technologies for Shipboard Missiles

N96-285TITLE:Smart Sensor Technology for Sonar Systems

N96-286TITLE:Innovative Broadband Transducer Technologies

N96-287TITLE:Passive Processing Technology

N96-288TITLE:Improved Undersea Towing Cable

N96-289TITLE:Affordable, Low Energy, Nanoscale Transistorless Static RAM

DEPARTMENT of NAVY
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SUBJECT/WORD INDEX

SUBJECT/WORD TOPIC No.

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM
96.2 SOLICITATION TOPIC DESCRIPTIONS

OFFICE of NAVAL RESEARCH

N96-144TITLE: Engineering Technologies for Large Complex Systems

OBJECTIVE: The objective of this topic is to improve the capability to develop and assess complex computer-based systems. Specifically, this topic relates to the description of methods, processes, and development product models and tools required to engineer large complex systems.

DESCRIPTION: Technologies to be investigated include, but are not limited to (1) process modeling, (2) virtual prototyping, and (3) simulation.

Process modeling technology is a topic of active research in the software engineering community. However, the engineering of complex computer systems places additional requirements on process modeling technology. Among the additional requirements are: timely feedback across disciplines and organizational boundaries; evolutionary requirements and open interfaces to accommodate new requirements and technology options; integration of heterogeneous tools as well as legacy systems and data bases; representation of the complex systems engineering process at multiple levels of abstraction and from multiple perspectives. Innovative approaches are sought to extend existing process modeling technology to address the real needs of complex computer systems.

Advances in computer simulation and visualization technology provide a unique opportunity to develop Virtual Prototyping technology for the engineering of complex computer systems. In the context of system engineering, Virtual Prototyping refers to the application of Virtual Reality (VR) technology to systems engineering activities. The vision is to be able to create and exercise prototypes that engage developers and users via visualization and sensory immersion. Such prototypes must be a faithful representation of the system under development and allow decisions to be made regarding development alternatives and tradeoffs. Areas which show promise relate to activities associated with the general area of "system evaluation and assessment."

The ability to synthesize evaluation results from various domains (e.g., functional and implementation) and to trade-off between multiple candidate design options such that key design issues within the context of the overall system design is crucial. Simulation techniques have been effectively used in assessing system designs. However, simulation models today are very expensive to build. With the existence of requirement and design data repositories, it is important to have the ability to automatically or semi-automatically generate different executable computer models.

PHASE I: Define a simulation based design concept, virtual prototype, and/or process model that supports the design and development of complex, computer based systems. Demonstrate the feasibility of the concept through prototype analysis of a sample Navy problem.

PHASE II: Develop an automated toolset that supports the simulation based design concept, process model, and/or virtual prototype and demonstrate its capabilities.

PHASE III: Transition methods and tools into standalone product applicable to current Navy development programs. Commercialize.

COMMERCIAL POTENTIAL: Applicable to large-sized, complex, computer based system including banking, traffic control, and communication, and military systems.

REFERENCES:
1. Curtis, B., Kellner, M. I., and Over, J., Process Modeling, Communications of the ACM, vol. 35, no. 9, pp. 7590, September 1992.
2. N. Karangelen and N. Hoang, "Simulation Based Design for Large
Complex Computer Based Systems", Pro. Systems Engineering of Computer-Based Systems Workshop, IEEE Computer Society Press, Los Alamitos, CA, 1994, pp 116-123

3. Jons, Otto P.,J. Christopher Ryan, and Gary W. Jones, “Using Virtual Environments in the Design of Ships,” Naval Engineers Journal, May 1994.

N96-145TITLE: System Engineering of Human Resources and Cognitive Task Analysis in Complex Navy Systems

OBJECTIVE: The objective of this topic is to obtain systems-engineering methods and tools to improve human integration and human-machine function allocation in complex systems. This research will also assist in the assessment of the human roles in the operation of Navy's ship systems. The developed method(s) and toolset are used to identify the system's functions that can be automated and the trade-off between man and machine in term of performance as well as cost. The method must also addresses the effect of the manning reduction in the organization structure.

DESCRIPTION: Naval ship systems, including surface ships and submarines, are normally operated and maintained by large group of crew members. Facing the new challenges, the fluctuation and non-determinism of the operational environment, and the reduction in defense budget, Navy's ships must be cost effective and perform better to cope with multiple unexpected scenarios and changing environments. Automation of human functions on ships must be carefully planned and evaluated throughout the design process and should provide optimal use of the total system. Method(s) defined within this research should show a system engineering approach where human operator is a part of the basic and implementation design. The method(s) must provide the capability to represent a wide range of human resources (from an individual operator to a complex organization structure), to characterize the human resources in a format that can support various type of analysis, and must address different evaluation techniques to assess the human role in the operation of the total ship. The methods should explicitly integrate the human, hardware, and software elements operating in dynamic and uncertain environments. Complexity can be optimized and integration between the human and other system elements can be improved by analyzing the cognitive demands, making appropriate design adjustments early in the design process, and by establishing design methods to address human operators and decision makers as adaptive elements in operational system designs. Tools should incorporate biologically motivated measures of cognitive complexity and help designers assess the difficulty of system learning, predict performance changes under stress, and modify the design accordingly.

PHASE I: Develop a model to derive complexity measures from task descriptions, and formulate design recommendations to mitigate the complexity by optimizing interface layout and providing support in interface navigation and action planning. Validate the model with respect to a significant Navy system.

PHASE II: Using the model and validation results from Phase I, develop a prototype systems-engineering aid for cognitive task analysis and complexity measurement. Phase II work should include the full scale development of an automated tool. Usefulness of the methods and tool should be demonstrated on a sample test case to facilitate the transition of the work into Navy systems. The initial methodology report should be updated to incorporate the lessons learned during the development of the tool.

PHASE III: Apply tools developed to improve the design of a Navy System by assessing the difficulty of system learning and foreseeing the impact of stress on performance.

COMMERCIAL POTENTIAL: The largest market for this technology would be the designers of complex consumer products and industrial systems, such as transportation, telecommunication networks, process plants, and power stations. Application of the tools in the design process entails the ease-of-use and other advantages with respect to the competing products of similar functionality.

REFERENCES:
1. Yufik & Sheridan, 1995. "Assessment of cognitive complexity: Helping people to steer complex systems through uncertain and critical tasks." NASA Ames Research Center, Final Report NAS2-1370.
2. Karangelen, N., Hoang, N., Howell, S., "Representing System Resources in Design and Analysis of Complex System," Proc. Energy-Sources Technology Conference and Exhibition, Software Systems in Engineering Track, Jan 1994.

N96-146TITLE: Vertical-Cavity Surface-Emitting Laser

OBJECTIVE: To produce an efficient vertical-cavity surface-emitting laser (VCSEL) that will operate in a spatially stable, single frequency mode.

DESCRIPTION: VCSELs have shown great promise as low cost singlefrequency sources for communications and spectroscopy. This is due to the inherent single longitudinal mode that exists in a short cavity VCSEL. Multiple lateral modes have resulted in more than a single frequency during operation of the devices. Currently, single-frequency devices can be made using techniques such as optical apertures on implanted structures. Many of these single-frequency devices rely on large optical losses, that result in single-frequency devices that have reduced efficiencies. Other methods rely on thermal lensing to define the optical mode, and this results in a bias dependent beam waist. For applications requiring external optics for the collimation of the light from the laser, it is preferable to have a well defined optical mode. The purpose of the investigation is therefore to produce highly-efficient VCSELs that operate in a single frequency with a spatially stable mode.

PHASE I: Demonstrate the fundamental technologies necessary to produce efficient, single frequency VCSELs. Design efficient, spatially stable, single-frequency VCSELs and show how the design improvements can be used for visible and IR VCSELs.

PHASE II: Produce single frequency VCSELs and demonstrate the single frequency and the stability of the optical mode under dynamically varying operating conditions, such as temperature and large signal modulation. This should be performed using at least two different material systems, demonstrating VCSELs operating at different frequencies.

PHASE III: Develop reliable single frequency VCSEL arrays applicable for laser printers and fiber communication systems.

COMMERCIAL POTENTIAL: Single frequency VCSEL arrays that operate with a stable optical mode will be used in the next generation of high performance laser printers. The devices are also applicable for low cost environmental spectroscopy and single-mode fiber communication systems.

REFERENCE: F.M. Peters, G.D. Robinson, M.G. Peters, D.B. Young, and L.A. Coldren, "Small Electrically Pumped Index-Guided Vertical Cavity Lasers," IEE Photonics Tech. Letters, 6, (10), 1176-1181 (October 1994).

N96-147TITLE: Dielectric Materials for Use with Wide Bandgap Semiconductors

OBJECTIVE: Develop new high temperature, high dielectric-strength insulating materials for use with wide bandgap semiconductor materials.

DESCRIPTION: New approaches have shown that wide bandgap (e.g., > 2 eV) semiconductors exhibiting significant improvements in thermal conductivity, dielectric strength, and charge carrier velocity may now be synthesized with purities approaching that in silicon. New insulating materials are sought for use as gate and field dielectrics in devices employing these wide band gap semiconductors in order to enable optimal device performance that will greatly exceed that of currently used silicon-based power devices. The full realization of this potential requires the development of new higher performance dielectrics that are more robust and can operate at higher temperature than silicon dioxide.

PHASE I: Demonstrate an insulating layer which when used as a passivating gate-dielectric with SiC or GaN permits the control of at least a factor of two more charge in the underlying semiconductor at the same value of gate voltage than would be possible with silicon dioxide as the gate insulator.

PHASE II: Demonstrate improved performance of the new dielectric over silicon dioxide in a wide-bandgap device operating at least 400C.

PHASE III: Demonstrate a power switching device (fabricated from the new dielectric and SiC or GaN) exhibiting at least 10 times the power handling capacity of a Si device of the same dimensions which will support the Navy's Power Electronics Building Blocks Program.

COMMERCIALIZATION POTENTIAL: New systems using this technology will handle power more efficiently, thereby wasting less power and lowering pollution. This capability will enable several new systems advances including replacement of vacuum tube microwave amplifiers with solid-state components, replacement of fire-prone hydraulic systems in aircraft with electrically actuated systems (more-electric aircraft), and all-electric vehicles.

REFERENCES:
1. Matus, L. G., Powell, J. A., and Salupo, C. S.,¢High Voltage 6H-SiC p-n Junction Diodes¢, Appl. Phys. Lett. 59, pp.1770-2 (1991)
2. B. J. Baliga, "New Materials beyond Silicon for Power Devices"
in "Power Semiconductor Devices and Circuits", Ed. by A. A. Jaecklin, Plenum Press, New York, pp. 377-388, (1992).

N96-148TITLE: Photonic Technology for RF, Microwave, and mmW Antennas

OBJECTIVE: Develop photonic technology and optoelectronic systems that enable future Navy C3I systems based on multi-function antenna systems.

DESCRIPTION: The effective utilization of photonic technology and systems provides the DOD with new options for the cost-effective implementation of multi-function RF/Microwave/millimeter wave antennas (MFA). Future MFA systems will need to operate over multiple radar/communications bands, be able to accommodate wide instantaneous signal bandwidths and be able to simultaneously form multiple frequency independent beams. Platform constraints will generally limit the size, weight and distribution of the antenna feed network and beam forming processor. Realization of this capability provides opportunities for a variety of innovative applications of photonic technology and system concepts. Examples of relevant topics include, but are not limited to the following: photonically controlled antenna elements, reconfigurable antennas, adaptive beam forming, optical fiber links, and related devices and components such as rapidly tunable lasers and spectral filters, wideband modulators, etc. Proposals that exploit the speed/bandwidth of photonic technology or the inherent parallelism of optoelectronic processors, and address component, device or systems issues relevant to MFA, as described above, will be considered.

PHASE I: Investigation of proposed concept; identification of innovation and discussion of technical issues. If necessary, a laboratory demonstration proving feasibility of concept or resolution of controversial issue.

PHASE II: Design of prototype; demonstration of concept with prototype system; discussion of all relevant performance issues and production or manufacturing issues;

PHASE III: Evaluation, modification and optimization of prototype within context of a Navy operational environment as provided by a suitable Navy System Command or Navy laboratory. Funding to be obtained by proposer from non-SBIR government funds or from commercial sponsors.

COMMERCIAL POTENTIAL: The wideband technology components and systems developed for this program have numerous dual-use commercial opportunities within the high-speed telecommunications, satellite communications and digital multimedia distribution markets.

REFERENCES:
1. IEEE Transactions on Microwave Theory and Techniques, Vol. 43, No. 9, (Special Issue on Microwave and Millimeter Wave Photonics), September 95.
2. IEEE Transactions on Antennas and Propagation, Vol. 43, No. 9, (Special Issue on Packaging Technologies for Phased Array Applications), September 95.
3. Optical Techniques on Microwave Applications VIII, SPIE Vol. 2560, 11-12 July 95, San Diego, CA
4. Proceedings of Photonic Systems for Antenna Applications, (ARPA Symposium), 18-20 Jan 95, Naval Postgraduate School, Monterey, CA.
5. Optoelectronic Signal Processing for Phased-Array Antennas IV, SPIE Vol. 2155, 26-27 January, Los Angeles CA.
6. Symposium on Optical Microwave Systems using Fiber Optics, 1994 Technical Digest Series, OFC 94, Vol. 4, Optical Society of America.

N96-149TITLE: Ultra-High Isolation Circulator/Duplexer for Surveillance and Communication

OBJECTIVE: The objective of this effort is to develop the best approach to obtain more than 75 Db of isolation in a UHF (200 to 400 Mhz) M port circulator/duplexer. Other performance criteria include low insertion loss (3 Db) and 60 dBm peak power handling capability for transmit and receive applications.

DESCRIPTION: The Navy has constraints in its ability to add new antenna systems to its ships due to the proliferation of antennas currently adorning their topside real estate. One solution to this problem is to combine shipboard systems to utilize a single antenna aperture thereby reducing the number of antennas required and making space available for new ones. To do this Ultra-High Isolation Circulators/Duplexers, exceeding 120 Db, need to be available to achieve the required isolation between transmit and receive functions as well as between systems. This problem is currently referred to as Electromagnetic Interference (EMI) and our goal is to obtain Electromagnetic Compatibility (EMC) between collocated systems.

PHASE I: This part of the investigation will entail defining the problem and assessing the current state of isolator technology in Active (solid state), Passive (ferrite), and Emerging (cancellation) technologies that will lead to solutions. Further, an initial design and demonstration of the isolation properties of the successful approach, and a prototype design of a three port Ultra-High Isolation Circulator/Duplexer, should be addressed.

PHASE II: This part of the investigation will entail transitioning the successful isolation technology to a two-port isolator, a three port circulator, and an M port circulator which meet the program specifications and packaging requirements for both Military and Commercial applications.

PHASE III: The successful devices from Phase II will be transitioned into a Navy Advanced Technology Demonstration.

COMMERCIAL POTENTIAL: The commercial sector will make use of ultra-high isolation circulators in the automobile and communications industries. A specific example of an application would be to combine functions such as global positioning, personal (cellular) communications, and intelligent vehicle highway system functions into a single wideband aperture mounted on/in the roof of a vehicle. These systems will be coming to automobiles by the year 2000 and the need for this technology to be identified in order to obtain the required system performance.

REFERENCES: Lockhart, Douglas K., Microwave Circulator Design, Artech House, Norwood MA; ISBN/ISSN: 089006329X; LCCN: 89-6550; OCLC: 19456097

N96-150TITLE: Four Dimensional (4-D) Atmospheric and Oceanographic Instrumentation

OBJECTIVE: Develop low-weight and small-volume systems to autonomously measure atmospheric and/or oceanographic parameters.

DESCRIPTION: Innovative sensors and measurement techniques are solicited to obtain marine atmospheric and oceanographic variables (e.g., physical, chemical, optical, geophysical, biological and acoustic) in 3-D space and time. The emphasis must be placed on (1) novel approaches and concepts for measuring a particular parameter(s) coherently in 4-D; (2) conducting these observations as autonomously as possible; i.e., for independent operation on Remotely Piloted Aircraft (RPA), Unmanned Under Vehicles (UUVs), or Buoys; and (3) provide a significant reduction in instrument weight and volume without reducing fidelity or resolution as compared to current state-of-the-art systems. The instruments solicited can utilize either active and/or passive measurement approaches. Full column depth capabilities are desired in instrumentation planned for subsurface use. Proposals can focus on one or more of the following Top level needs:

1. Measure atmospheric turbulence to resolutions of a few centimeters a second utilizing a GPS based approach;
2. Measure water vapor (in and out of cloud) to provide high fidelity and resolution measurements;
3. Obtain vertical profiles of ocean current, temperature, salinity, and sound velocity throughout the water column on scales of the order of 1 meter per second;
4. Measure temperature, salinity, pressure in the water column with resolution adequate to address issues of microscale mixing and ocean turbulence;

5. Measure upward and downward solar and terrestrial broad band radiation to include important windows and absorption wavelength bands to quantify the presence and radiative impact of aerosols, water vapor (measure the vertical and horizontal variability), and ozone;
6. Measure aerosol spatial distributions with an eye safe airborne lidar;
7. Measure cloud properties to provide high fidelity and resolution of extension parameters and cloud physics (covering the widest possible droplet size distributions);
8. Measure small scale turbulent fluxes of heat mass and momentum through out the water column;
9. Measure the acoustic properties of the water column, surface and bottom boundary layers, and the bottom sediments; and/or
10. Improve accuracy and precision of underwater navigation.

PHASE I: Provide both an exact description of the parameter to be measured include accuracy and coherence along with the design concept for achieving the measurement.

PHASE II: Produce a viable system and demonstrate it's ability to support in field measurements from an operating autonomous research vehicle.

PHASE III: Transition the technology to scientists in the atmospheric, oceanographic and environmental monitoring research communities, and operational DOD systems.

COMMERCIAL POTENTIAL: New instruments can be used in commercial environmental monitoring systems.

N96-151TITLE: Radar and Electro-optical Analysis Tool

OBJECTIVE: Develop a system to enable calculation of electro-magnetic (EM) and electro-optical (EO) sensor system performance characteristics.

DESCRIPTION: Innovative techniques are solicited to develop a work-station based analysis tool to facilitate analysis of CW, pulsed Doppler, coherent pulsed, and non-coherent pulsed radar's. The system shall calculate basic radar performance characteristics; plot vertical coverage diagrams; calculate beamwidths, sidelobe levels and beam patterns for parabolic phased (periodic and aperiodic) and frequency steered array antennas; calculate moving target indicator (MTI) response curves; and calculate and plot ambiguity functions. The system shall include environmental effects such as rain, fog and ducting conditions on radar signal propagation. It will also include the effects of signal degradation due to electronic means and physical jamming such as the release of chaff and aerosols. In addition, the system will accept input of antenna edge taper or more precise antenna calculations.

The system shall also include electro-optical systems analysis capability. It will determine the maximum range at which an input electro-optical system would be able to detect a verity of ship and aircraft targets in different environments and with various backgrounds. The model must work over a spectrum from approximately .01 to 14 microns and should contain modules for targets, atmospherics, various backgrounds, and electro-optical system characteristics.

The primary objective for the EM/EO analysis tool is to support a general assessment of sensor systems where some specific system characteristics maybe unknown. The analysis tool shall facilitate the determination of sensor performance through utilization of fast modeling runs that allow for quick variation in sensor characteristics and performance (some sensor compotes may be parametrized). Each model run should cover a specific spectrum of parametrized environmental, ECM and target and background characteristics. Modeling results require only a basic out-put of sensor performance to allow the assessment of system trends or variation in the threshold of detection based on component performance. Utilization of existing models or algorithms is strongly supported.

PHASE I: Establish the framework for implementation of this effort, establish the criteria and methodologies that will be used, and document and describe, in detail, how the system will be designed and implemented.

PHASE II: Develop a system and validate by test and evaluation using novice and experienced EM/EO system analysts and engineers. The system must be user friendly, have clearly defined fields and be able to provide an output with limited input detail. The system will provide measurements of error based on accuracy of the input values. Deliver and demonstrate the final product with detailed manuals.

PHASE III: The EM/EO model solicited here is likely to transition to DoD users of EM/EO analysis tools for system assessments. Variations of the model developed could support intelligence, engineering, and tactical assessments of various EM/EO systems configurations in varying environments.

COMMERCIAL POTENTIAL: EM/EO analysis tool could support cost to performance analysis of developmental sensor systems to aid in early system engineering decision making. Radar and EO designers and users will find this system as a useful analysis tool.

REFERENCES:

1. Blake, L.V., "A Guide to Basic Pulse-Radar Maximum Range Calculation," Part 2, NRL Report 7010, December 1969
2. Blake, L.V.,"A Fortran Computer Program to Calculate the Range of a Pulse Radar," NRL Report 7448, August 1972
3. Fielding, J.E., and Reynolds, G.D., "VCCALC: Vertical Coverage Calculation Software and User's Manual," Artech House, 1988; and
4. White Paper: Radar Analysis Workstation, Radian Corporation.

N96-152TITLE: Low-Cost, Covert, Moored Environmental Monitoring Package

OBJECTIVE: The objective is the development of a practical, low cost, self-deploying fixed environmental monitoring system for shallow water which is not readily detectable during or after deployment and which returns data in a covert or low profile manner.

DESCRIPTION: Fixed sensor packages are required to allow covert monitoring of environmental conditions in hostile or denied littoral regions to aid Naval Special Warfare, Amphibious Warfare, Mine Warfare and Mine Counter Measures, and Antisubmarine Warfare. These packages must be delivered in a covert or very low profile fashion, must not be readily detected while collecting data, must remain in a fixed, known location during collection, and must be able to return their data surreptitiously with little or no human intervention. Recovery must not be necessary. Desired environmental parameters include: temperature, sound speed, optical profiles, sea state/wave conditions, tidal parameters, ambient noise, current profiles. (Not all need be implemented on one unit.)

PHASE I: Prepare a detailed hardware, software, and communications concept, demonstrate the feasibility of the concept through assessment of the current maturity of necessary technologies and identification of critical issues and likely solution approaches, identify the work necessary for a Phase II effort necessary to demonstrate the concept, and increase the likelihood of a Phase III transition through exploration of dual use potential.

PHASE II: At the end of a two year effort, fabricate and demonstrate several working prototypes that could be used as reliable instrumentation by other basic and exploratory development programs. The hardware, software and communications concepts should have been developed and demonstrated completely enough to transition to an active advanced development program, to become the basis for an operational requirement, and to be commercialized for private sector use. Deliver prototype units to Naval Research Laboratory for use in its Coastal Ocean Sensing and Data Fusion project.

PHASE III: Transition to advanced development, and commercialization as a low cost, low profile coastal oceanographic/water quality measurement system to areas of high shipping/boating traffic and other human activity.

COMMERCIAL POTENTIAL: Measurement of oceanographic and water quality parameters in coastal areas is hindered by high levels of human activity resulting in damage to and loss of expensive instrumentation. This system would be low profile enough that damage and theft would be minimized and low cost enough that loss would not be as economically serious as with present systems.

N96-153TITLE: Acoustic Clutter Discrimination and Classification

OBJECTIVE: Develop discrimination techniques and methodologies to distinguish and classify bottom clutter and false targets from high resolution acoustic sonar systems as either natural (or environmental) or man-made objects on or near the bottom.

DESCRIPTION: High resolution acoustic sonars are being developed for Mine Countermeasures (MCM) with dramatic improvements in sonar signal and image quality and image resolution[1]. This requires equal increases in sonar signal processing and tends to increase the operator's workload. Clutter suppression is typically accomplished through averaging and thresholding so that low level peaks are not seen by the detection processor, thereby greatly reducing processing time and operator workload. However, thresholding is often indiscriminate when applied to a characteristic, such as received level and may eliminate a weak but desired signal. Clutter can both prevent mine detection as well as cause false targets that waste MCM resources. Clutter discrimination uses signal and image processing techniques to identify and classify clutter both before and after the detection processor. Clutter discriminators can be developed from various mathematical transforms as well as from existing statistical, fractal, chaotic, and texture theories. Discrimination provide a mechanism for distinguishing clutter and separating it into different classes. Clutter discriminators offer the possibility of finding mines within the clutter that would fall below the threshold of clutter suppression techniques and for determining adaptive thresholds for clutter suppression. They can be used on a ping-to-ping basis or in multiping correlation. Automated classification and discrimination of high resolution sonar clutter should reduce operator workload, reduce false target prosecution, and increase detection in highly reverberant environments.

Phase I. Explore methodologies and techniques from radar, medical, satellite, and side-scan signal and image processing that may be applied to high resolution acoustic sonar in order to characterize and classify clutter as natural (or environmental) vs man-made.

Phase II. Perform a trade off analysis of selected methodologies and techniques with existing high resolution signal returns and imagery including hardware requirements and computer workload.

Phase III. Implement and test clutter discrimination on a real-time high resolution sonar system.

COMMERCIAL POTENTIAL: This technology would have wide commercial application in the field of undersea mapping and charting as well as environmental assessments and cleanup in bays, lakes, and estuaries, mapping navigational hazards in commercial shipping lanes, and in oil and gas drilling operations and pipeline maintenance.

REFERENCES:
1. Ramsdale, Dan J., J. Stephen Stanic, Edgar T. Kennedy and Roger W. Meredith, "High Frequency Environmental Acoustics Research for Mine Countermeasures," Proceedings of the Symposium on Autonomous Vehicles and Mine Countermeasures, 4-7 April 1995.
2. Daniel F. Lott and Roger W. Meredith, "Mine Countermeasures Sonar Performance Models: Survey Results and Environmental Issues," SACLANTCEN Programme of Work.

N96-154TITLE: Fuel Cells for Underwater Vehicle Propulsion

OBJECTIVE: Demonstrate the performance capability of fuel cells for underwater vehicle use.

DESCRIPTION: The silver oxide/zinc (AgO/Zn) battery is the Navy's workhorse power supply for driving a number of its underwater vehicles, like Swimmer Delivery Vehicles, Deep Submergence Rescue Vehicles, torpedoes and torpedo targets. For such use, AgO/Zn offers the highest energy density of any commercially available, high power rechargeable battery. However this energy density is still insufficient to power the run times needed by future vehicles. A hydrogen/oxygen fuel cell has over six times the theoretical energy density of AgO/Zn (1082 Wh/lb for the fuel cell operating at 0.8 V, versus 176 Wh/lb for Ag/Zn operating at 1.5 V). The object of this SBIR Topic is to bring closer to reality this potentially enormous superiority of fuel cells for increasing the range and speed of underwater vehicles.

PHASE I: Conduct a design analysis of fuel cell power supplies for underwater vehicle propulsion. Evaluate energy and power densities (both gravimetric and volumetric) as a function of the energy content and physical size (including all ancillary components) of the fuel cell. Detailed electrical and physical specifications for the power supplies of several targeted underwater vehicles will be provided, after contract award. The vehicles are cylindrically shaped and cover a size range (diameter x length) of from 18" x 81" to 4' x 20'.

PHASE II: Bench top demonstration of optimum fuel cell chemistry.

PHASE III: Application of scaled up in a vehicle demonstration.

COMMERCIAL POTENTIAL: Electric vehicles for civilian use.

N96-155TITLE: Thin Film Thermoelectric Device Science & Technology

OBJECTIVE: The goal of this program is to develop thin film based thermoelectric devices and evaluate their potential for large area cooling or power generation.

DESCRIPTION: Thermoelectric (TE) materials offer a huge potential for a variety of heating and cooling applications. Current manufacturing techniques are based on the assembly of bulk TE modules. This topic seeks a new approach to the fabrication of TE devices based on thin film techniques. This is particularly important as advances in material performance (ZT) are likely to include superlattice engineering. The ability to fabricate functional thin film TE devices for a wide range of heating or cooling application is required. Navy cooling requirements can range from a few W (cooling electronic components) to Kw (shipboard AC) depending on application. In addition thermoelectric devices could be exploited for exhaust heat recovery for power generation from a number of Navy systems. Thin film TE technology offers the potential for low cost, light weight, high COP heating or cooling systems. However, the range of applications over which the thin film based technology is viable and the science & technology needed to prepare such devices requires further development and is the subject of this topic. Either physical or chemical deposition methods are envisioned for the fabrication of the thin film devices. Basic issues related to thin film deposition will be explored (i.e. substrate compatibility, growth temperatures, growth rates, etc.). Processes compatible with current semiconductor processing methods are desirable.

PHASE I: Phase I will develop a demonstration of a thin film based thermoelectric device and will develop models for incorporating these thin film devices into systems with specific cooling or power generation capabilities. Modeling of the TE devices will be an integral part of phase 1. The models developed in phase one will define limits to the cooling/heating output of these devices from a total system point of view and will provide designs to exploit the thin film devices for obtaining the highest cooling capacity or power generation capacity that is realistic.

PHASE II: This aspect of the program will focus on the details of making TE thin devices a viable commercial technology. Thin film growth efforts will address large area deposition and property/materials uniformity. Optimization of the deposition technique will be addressed. Appropriate device manufacturing issues will be addressed in phase II which include development of etching and masking technologies, device isolation, metallization (with specific emphasis on contact resistance issues), multi-staging, and heat sink integration. Modeling studies will focus on the details of employing large arrays of thin film

TE devices for large scale applications. Integration of thin film arrays into an overall heating or cooling system will be of specific interest.

PHASE III: A prototype fabrication system will be designed for producing thin film devices on a large scale. factors associated with production cost and scale-up will be studied. Specific system designs for cooling or power generation will be available for a variety of heating and cooling applications.

COMMERCIAL POTENTIAL: The commercial potential of thermoelectric based technologies is enormous. Currently TE technology is a critical component of the recreational cooler industry. Low cost passive cooling techniques are reaching their limits for current consumer electronics. It is anticipated that TE cooling technologies can play a major role in thermal management of microprocessors used in future generation computers, a tremendous market. From a power generation point of view, the ability to harness exhaust heat opens up an entire new set of applications and commercial interests ranging from enhanced automobile fuel economy to auxiliary power systems.

N96-156TITLE: Advanced Polymer Optical Fibers

OBJECTIVE: Develop high performance polymer optical fibers (POFs) that can be used as generic device components in high-bandwidth systems.

DESCRIPTION: Optical fiber is used predominantly for information transmission, with high-bandwidth long-haul communications bing dominated by single-mode glass fiber. For *short-haul* applications, however, graded index polymer optical fibers have many advantages, including low cost, flexibility, and ease in making connectors. With the development of graded index POFs the bandwidth of these materials has exceeded the gigahertz-kilometer range which has significantly increased data transmission capacity. However, commercially available POFs have relatively low service temperatures, typically <80□C. Innovative techniques are sought for the development of both step-index and graded index POFs for high temperature applications. The performance of the developed materials should have comparable or better properties than that of the current commercial POFs. This work will include the technology for fabricating high quality waveguides in device materials, and may include the technology of making waveguiding fiber structures with optically nonlinear materials.

PHASE I: Demonstrate feasibility of the concept to prepare high performance step and graded index POFs. Develop a process to make reliable low loss single mode fiber with both single an dual cores. Characterize waveguiding properties and thermal and environmental stability. Demonstrate methods of coupling light between cores. Construct structures of nonlinear optical materials.

PHASE II: Fabricate materials into optical fibers and characterize properties. Build a prototype linear device such as a 3dB splitter in a single mode fiber with connectors. Demonstrate coupling to a single mode glass fiver and demonstrate thermal and environmental stability. Investigate methods of making active devices, such as optical switches.

PHASE III: Demonstrate compatibility of devices in local area network and transfer technology for commercialization. Demonstrate thermal and environmental stability in the working environment, e.g., simulated shipboard and air environments.

COMMERCIAL POTENTIAL: High temperature POFs will find a large market section in data communication systems in aircraft, ships and automobiles. Coupler devices can be used in local area networks, fiber to the home, computer data links, and connections between communications systems.

N96-157TITLE: Flame Resistant Organic Composites

OBJECTIVE: To demonstrate structural organic composites with flame-hardened matrices.

DESCRIPTION: Currently, composites with organic matrices can not be applied in high temperature environments, and burn with the production of large quantities of smoke and toxic gases. There is a need for materials with elevated operating temperatures and with matrices which are difficult to ignite or are self-extinguishing, once ignited. New matrix or sizing chemistries to promote such behavior are required.

PHASE I: Demonstrate flame hardness or self-extinguishing capacity of organic matrices suitable for use in fiber-reinforced composites.

PHASE II: Scale-up matrix synthesis capability to produce quantities sufficient for processing fiber-reinforced composites. Produce sufficient quantities of composites for preliminary mechanical characterization.

PHASE III: Pilot-plant operation for production of flame-hardened organic composites.

COMMERCIAL POTENTIAL: Private sector applications will include safer materials for air and maritime transportation.

N96-158TITLE: Alternative Curing Technology For Composites and Adhesive Bond Processing

OBJECTIVE: Develop Microwave/RF heating techniques for the processing of thermoplastic composites and adhesive bonds.

DESCRIPTION: One of the problems in applying thermoplastic composites and adhesive bonding technologies is the high temperatures required for processing and the issues with equipment and processing materials that is inherently related to this problem. One concept to eliminate these issues is the use of directed energy to heat only the polymer in the composite or the bondline. This would eliminate the need for high temperature bagging materials and sealants, high temperature tooling and processing equipment, and allow thermoplastic bonding to be used for low temperature substrates. This bonding could be accomplished through the use of microwave or RF energy, Many thermoplastics are inherently receptors for these types of energy and others can be compounded with receptors. In the case of adhesive bonding, just the bondline would be heated allowing thermoplastic bonding to be used on epoxy composite, aluminum bonds, or repairs. Further the bond could be easily be reheated and removed if desired thus providing a bond with the advantage of mechanical fastening.

PHASE I: Demonstrate the feasibility and physics understanding of various tuned frequency energies for consolidating thermoplastic composite laminates and for bonded panels.

PHASE II: Develop and demonstrate the capability to fabricate complex composite parts and bonded structures.

PHASE III: The successful products of this effort will transition to support of McDonnell Douglas aircraft programs and Navy aircraft repair activities.

COMMERCIAL POTENTIAL: Current efforts involve development of thermoplastic composites for rehabilitation equipment and devices (such as prosthetics, braces, wheelchairs, and lifting devices. Recreational products such as commercial aircraft, automotive, and mass transit have potential use for thermoplastics and bonding techniques

N96-159TITLE: Improved method for the production of difluoramine energetics

OBJECTIVE: Development of an improved method for the introduction of the gem-difluoramine group in the synthesis of oxidizers that will contain difluoramine and nitramine groups.

DESCRIPTION: Oxidizers that contain mixed difluoramine and nitramine functionality are calculated to give significant performance enhancement as components in propellant and explosive applications. The current synthesis methods involve the use of harsh acid conditions and the generation of the very hazardous difluoramine gas. Alternate synthetic methods must be found for gem-difluoramine materials in order to exploit their use in energetic applications.

PHASE I: Exploration of new routes to gem-difluoramine compounds in gram quantities. Emphasis should be on synthetic methods that are safe and capable of being transitioned to pound level production. Reagents and conditions should be selective for introduction of the gem-difluoramine in high yield without the use of harsh conditions.

PHASE II: Development of the synthetic routes discovered in Phase I to further refine the processes for their use in multi-pound preparative reactions. The focus will be on achieving a practical and economical process for the production of these materials.

PHASE III: Scale-up the most efficient/safe route to produce quantities (> 100 pounds) that will allow the development and large-scale testing of formulations containing difluoramine compounds.

COMMERCIAL POTENTIAL: High energy propellants for commercial launch vehicles especially when weight and performance requirements are critical (for example, final stage rocket motors).The potential exists also for applications in the field of oil recovery. The industry needs very high performance explosives for the enhanced recovery of oil from mature fields. The process of rock fracturing could be considerably improved by the high metal accelerating ability of the NF2 explosives. The industry has already shown interest in CL-20 for this application, a Navy explosive whose performance is calculated to be less than that of NF2 compounds. The NF2 oxidizers offer the additional capability, in composite formulations with metals, of tailoring the output to maximize fracturing in various rock formations.

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1. Baum, K.; *J. Am. Chem. Soc.* 1968, 90, 7083-7089.
2. Adolph, H. G.; Koppes, W .M.; *Synthesis of Fluoronitro Compounds*; In *Nitro Compounds. Recent Advances in Synthesis and Chemistry*; Feuer, H.; Nielsen, A. T., Eds; VCH Publishers, Inc.: New York, 1990; pp 387-90.
3. Hudlicky, M.; *Chemistry of Organic Fluorine Compounds, 2nd (Revised Edition)*; Ellis Horwood PTR Prentice Hall: New York, 1992; pp 295, 415-16, 441.

N96-160TITLE: Production of Strained Liquid Hydrocarbon Fuels

OBJECTIVE: Develop the methodology to produce large quantities of strained liquid hydrocarbon fuels, namely, substituted quadracyclines, alkyl substituted cubanes, and substituted benzvalenes.

DESCRIPTION: Increasing the range and speed of cruise missiles and ramjets and aircraft is an important Navy need. As increasing the combustion efficiency can provide only marginal increases in these parameters, a more desirable and logical approach is to increase the volumetric energy content of the fuel. An innovative way of obtaining this is to incorporate additional strain energy into the fuel molecules, during synthesis, by straining the molecular bonds, and closely packing the molecules. This project identifies three such classes of fuels indicated above. Primary focus will be on the production of nitro and azido quadracycline, azido dihydro benzvalene, and 1,4-dialkylated cubanes. Attention will be paid to reducing the number of steps in the synthesis process, using cheaper starting materials, using safe synthesis procedures, and ensuring purity.

PHASE I: Produce gram quantities of three target fuels: nitro and azido quadracycline, azido dihydro benzvalene, and 1,4-dialkylated cubanes.

PHASE II: In Phase II, scale-up criteria will be developed, and kilogram quantities of fuels from Phase I will be prepared for evaluation in combustion systems.

PHASE III: Of the fuel which emerges from Phase II as the superior fuel, one hundred to one thousand kilogram quantities will be produced, in the most economical way possible, in collaboration with a chemical manufacturer. (Eastman Chemical Co. has expressed interest).

COMMERCIAL POTENTIAL: Reduced number of steps in the synthesis process, cheaper raw materials, and large-scale production (as envisioned in this program) will lower the cost of the fuel. Because of the increased volumetric energy density of these fuels, the aircraft industry will benefit, particularly for use in long- range aircraft.

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1. H. K. Hall, Jr., C. D. Smith, and J. H. Baldt, "Enthalpies of Formation of Nortricyclene, Norfornene, norbornadiene, and Quadracycline," Journal of the American Chemical Society, Vol. 95, p. 3197, 1972.
2. R. M. Moriarty, S. M. Taladhar, R. Penmasta, and A. K. Awasthi, "The Cubyl Cation," Journal of the American Chemical Society, Vol. 112, P. 3228, 1990.
3. U. Burger, G. Gandillon, and J. Mareda, "The Ring-Closure of Cyclopenta-1,3-diens-5-YL-Carbene into Benzvalene," Helv. Chem. Acta., Vol. 64, P. 844, 1981.

N96-161TITLE: Quiet, Compact, Efficient Variable Ballast (VB) System for Small Undersea Vehicles

OBJECTIVE: To develop a compact, quiet, and energy efficient a variable ballast (VB) system for use in Remotely Operated Vehicles (ROV) and Unmanned Undersea Vehicles (UUV).

DESCRIPTION: Current VB system used in ROVs and UUVs exceed the noise, volume, and energy requirements to meet the goals of future Navy missions. These system use state-of-the-art, high-pressure, positive-displacement pumps and valves. The pumps present a noise source that can not be adequately isolated for the sea within in the volume constraints for these small UUVs and ROVs. These pumps also represent a significant energy drain on long duration missions. The objective of this topic is to develop innovative ways to significantly reduce the pump noise, improve isolation, or totally eliminate the need for a high pressure pump, while simultaneously reducing system volume and energy requirements.

The Navy is seeking new, innovative, high risk/payoff ideas for compact, quiet, efficient VB systems. These ideas may include an innovative concept for entire VB system or innovative ways to reduce the noise, volume, or energy of existing conventional (pumping) VB systems. The ultimate goal is to develop ballast systems which operate to depth pressure in the range of 20-30 atmospheres (600-900 psig) and have differential buoyancy capacity on the order 20 kg. (44 lb.) in a total system volume of less than 85 liters (3.0 cu. ft.). If the system operates by moving seawater in and out of the vehicle it must be able to operate with the seawater inlet port at only 0.5 m (1.64 ft) below sea level.

PHASE I: At the end of a six month effort, work should have demonstrated the feasibility that the system concept can meet the ultimate goals stated above, identified critical subsystems or technologies that must be matured for transition into the Navy's acquisition system, outline the state of current technology maturity, provide evidence that the scientific principles on which the proposal was based are sound and justify further work, and identified the work necessary in Phase II effort to demonstrate the system concept for Navy applications.

PHASE II: At the end of a two year effort, technology or system concepts must have been developed enough to enable critical subsystems or technologies to be transitioned to an advanced technology demonstration or into a higher category of RTD&E, or become the basis of a statement of need and acquisition for systems for a Navy application.

PHASE III: The Navy has identified the top three UUV Missions as mine reconnaissance, improved (long range) mine reconnaissance and surveillance. All of these missions required stealthy UUV systems that will transit through the density gradients between open oceans and littoral waters. These long range mission will also require surfacing for GPS navigational fixes. These requirements dictate the need for a quiet, compact VB system. Such a system will be transitioned to Navy UUV acquisition programs such as the Long Range Mine Reconnaissance System (LMRS) and could potentially support upgrades to the Near Term Mine Reconnaissance System (NMRS).

COMMERCIAL POTENTIAL: ROVs and UUVs are currently used for numerous commercial operations including oceanographic surveys, underwater inspection, and search and salvage operations. Many of these commercial missions require highly maneuverable neutrality buoyant vehicles. More compact and efficient systems are required to make UUVs and ROVs logistically and economically viable for commercial use. Commercially available sonars are becoming more sensitive. To gain the full commercial potential benefits of these sonars it will be required to reduced self-noise signature of the of the UUV and ROV platforms on which they are deployed.

N96-162TITLE: Micro-Actuators and -Sensors based on Terfenol-D Film

OBJECTIVE: Development of adaptive composites magneto-elastic composite micro-sensors and actuators.

DESCRIPTION: Micro-actuators and -sensors utilizing giant magnetostrictive materials alone or in combination with others as thin film bi- or multi-morphs provide a promising basis for smart MEMS. Domain structure engineering may adapt the micro-system to a variety of applications such as high resolution magnetic field vector sensors and variable micro-actuators. Research and development is required to determine the possibilities and limits of domain engineering in giant magnetostrictive films in a variety of environments such as different substrates, modes of adhesion and resulting stresses. Successful development of micro-actuators and -sensors based on giant magnetostrictive materials will lead to novel and inexpensive environmental monitors and actuators for military, such as (flow control) and other non-military applications.

PHASE I: Define the basic concepts of adaptive structures utilizing magnetostrictive composites.

PHASE II: Produce and fully characterize magnetostrictive composites, develop a manufacturing process, fabricate prototypes of select composite micro-sensors and actuators and demonstrate their capabilities.

PHASE III: Demonstration of micro-device compass capabilities, for instance micro-compasses for ground positioning and guidance systems.

POTENTIAL COMMERCIAL MARKET: The micro-sensors have great potential as interactive monitors for magnetic and stress fields. The actuators can be integrated into aircraft meso-structures, ground transportation and engine management systems to enhance their capabilities.

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N96-163TITLE: Nonlinear Dynamics Control of Advanced Electrical Power Systems

OBJECTIVE: Apply advanced mathematical tools to characterize the non-linear, time dependent nature of advanced electrical power system architectures. These tools will be fundamental to the control and management of the next generation submarine electric power systems.

DESCRIPTION: Navy needs of affordability, size reduction, high speed response and robust process control are leading to highly complex, solid state controlled power distribution systems. These systems will be highly non-linear, time, load and environmental dependent networks, with a large number of possible partially independent control points. Mathematics is to be demonstrated to provide efficient transient characteristics to be used for real-time, robust monitoring of central and distributed controls. Develop techniques for apportioning responsibility for control between central and distributed control. These characteristics shall be demonstrated useful in managing the power security of the network to be insensitive to load configurations.

PHASE I: Prove that specific advanced mathematical tools can extract characterizing features of power and control networks that are transient and load dependent.

PHASE II: Design a centralized and distributed controller for advanced power distribution system networks that allows the network to operate at maximum efficiency with energy bounds. Address how to apportion responsibility of centralized and local control.

PHASE III: Develop a software integrated to a hardware demonstration of an advanced solid state power distribution network, exhibit transient and load feature characterization transformers and control apportionment techniques developed in Phase I and Phase II.

COMMERCIAL APPLICATION: Solid State Power Distribution Control in more electric cars, aircraft and factory control systems.

N96-164TITLE: Expert System for Underwater Vehicle Maneuvering Control

OBJECTIVE: Develop a knowledge based expert system to assist in submarine maneuvering and control operations.

DESCRIPTION: Knowledge based expert systems have in some instances been shown to have the capability to replace or assist human operators in controlling complex multi input/multi output systems. A maneuvering underwater vehicle is such a system. Multiple sensors can provide input on vehicle position, velocities, accelerations, environment, ballast, etc. Numerous control effectors are available including propulsor, rudder, control surfaces, thrusters, ballast movement, etc. Numerous operational requirements and constraints can exist; maximum pitch angle, desired track line, maximum roll, desired depth, recovery from various casualties, etc.

PHASE I: Develop and demonstrate an expert system for controlling an underwater vehicle. For a generic vehicle, with assumed but reasonable sensors, effectors, mission requirements and constraints deliver a working expert system prototype.

PHASE II: Develop such a system for a Navy specified vehicle. Include assessments of required sensor accuracy and required control forces to meet operational requirements. Document and deliver source computer code.

PHASE III: Provide the demonstrated system for future vehicles both Navy and commercial.

COMMERCIAL POTENTIAL: Many underwater vehicles both autonomous and remotely controlled could utilize this technology to improve performance.

N96-165TITLE: Low Profile Motion Sensor

OBJECTIVE: Develop a cost effective, low profile, spatially distributed sensor which measures the motion of the surface to which it is attached.

DESCRIPTION: Pressure release coatings are used in the Navy to reduce the target strength and radiated noise on surface and submerged vessels. On a pressure release surface the velocity of an incoming acoustic wave doubles and its pressure goes to zero. Normal pressure sensing hydrophone arrays will not work at such a boundary condition. In order to measure the propagating acoustic field at a pressure release surface, the hydrophones have to be replaced with motion (displacement, velocity or acceleration) sensors. These sensors will be mounted on the pressure release coating and will be covered by a waterproof protective layer of rubber like material. The sensors should measure the motion perpendicular to the surface of the pressure release material and should be insensitive to the motions transverse to that plane. Since the sensor must be placed between the pressure release coating and the outer protective coating it should have minimum height in the direction perpendicular to the surface (less than 1 cm). The sensor should also match the density of the layer in which it is imbedded which is typically about 1.3 times as dense as sea water. In a typical application, the sensor must give the average motion of a square section of the pressure release coating. The averaging area will be related to the s dimensional array whose design frequency will vary according to the particular array application. Since short wavelength noise mechanisms may be present the sensor should either continuously average the motion over that area or spatially sample that area effectively. The sensor should have an electronic noise floor lower than an equivalent output produced by a sea state 0 ambient acoustic field. The final requirement is that the motion sensor group be cost effective. There are existing sensors which can satisfy several of the above requirements but they are all prohibitively expensive when applied to sensing large areas.

PHASE I: Develop analytical model for candidate motion sensors attached to a pressure release surface. Predict electronic noise floor and determine spatial response and predict response for sensor group (if more than one sensor is used). Test basic principals of candidate sensors in the laboratory to document sensitivity as predicted by modeling. Estimate sensor cost in production quantities.

PHASE II: Select final sensor design and associated electronics. Fabricate prototype sensors and test for sensitivity, electronic noise floor, acoustic sensitivity on a pressure release material and operation while under pressure. Manufacture and test enough sensors to make 28 groups and acoustically test them as a line array.

PHASE III: Engineering development and full scale production. Marketing for commercial applications.

COMMERCIAL POTENTIAL: Low cost, low profile motion sensors would have commercial applications in smart skins being considered for airplanes and other high tech vehicles. The smart skins need to sense the forces and motions that they are subjected to in order to adjust their properties to those motions or forces present. The sensors would also prove to be useful in noise control applications where the sound level in either a air or water medium is to be controlled by active feedback.

N96-166TITLE: Laser Scanning Three Dimensional Surface Velocity Vibrometer

OBJECTIVE: Develop Laser Doppler Vibrometer (LDV) using a scanning laser for three dimensional velocity field measurements on naval ships.

DESCRIPTION: Scanning laser vibrometry is presently used as a diagnostic tool for noise reduction in a number of industries but is limited to the measurement of out of plane vibrations. Existing laser vibrometers which measure three dimensional surface velocity obtain the in-plane vibrations using a dual beam optic head which must be very precisely positioned, The proposed approach will use computer controlled scanning mirrors to position the laser beam. The in-plane and out-of-plane coordinates of the surface vibration velocity will be obtained by scanning from a number of locations and then obtaining the three dimensional field using coordinate transform techniques. Using computer control and by scanning with the laser beam as compared to a mechanical positioning apparatus, it will be possible to quickly obtain the complex velocity of many surface locations.

PHASE I: Demonstrate system for measuring three dimensional velocity field on submerged structures. System should be capable of quickly measuring velocity spectra components smaller than one micrometer/sec for frequencies up to 10 Khz on both rigid and compliant structures.

PHASE II: Develop system for implementing the Laser Scanning Three Dimensional Surface Velocity Vibrometer for measurements on both full and large model scale static and underway conditions. Demonstrate approach for measurements on non-metallic structures as well as rotating components such as propulsors.

PHASE III: Configure the device into portable, computer controlled packages. Determine and implement user friendly post processing and imaging outputs required to optimize the device as a diagnostic tool for acoustic signature reduction applications.

COMMERCIAL POTENTIAL: Extending scanning laser Doppler vibrometry technology to the measurement of in-plane surface velocity will greatly increase its usefulness as a noise reduction diagnostic tool in the automotive and aerospace industries, since acoustic radiation and radiation control techniques are often associated with in-plane vibrations. A three dimensional system will be developed for an application where whole field, complex velocity response of structures would be of interest.

N96-167 TITLE: Container for Storing and Processing Injectable Carbon Dioxide-Containing Fluids and Freeze-Dried Blood Components

OBJECTIVE: To develop a light-weight container for preparing and storing injectable gas-containing fluids and freeze-dried blood components.

DESCRIPTION: A multicompartment container that is capable of storing injectable gas-containing fluids in one compartment and is also capable of supporting the lyophilization of red blood cells and platelets under low temperatures and high vacuum conditions in a second compartment is required. The container should be composed of materials that are compatible with parenteral fluids, blood, and blood products, and which retain carbon dioxide at a concentration of at least 1.4 mM (45 mm Hg pressure) for more than 1 year. The container should be light weight, flexible, suitable for sterilization, and have sterile docking ports for loading, processing, mixing and transfusing the contained products. In addition, the container should have features that allow for uniform freezing and drying of the solid product and limit the exchange of ambient gases and water vapor after sealing.

PHASE I: The contractor should design a flexible container composed of sterilizable, pyrogen-free materials meeting the above criteria with the appropriate dimensions to maximize exposed surface area and minimize storage space.

PHASE II: Compatibility of the container with injectable fluids and lyophilization buffers and the low temperature/high vacuum lyophilization process should be continually assessed during this phase of development. Design and integration of the container with existing DoD/DoN support and logistics will be assessed during this phase. Submission of the device for approval by the FDA will be initiated.

PHASE III: Advanced development of system to reduce risks.

COMMERCIAL POTENTIAL: The commercial potential for this product is high. Parenteral fluids are under development employing carbon dioxide as part of a physiological buffering system, and these fluids will potentially replace currently employed parenteral fluids, millions of liters of which are used annually in trauma medicine and dialysis therapy. Lyophilized blood products, particularly platelets, may replace existing blood component storage modalities; millions of units of platelets and tens of millions of red cell units are used annually in trauma medicine and surgery.

N96-168TITLE: Biological Neural Network Software Toolkit

OBJECTIVE: Develop a biological neural network toolkit to enable system developers and signal processing engineers to utilize state-of-the art neural architectures emerging from interdisciplinary research in biological neural networks for challenging pattern recognition and control applications.

DESCRIPTION: A number of novel biologically-inspired neural network architectures, many with Hebbian learning rules, have been developed and demonstrated on DoD applications in the past decade. These architectures have advantages in scaling, speed, hardware resource use, robust performance with noisy data and high capacity. Despite these advantages, these algorithms and architectures have not been as widely used in the commercial and defense sectors as artificial neural networks such as feedward nets with backpropagation of errors. This is largely due to the fact that the biological networks are often configured as stand-alone experimental tools for university research. There is a need for efficient, user-friendly versions of these biological networks to be made available to the wider engineering community, either as software packages, or as extensions or libraries to the more widely used software packages.

PHASE I: Identify the most promising biological neural networks for general engineering applications in signal processing, pattern recognition and/or control. Develop a system design for a software package or extension to a standard package for identified biological neural networks and learning rules. Develop an efficient implementation of at least one of these biological networks, with user-friendly interface.

PHASE II: Develop a complete software package, or set of extensions for a commercially significant software tookit, incorporating a number of the biological neural networks and learning rules. The system should have flexibility and ease of use, and take advantage of high performance microprocessors, or accelerator cards for high throughput and shortened training times. Demonstrate the performance of this package on a difficult pattern recognition or control problem.

PHASE III: Prepare the software package for commercial and DoD use, including debugging and documentation.

COMMERCIAL POTENTIAL: Artificial neural network software is now widely used in many industries and services, and is estimated to be a $1 billion industry. Networks with demonstrated training and performance advantages will be made available for wide spread use

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N96-169TITLE: Smart Analog Vision Chip with Spatio-temporal Filtering

OBJECTIVE: Computational sensors -- that is, smart vision chips; also known as on-focal plane array processors -- which will detect significant temporal changes in pixel intensity and report these locations so as to direct the attention of image coding algorithms to these regions for intensive analysis.

DESCRIPTION: Spatio-temporal changes (e.g., motion) in visual scenes provide a powerful cue to human viewers, drawing attention and an intensive analysis of active sub-regions. However, current methods in computer vision for coding images focus on quasi-static images, neglecting the all-important temporal domain. One approach for overcoming this limitation is to compute the optical flow field, mark the region with the most significant motion field, and use this information to perform localized image coding. Digital techniques that implement optical flow and other algorithms are computationally very intensive. A cheap, small, low-power and real-time alternative might consist of analog image processing circuits that continually analyze the incoming image. When significant changes are detected, presence and location of these events are reported to subsequent systems for in-depth analysis. The processor must be operational in both an infrared and visible band focal plane array.

PHASE I: Comparison and selection of algorithms, and development and simulation of chip architecture.

PHASE II: Vision chip design and fabrication via commercial CMOS foundry. Interface to PC to demonstrate functionality.

PHASE III: Development of integrated system, including optics, programmable microprocessor and interface, to be used in stand-alone application.

COMMERCIAL POTENTIAL: Smart vision chips are expected to be of use in many military, commercial and home applications, ranging from smart target detection and homing devices to chips for autonomous vehicle navigation for automobiles to video conferencing and clinical applications. Major advantages of this technology are affordability, speed and compactness.

REFERENCES: Koch, C. and Li, H. (1994) Vision chips: implementing vision algorithms with analog VLSI circuits. IEEE Computer Science Press.

N96-170TITLE: Novelty Detection for Condition-based Maintenance of Mechanical Systems Using Neural Networks

OBJECTIVE: Develop neural network architectures and/or algorithms for the detection of novel (presumably faulty) status data from continuously operating mechanical systems for use in condition-based maintenance of these systems. Novelty detection is defined as the recognition of faulty system states when prior training has been limited to "no fault" data only.

DESCRIPTION: The Navy is interested in applying biologically-realistic neural networks to the recognition of faulty states of mechanical systems. These devices must be robust in recognizing faulty states even when trained on "no fault" data only. The neural network architectures must be novel and based on biologically-realistic neuronal systems found in animal and/or human nervous systems. The mechanical devices may be pumps, gears, or other devices or they may be large-scale structures in motion (e.g., aircraft) and under stress. The status data are vibration data from collection points on the mechanical system (e.g., accelerometers).

PHASE I: Develop neural network architecture, apply to sample data sets to show feasibility of system for the detection of faulty mechanical devices, and compare with current methods of fault detection.

PHASE II: Develop, test and operationally demonstrate a complete fault diagnostic system under realistic field conditions for one or more mechanical devices, conduct field tests and evaluate this system for at least six months of normal operation, and compare to alternative methods for fault detection.

PHASE III: Produce a complete product which implements the architecture developed and refined in Phase II.

COMMERCIAL POTENTIAL: There is a clear widespread potential for industrial machinery involving rotational machinery (e.g., pumps) as well as civilian aircraft and other large systems under routine stress. Likely commercial clients include manufacturers of such systems, current owners of such systems, and insurance companies which insure against damage and loss due to failure of such systems.

REFERENCES: Petsche, T., Gluck, M., Hanson, S. (1994) Workshop on Novelty Detection and Adaptive System Monitoring. Neural Information Processing Systems, 7.

N96-171TITLE: Operation Evaluation of Advanced Integrated Air Vehicle Suites

OBJECTIVE: To develop methodology/tools in predicting and qualifying/quantifying the operational benefits of 'smart' air vehicle components/systems integration efforts.

DESCRIPTION: Aircraft subsystems have traditionally been developed as stand alone systems and only integrated at the subsystem or vendor level and not at the vehicle level. This has created a myriad of control approaches that were not tightly coupled limiting future integration efforts. Recognizing this, the Navy is (in the exploratory development phase of) developing a Vehicle Management Avionics System (VMAS) to continually monitor and control the health and performance of the aircraft. However, it is very difficult to quantify the benefits of an integrated aircraft system approach in terms of operational measure of effective (MOE) and measure of performance (MOP). To complicate matters, future air vehicle system will exhibit 'smart' components (i.e., smart structures) that contain a high degree of intelligence offering reconfigurable vehicle systems. Coupled that with development in data fusion and cognitive decision aiding knowledge base systems will enable additional operational capabilities. These integrated and intelligent systems will provide the pilot coordinated control of the available air vehicle systems in response to degraded and emergency situations, making the aircraft more battle damage tolerant, less vulnerable and more survivable. No clear methodology exists to evaluate these smart system capabilities and obtain a first order benefits analysis of these technologies in terms of MOEs and MOPs either at the mission level, or campaign level. Existing MOP and MOE simulation techniques do not have the flexibility to account for these type of vehicle enhancements. This analysis is needed to show the impact on aircraft availability and life cycle cost (LCC).

PHASE I: Feasibility study to define and identify promising approaches which can be used to quantify the MOE/MOP of aircraft equipped with smart air vehicle components and systems. Identify simulation tools to support the selected methodology.

PHASE II: Optimize the simulation/evaluation tool(s) and provide a prototype demonstration of the concepts defined in Phase I.

PHASE III: Transition the technology into F/A-18 E/F and/or JAST or an advanced technology demomstration (ATD).

COMMERCIAL POTENTIAL: The products developed under this effort will include avionics design methodologies, design software and computer simulation tools. Application areas include, but are not limited to commercial avionics and automotive electronics development.

N96-172TITLE: Incorporation of Gap Effects in the Design of High Performance Missile Control Fins

OBJECTIVE: Develop and implement new technology for the design and analysis of high-performance missile control fins including gap effects.

DESCRIPTION: The design of high performance missile control fins is aimed at maximizing lift and minimizing actuator torque requirements. Although efforts have been undertaken in the areas of fin platform optimization and chord-wise flexibility to satisfy aerodynamic objectives subject to geometric and other constraints, the effects of gaps have not yet been considered in the optimization process. Gaps appear at the root chord of control surfaces where the span-wise loading is likely to be a maximum, and where changes in the lift distribution can have large effects on hinge moment. Thus advanced control design methods must include these effects based on knowledge gained from a combined theoretical/experimental approach to analyze the flow details in the gaps. The ultimate objective is a comprehensive tool capable of handling gap effects in the design of missile control fins optimized to satisfy user-specified aerodynamic objectives subject to constraints.

PHASE I: Develop techniques for designing effective controls including gap effects. Include methods for accurately analyzing the performance of selected controls including suitable CFD gridding techniques, such as those indicated in Ref. 1, applicable to analyzing the flow in fin gaps. In this phase, demonstrate feasibility by generating flow solutions and comparing results with available data such as that provided in Ref. 2. Provide a plan for the experimental program to be performed as part of Phase II.

PHASE II: Generate flow solutions with the basic grid strategies developed in Phase I, examine among other things the effects of shock/boundary layer interaction in the gap and effects on fin aerodynamic loads. Extend the gap calculations to non-stream-wise gaps and non-circular body cross sections. Compare results with available data. Incorporate the theoretical/experimental findings in a missile control fin design method. Design promising low hinge moment fin configurations including fin gap root chord/body contours optimized for fin lift, minimum actuator torque, and controlled vortex (fin wake) formation. Conduct an experimental program to validate the designs. Develop a commercially marketable code.

PHASE III: Make available techniques for designing and for accurately calculating the aerodynamic characteristics of missile controls including gap effects. Apply the techniques to improve the performance of future missiles. Address dynamic effects, such as post-stall performance, and indicate how they might influence control fin design.

COMMERCIAL POTENTIAL: A comprehensive design code for lifting surfaces which includes effects of gap between the surface and another component such as the body or another portion of the lifting surface will be of great utility to the aerospace industry for applications to high performance missile control fin and aircraft aileron, flap, and other control surface designs. In addition, the design code will be useful to designers of submarine control surfaces, gas turbine blades, and windmill blades with movable portions for controlling speed.

REFERENCES:
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2. Schindel, L., and Lam, L. "Payoffs of Improved Control Effectiveness", AIAA paper 95-1898, June 1995.

N96-173TITLE: <u>Superconductor Applications to Aircraft Electric Systems</u>

OBJECTIVE: To investigate various superconducting materials to determine if they are currently within five years of being applied to aircraft electric power generation and distribution components. To design and fabricate a prototype superconducting electrical system component.

DESCRIPTION: Current electric systems provide, at best, system efficiencies of 70-85%. These efficiencies are low because of the inherent losses within the generator and distribution system wiring. The impact of these losses in an aircraft electric system translate into high specific fuel consumption (SFC), reduced time on station, reduced payload capability, and high electric system weight.

Superconducting materials will have a large impact on electric system weight, efficiency, reliability, and survivability. Using superconductive materials to replace conventional copper conductors in generator/motor winding or as core material would provide lighter weight devices. Superconductors are also candidates for the electric system distribution cables. Electric system efficiency would increase from present efficiencies to 98%. This is due to the zero resistance characteristic of superconductors.

Recent advances in producing high temperature superconducting materials make them more realistic for application to aircraft power systems since cryogenic systems required for cooling are much simpler and smaller than those cryogenic systems of the lower temperature superconductors.

PHASE I: Phase I should consist of the study that will identify the aircraft electric components in which superconductor materials will have the largest impacts. Weight, reliability, survivability, and efficiency must be considered during the study. This study should result in the selection of an electric system component most near term for development and a preliminary design of this component.

PHASE II: Phase II should result in a final design and the fabrication of the superconductor component identified in Phase I. Initial functional testing shall be performed by the contractor prior to delivery to the government.

PHASE III: Phase III will result in testing and evaluation of the component fabricated in Phase II. Further development efforts may be conducted depending on the results of Phase I and Phase II.

COMMERCIAL POTENTIAL: Superconducting components have applicability across most electrical systems, including civilian aircraft systems.

N96-174TITLE: Model Development for Shock-Induced Reactions in Non-Explosive Materials

OBJECTIVE: Develop constitutive models for the mechanical shock compression and release behavior of selected non-explosive materials, with emphasis on shock-induced chemical reactions for rapid production of heat and gases.

DESCRIPTION: The Navy is evaluating the rapid production of gases from non-explosive sources. The shock compression and release processes in selected porous materials (powders and/or foams) has the potential for replacing common explosive and propellant formulations as generators of heat and gases for actuators, ejection systems, and various ordnance-related items, to achieve improved safety for manufacturing, storage, and operational use.

PHASE I: Develop basic analytical mathematical models applicable to several porous material systems to be specified by the Navy. These models will include effects of initial density, particle and/or foam morphology, shock stress amplitude, risetime, and duration for initiating reactions that produce heat and gases, and the relative time-dependent yields of the produced compounds in terms of the threshold stress conditions and the amount by which the threshold conditions are exceeded. The material specimen geometry for initial consideration would be a disk of material, with a transient mechanical shock stress applied uniformly over one of the flat surfaces, and would include the effects of shock compression and release waves in the specimen.

PHASE II: Extend models developed in Phase I to address more complex materials systems to be specified by the Navy. Integrate models into an established dynamics simulation code (e.g., CTH, EPIC, or DYNA3D) to address complex boundary geometries and the mechanical interaction of produced gases with boundary materials. Use the resulting computational simulation capability to predict the dynamics of selected Navy-supplied problems.

PHASE III: Enhanced Warhead Advanced Technology Demonstration scheduled to begin in FY 1998.

COMMERCIAL POTENTIAL: The models and simulation capability would find application in the design of vehicle air bags, shock mitigation systems, and other safety-related items for civilian use.

N96-175TITLE: Microscopic Investigation of Rocket Propellant Processing Parameters on Cure Shrinking

OBJECTIVE: Control cure shrinkage in rocket motor propellant through the use of grain design, temperature and pressure through a thorough understanding of propellant ingredient and cure phenomena.

DESCRIPTION: Many of the rocket motors manufactured for the Navy have used a cure to height grain former to save machining costs. This technique exacerbates the effects of cure shrinkage of the propellant creating visible voids, unbonds and dendrite cracks in propellant. These defects can result in motor failures. Cure shrinkage is a phenomena of the reaction of the binder with the curative and always occurs in propellants. Although the physical sign of cure shrinkage are well known in the propellant industry, the extent of the non-visual damage to the microscopic structure of the polymer network is unknown. Sidewinder, HARM, and AMRAAM are examples of motors being produced with cure shrinkage. With current production of these motors coming to an end and new propellant formulations forthcoming, it is imperative that the Navy understands the phenomena of cure shrinkage and its effects on motor shelf life.

PHASE I: Provide a study of the cure shrinkage phenomena of the hydroxyl terminated polybutadiene (HTPB) binder with various curatives (IPDI,DDI) and plasticizers (DOA,IDP) currently used in the propellant industry. Use a baseline propellant formulation similar to HARM and Sidewinder propellants at various solid loading conditions. Study ammonium perchlorate/aluminum (AP/Al) loaded propellants and the effects of cure shrinkage. Study and develop means of controlling the cure shrinkage that will lead to better processing and understanding of propellant physical properties. Develop high level models, incorporating key parameters based on the findings.

PHASE II: Design and develop a test motor that will induce cure shrinkage effects into the propellant grain. Measure the physical values of the propellant throughout the motor and around the induced voids and cracks. Look at the microscopic structure of the propellant binder network. Investigate accelerated aging effects. Develop methods to control and eliminate the detrimental effects of cure shrinkage. Modify the high level mathematical models based on the data collection/extension of other models.

PHASE III: Demonstrate the understanding of the cure shrinkage phenomena by producing full scale motors with long length to diameter ratios (greater than 10 to 1). Induce cure shrinkage into half of the motors and provide half of the motors with damage free propellant by implementing cure shrinkage fixes. Cold X-ray all motors. Temperature shock cycle a statistical quantity of each motor type to failure. Accelerate age motors for one year and then temperature shock cycle motors to failure. Modify the high level models based on the scaled up data.

COMMERCIAL POTENTIAL: Understanding this phenomena of propellant cure will allow the NASA/private sector to obtain better rocket motors with longer shelf lives by including proper requirements in production contracts. A better understanding of service life of motors will also be obtained. This technology can be applied to polymer resins and adhesives in the manufacture of plastic and composite parts in multiple industries.

N96-176TITLE: Rapid Positioners for Precision Manufacturing

OBJECTIVE: Design, develop and demonstrate a positioning system which enables significantly higher production rates in precision manufacturing.

DESCRIPTION: One of the factors which limits throughput in precision manufacturing is the rate at which tools can be repositioned so as to minimize errors from processing operations. A typical positioning system consists of a piezoelectric actuator, a position/velocity sensor, and a feedback control loop. The speed of such a system is often dictated by how fast the control loop can respond. This effort would advance control loop performance through innovative approaches such as active damping and sensorless feedback. Speed improvements by a factor of 10 or more are expected.

PHASE I: Design, fabricate and test a generic positioning system which incorporates the proposed control loop innovations. Demonstrate that this system has a significantly enhanced response speed as compared to a well engineered conventional positioning system. A limited range of motion of about 10 micrometers in 3 dimensions is acceptable.

PHASE II: Develop and demonstrate a prototype positioning system with the full range of expected motion for a specific manufacturing operation, such as diamond turning,

PHASE III: Develop a well engineered positioning system for precision manufacturing suitable as a commercial product..

COMMERCIAL POTENTIAL: Rapid positioning systems based on these advanced concepts would have a major payoff wherever dynamic response is an important factor. Potential commercial applications include auto-focusing lenses, bubble jet printers, anti-lock brakes, and audio speakers.

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MARINE CORP SYSTEMS COMMAND

N96-177TITLE: Composite Mine Vehicle Survivability Kit

OBJECTIVE: To develop a low cost, efficient lightweight composite material that will provide vehicle crew protection during mine encounters.

DESCRIPTION: The USMC has been developing crew/vehicle protection kits to provide increased crew survivability for tactical wheeled vehicles. Commonly encountered threats include on-route large blast mines with an additional threat of off-route fragmentation mines. While the USMC is achieving success against the threat levels of mines/fragmentation with conventional steel/aluminum protection kit fabrication, there are payload and mobility penalties associated with these protection kits. This research area is targeted at reducing these penalties while still providing the same level of crew/vehicle protection or improving the energy absorption performance of deflectors.

The protection kit will protect the crew from blast, fragments, and injurious acceleration effects of blast mines up to the equivalent of 16 pounds of Composition B. The composite material should mitigate more than 50% of mine energy, through absorption (material deformation) and blast deflection. Vehicle vertical and lateral acceleration should be minimized. The following are typical loading curves from a mine blast under a steel/aluminum protection kit:

Max Pressure Over Time	Max Stress Over Time
3000 ATM @ .74 millisec	67K PSI @ 5 millisec
1400 ATM @ .23 millisec	71K PSI @ 15 millisec
150 ATM @ .58 millisec	72K PSI @ 25 millisec
	60K PSI @ 30 millisec

PHASE I: Addresses the full matrix of tradeoffs for materials, performance, performance penalty, and manufacturability. Included in the matrix should be maintenance, quality control and cost variables. Phase I efforts which propose to accomplish this study and proceed to actual materials work will be weighted. The proposal must address, in detail, techniques for composite technology assessment of design without relying on costly repetitive testing and demonstration. It is not critical that the proposer address hardware configuration for the protective kit. But contractor must demonstrate they are using a process which can produce the items in general lengths/widths/thickness and surface relief. Military corporate knowledge can assist in this phase of development. Phase I proposal must contain at least an outline of the Phase II plan.

PHASE II: Composite construction and evaluation will be conducted. Of primary importance is the blast/acceleration energy absorption protection offered by the composite material as compared with vehicle weight penalty. Phase II will also address additional materials parameters of induced vehicle vibrations, climatic response conditions, manpower, etc. The proposed process must be low cost and easily adapted to new component designs/configurations.

PHASE III: The commercial composite material process development and validation should be completed. Kits should be ready for fabrication and operational testing by military installations for selected vehicle frames. The commercial marketing plan submitted with Phase II should clearly specify additional uses for the composite material. These efforts should be pursued independently by the contractor to ensure a viable source for material production.

COMMERCIAL POTENTIAL: Lightweight composites are finding many applications in the recreation industry. Security issues are increasing in the commercial sector which would provide ample opportunity for a lightweight ballistic material application. The aerospace industry is growing, with a high need for lightweight extremely resilient materials for satellite/space flight payloads.

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3. "Blast Simulation and Analysis", SAIC, Science Applications Int. Corp., 30 May 94; "Development of Mine-Resistant Vehicles", SAIC, 2 July 1993;

4. "Lightweight Hull floor Program", LH-92-80711-001, General Dynamics Land Sys Div, Jan 1993

N96-178TITLE: Anti-Personnel Obstacle (APOBS) Breaching System Manufacturing Technology

OBJECTIVE: The Anti-Personnel Obstacle Breaching System (APOBS) is a line charge system that consists of 108 grenades fastened to ropes that are propelled by a small rocket. It is intended to clear wire obstacles and anti-personnel mines. The grenade rope fabrication process is presently accomplished using a banding machine that clamps metal bands over the grenade and ropes. There is a critical need to identify alternative manufacturing sciences that will increase production reliability and reduce manufacturing costs.

DESCRIPTION: The manufacturing technique will focus on the assembly process connecting the nylon ropes to the oval grenade. The fastening process must: (1) Be capable of withstanding the dynamic loads seen by the current banding system during APOBS employment;(2) Be of a design and material that does not exceed the weight of the current grenade clamping system-with a goal of further reducing weight;(3) Be of a design and material that is compatible with the manufacturing and/or fabricating processes of Class V explosives used in the APOBS;(4) Meet or exceed the test requirements used to test the current banding system which is required to withstand 250 LBS. of pull before the clamps slip off the rope;(5) Be of a material and design that will not appreciably change properties when exposed to storage and operational extremes of heat, cold, and humidity. This ranges from -60 to 160 degrees Fahrenheit and 0 to 100% humidity;(6) Be composed of environmentally safe materials;(7) Be of a material design that will not degrade or appreciably change properties during a storage life of 15 years;(8) Be of a design that continues to allow the string of grenades to be coiled and fit into the current container used for storage, transportation, and employment;(9) The proposed new procedures for fastening the grenades to the nylon ropes must demonstrate low cost, simplicity, and repeatability in a manufacturing or fabrication environment.

PHASE I: Design a fastening, bonding, clamping or any other mechanism to securely fasten the ropes to the grenades. Evaluate all the concept, identify costs and availability, and provide a report on this feasibility. Proposers reaching the hardware stage within Phase I will be given weighted consideration. The Phase I proposal must contain the Phase II effort in at least outline form.

PHASE II: Demonstrate a proof of concept prototype for the two most promising manufacturing/fastening technique's concurred with by the Project Program Manager. Test and demonstrate the two prototypes. Provide a Phase II report that includes the Phase III. plan.

PHASE III: The contractor must mature the fabrication procedure to the point that it merits commercial production consideration. This includes total costs associated with the procedure.

COMMERCIAL POTENTIAL: This would have wide spread commercial and military applications that require irregular surface bonding technology. The Safety Industry could greatly benefit by having an inexpensive means to attach safety equipment to ropes. Recreation applications may also be possible especially in Sailing where knots could be reduced. Additionally, the technology would have application in foreign countries that are striving to improve their economies but are limited due to the mining of the terrain.

N96-179TITLE: Battlefield Information Warfare

OBJECTIVE: The objective of this topic is to determine the application of Information Warfare (IW) techniques on the battlefield to attack tactical adversary Command Control and Computer (C2) systems.

DESCRIPTION: IW Attack on the battlefield: Battlefield techniques effecting adversary Information, Information Based Processes, and Information Systems outside of traditional Electronic Attack (EA) applications of C2W. Potential targets could include, but are not limited to, computers, fiber optics, modems, and computer based sensors.

PHASE I: Design information warfare tactics, strategies, and matching technologies applicable to electronic attack of information systems targets as described above. The design should include details of hardware and software required. The application of these solutions will be on a conventional battlefield and for military operations other than war (MOOTW). The emphasis will be on tactical systems as opposed to strategic or national information infrastructure. In addition to designing technology and techniques, a system concept and requirements analysis should be delivered with proof of concept performed via modeling and simulation if possible. The focus of this topic is Information Attack, however, friendly systems vulnerabilities must be considered as well. Conduct an analysis to identify those strategies that will be most effective in the conduct of battlefield IW. Report in detail this feasibility effort.

PHASE II: Demonstrate the ability of the selected system(s) designed in Phase I, to disrupt C4I networks and equipment. Provide prototype of equipment and software developed during Phase II based on proof of concept developed in Phase I. From the lessons learned, transfer vulnerability information to Command, Control, Communications, Computers, and Intelligence (C4I) Information Security programs.

PHASE III: With supporting doctrine, build, test, and procure hardware and software solutions, sufficient IW attack systems for integration into the MEWSS system to meet projected Marine Corps requirements as determined by the appropriate requirements validation authority.

COMMERCIAL POTENTIAL: While the application of this research to commercial products would be limited due to security considerations in the law enforcement community. Also, application exists in developing, form the lessons learned in attacking information systems, appropriate information protect procedures for commercial networks particularly those involved in cyber-commerce.

REFERENCES: Joint Chiefs of Staff, Memorandum of Policy 30, 8 March 1993; Information Warfare Technologies: Survey of Selected Civil Sector Activities, Draft November 1995, Institute for Defense Analysis, D-1792

N96-180TITLE: Deployable Power Distribution System

OBJECTIVE: To develop an innovative single lightweight power distribution system with companion wiring harness connectivity, providing autonomous intelligent distribution configuration for multiple generator inputs and multiple equipment outputs.

DESCRIPTION: The USMC relies on families of generators for deployable power, ranging nominally from 3KW to 100KW. Distribution of this power is presently provided by a parallel family of distribution systems, consisting of a cabinet, breakers, and input/output receptacles. Each distribution system is designed for different power grids, providing multiple 120/208 volt, 1-phase loads. The 15KW distribution panel weighs approximately 56 lbs per panel, consists of 10 total panels, and requires a stowage of 50.6 ft cubed. The 30KW distribution panel weights approximately 161 pounds per panel and requires a stowage of 132 ft cubed. The 100KW distribution panel weighs 345 lbs per panel and requires 388 ft cubed of stowage. The USMC would like to reduce the weight/cube of its present inventory by combining these separate units into a single comprehensive distribution unit. State of the art technology will allow this single lightweight panel to facilitate power distribution from various KW-rated generators at the same time. The proposed unit weight/cube must be commensurate with present minimum weight/cube limits. Also considered in this development is lifecycle maintenance as well as receptacle versatility. Power panel output receptacles presently focus on direct hard wiring of equipment. Inventory wiring harness kits are available to provide distribution of electrical power to the field tents and shelters. However, there is need for an innovative solution for rapid connection of the wiring harness/equipment cables to the distribution panels. The solution should address time/manpower/safety for rapid connect/disconnect while leaving the electrical harnesses completely reusable.

PHASE I: Phase I should identify the technology used in designing a single unit power distribution panel which can facilitate the full 3-100KW range of power generators. The unit proposal must address weight/cube. Technical details of system capacity, proposed input/output connection schemes, and protective circuitry must be detailed. Modularity should be considered. Proposals with proof-of-concept hardware in Phase I will be weighted.

PHASE II: The Phase II demonstration will entail developing several field-testable prototypes. Development will also include manufacturing practices, packaging, display optimization, innovative materials investigation for connect/disconnect, etc. Possible integration of self-diagnostics, percent loading display, etc. will be addressed.

PHASE III: This product, based on Phase II progress, will be identified for inventory inclusion in the USMC family of Power Equipment Assorted.

COMMERCIAL POTENTIAL: The power industry as well as field testing facilities in a variety of disciplines would benefit from this development. Applications exist in the construction, mining, camping industries, and disaster relief.

REFERENCES: TM11275-15/3C, pg 2-58 through 2-61; NSN 6110-01-272-6952/6953; NSN 6110-01-273-2387; NSN 6150-01-254-1666 (wiring harness); Navy MIL-STD MIL-P-29183/2/6 panel boards, power distribution, portable; Navy MIL-STD MIL-C-29184/1 cables and connectors

N96-181TITLE: Multipurpose Lifting/Excavating Arm

OBJECTIVE: Develop a lifting/excavating arm that can readily attached and detached to vehicles, specifically the M-9 Armored Combat Earthmover.

DESCRIPTION: There is a requirement for a multipurpose arm that can be attached to the M-9 ACE using its existing hydraulic system. The arm must be capable of: 1.) lifting a minimum of 4,000 pounds with a desire of 10,000 pounds and placing it in the bowl of the vehicle. 2.) requires an attachment that can be used for excavating. 3.) requires an attachment that can be used for auguring a minimum of 12 inches with a desire of 24 inches in diameter and 4 feet in depth.

PHASE I: Investigate feasibility and methods of attaching an arm to the M-9 ACE as well as develop functional specification. Develop system configuration, evaluate concepts and report on the results. Proposers reaching the hardware stage within phase I will be given weighted consideration. The Phase I proposal must contain the Phase II effort in at least outline form.

PHASE II: Develop a proof of concept prototype, test and demonstrate the prototype, plan Phase III, and report.

PHASE III: Phase III will require military program sponsorship. For successful advance to this phase, a successful proof-of-concept must have been demonstrated, and the USMC sponsor for this SBIR effort will have coordinated transition to demonstration/validation. The contractor must support a successful Phase III transfer by maturing the product to a point for commercial consideration, including manufacturability and cost.

COMMERCIAL POTENTIAL: This arm would have wide spread commercial and military applications. The arm would have the ability to attach to existing platforms that have hydraulic systems. For example construction firms could buy this arm attachment mount it to an existing vehicle instead of purchasing an additional vehicles that would perform the same task. Other military applications would apply as well. For example units could have this arm attached to a non-engineer vehicles therefor, freeing the limited number of engineer assets to perform more critical missions.

N96-182TITLE: TRSS Air Delivered Target Acquisition Sensors

OBJECTIVE: The objective of this topic is to validate the application of target acquisition sensors which can be delivered from Marine Corps/Navy high performance tactical aircraft in support of amphibious operations and expeditionary operations ashore. Such Sensors would become an integral part of the USMC Tactical Remote Sensor System (TRSS).

DESCRIPTION: TRSS is an existing suite of systems which, in combination provide Marine commanders the capability to remotely monitor areas of interest with minimal manpower resources. The proposed sensor would overcome a current inability to emplace and monitor activity in areas beyond the safe operational range of rotary-winged platforms and ground reconnaissance forces. Additionally, this sensor needs to be able to discriminate between various vehicle types sufficiently to improve targeting by Marine Air Ground Task Force (MAGTF) weapons systems.

PHASE I: Explore the application of technologies required to passively classify tactical targets to the degree necessary to identify specific types of combat vehicles employed by possible opposing forces. This phase should also address the packaging of such technologies into stores which can be easily integrated into existing aircraft stores delivery systems. Specifically, Phase I should address sensor performance goals and provide evidence that the goals are technically feasible as well as identify all necessary efforts required in Phase II.

PHASE II: This phase entails the demonstration of the proposed sensor to include: detection, self location, target classification, target location, direction of motion, delivery from a Marine Corps high performance tactical aircraft, and integration into the existing USMC TRSS. Target classification refers to the ability to distinguish between vehicles types, e.g. T-72 Tank, M1A1 Tank, Bradley IFV, etc.

PHASE III: Produce the hardware developed in Phase II of this effort.

COMMERCIAL POTENTIAL: Application of this research will benefit numerous security system manufacturing companies seeking to target specific activity in highly active distant locations. additionally, such technology has a wide range of applications in law enforcement and the defense industry. There also be a requirement for acoustic recognition in the maintenance diagnostics fields for machinery, automobile engines, or medicine.

N96-183TITLE: Knowledge-based System

OBJECTIVE: Using Intelligent Agent technology, automate the reasoning process used by commanders in making decisions to execute command and control.

DESCRIPTION: The proposed Knowledge-based system will solve the problem of how to symbolically represent information about complex real-world entities and processes, and how to reason with this information in time for the results to be useful. The system should address knowledge representation, automated reasoning, and automatic planning.

With the use of techniques from Artificial Intelligence called "autonomous agents", implement a style of user interaction in which human and computer agents both initiate communication, monitor events, and perform tasks.

PHASE I: Investigate available Intelligent Agent architectures, agent languages, and agent technology applications. Based on available agent technology, identify an architecture suitable for command and control and appropriate applications. Prepare a report with the results and recommendations for the Phase II effort.

PHASE II: Develop a prototype system based on the recommended agent architecture. Implement software agents which interoperate as applications in this environment to demonstrate proof of concept.

PHASE III: Implement and integrate more complex software agents that provide automated decisions in which the user has confidence, in addition to a social interface where the user has the feeling of being in control.

COMMERCIAL POTENTIAL: Today the dominant form of human interaction with computers is via commands and/or direct manipulation initiated by the user. This mode of operation will have to change as more untrained users are introduced to the world of computers and networks of tomorrow. The use of Intelligent Agents can assist users in several ways: they hide the complexity of difficult tasks, they perform tasks on the user's behalf, they can train or teach the user, they help different users collaborate, and they monitor events and procedures.

REFERENCES: Communications of the ACM, July 1994 - Volume 37, Number 7

N96-184TITLE: Ultra-WideBand Antenna

OBJECTIVE: Develop/identify High Power Microwave-Ultra-WideBand (HPM-UWB) antennae, suitable for employment in the various tactical environments that Marine Corps use requires.

DESCRIPTION: Physical antenna parametrics are typically tailored to provide the desired directivity and gain for a relatively narrow bandwidth (as a percentage of center frequency). Ultra-wideband signals and high power microwave, create a family of problems for antenna optimization and will require the development of new techniques or modification of existing techniques to provide for efficient coupling of electromagnetic energy to the atmosphere. Desirable attributes are beamwidths tunable from hemispherical to quadrant or better, with an appropriate positive Db gain. These antennae will be principally used for transmission but may have applications for detection as well.

PHASE I: Explore the potential solutions to the problem of efficient coupling of high powered microwave and ultra-wideband electromagnetic energy to the environment. Phase I should focus on the efficient coupling of HPM-UWB energy as well as addressing the appropriate techniques to address directivity.

PHASE II: Using the concepts developed in Phase I, demonstrate the ability of the selected antenna application and techniques to efficiently couple the RF energy with the environment.

PHASE III: With supporting doctrine and force structure, build test and procure sufficient UWB antenna systems to meet projected Marine Corps deployment of HPM-UWB generators as determined by the appropriate requirements determination authority.

COMMERCIAL POTENTIAL: With the growing family of communications and entertainment systems, antenna technology has come to the forefront in an effort to maximize performance while minimizing cost and providing a non-obtrusive profile. The developer of the this antenna could potentially market this item or products derived from lessons learned, into one of the burgeoning markets for antennae.

N96-185TITLE: Detection of Unexploded Ordnance (UXO)

OBJECTIVE: The objective of this topic is to develop a man portable system, based on Nuclear Magnetic Resonance technology to enhance and improve the detection of all types of UXO regardless of case composition. This would be accomplished by detecting the primary explosive instead of the UXO case material.

DESCRIPTION: While in the past, the majority of all UXOs have been magnetic and/or metallic, in the future they are expected to have a higher and higher concentration of composite material casing. Most operational locators are severely handicapped in the detection of plastic or composite type materials and a need exists for a technology that is capable of detecting the basic element of the UXO i.e. the explosive. Past efforts involving several different technologies indicate that Nuclear Magnetic Resonance techniques offer significant promise in the detection of various explosives regardless of the type of exterior case. While other technologies may be able to detect explosives they have exhibited serious limitations both with the environment and with UXO case composition. In addition, some that would be otherwise suitable, are not considered for man portable operation because of safety issues.

PHASE I: Demonstrate the feasibility of detection either with rigorous mathematical analysis or through laboratory demonstration.

PHASE II: Develop a fieldable prototype capable of man portable performance.

PHASE III: Implementation into one or more of the ongoing UXO clearance programs.

COMMERCIAL POTENTIAL: While the detection of solid explosives has very limited application with police and anti-terrorist organizations, the technology might also be expanded to detect other potentially toxic or explosive chemicals that may be present in the ground or behind sealed walls.

N96-186TITLE: State of Charge Monitoring for Hybrid Electric Vehicles

OBJECTIVE: The objective is to improve vehicle fuel efficiency and operating range of future hybrid electric vehicles.

DESCRIPTION: Hybrid electric vehicles are being developed for both commercial and military applications. In all instances, batteries on-board the vehicle are used for energy storage and buffering of power between the engine/generator and the drive motor(s). An accurate state of charge indication of the battery pack is critical for proper operation of the engine/generator and for maximum fuel efficiency. The state-of-charge will determine the on-off operation and the duty cycle of the engine which ultimately affects fuel usage and fuel efficiency.

PHASE I: Explore software and hardware based solutions to accurately and in real-time provide indication of the state of charge of battery packs that utilize both lead acid and nickel-cadmium technology. The battery pack shall operate in the 300-400 Volt range with through put power capability of 75 to 100 kilowatts and energy storage ranges of 5 to 20 kilowatt-hours. Electrical schematics, hardware concept drawings, and software and logic flowcharts shall be delivered at completion of Phase I.

PHASE II: Using the chosen design for a single battery technology, a brassboard system shall be developed and delivered, with interface information, for on-vehicle test purposes.

PHASE III: Ruggardize, miniaturize, implement and test in hybrid-electric vehicles.

COMMERCIAL POTENTIAL: The Clean-Air and Zero Emission vehicle mandates that take effect in 1998 are requiring electric and hybrid-electric vehicles in increasing numbers. Maximum efficiency from the on-board stored energy (battery) and user confidence that the battery will propel the driver/passenger to the destination is required for electric vehicles to have commercial acceptance. Current technology can not provide this capability. With greater use of hybrid-electric vehicles in the future, accurate knowledge of state-of-charge is critical for reliable and clean operation of the automobile.

NAVAL AIR SYSTEMS TEAM

N96-187TITLE: Fretting and Wear Resistant Blade/Vane Coatings

OBJECTIVE: Develop fretting and wear resistance for Gas Turbine Engine Blades and Vanes in attachment areas using surface modification techniques other than traditional plasma sprayed (Cu-Ni-In, Ni-Graphite, etc.) coatings.

DESCRIPTION: Navy gas turbine engine blades and vanes typically have plasma sprayed anti-fretting and wear resisting coatings on their mating surfaces. Difficulty is often encountered in producing dense, tightly adhering, uniform coatings using this coating method even though the method has been used for many years. The coatings often have different properties, part to part, due to slightly different application parameters. This leads to uneven wear rates and possible catastrophic early failures.

New coating technologies may provide fretting and wear resistance comparable or better than the traditional coatings. As with any new technology, undesirable characteristics might also be present, therefore, properties such as fatigue, etc. must be quantified and related to overall coating performance. This effort will identify, qualify and develop new coating technologies for anti-fret and anti-wear conditions.

PHASE I: Provide a feasibility study to identify components eligible for this program, identify new coating technologies (PVD, ion implantation, CVD, etc.) and coating materials (DLC, PVD/MoS2, TiN, etc.) with suitable properties to be considered, and propose methods for evaluation, testing, qualification, and implementation of the new coatings into Navy gas turbine engines.

PHASE II: After verification/validation of the candidates with appropriate Navy personnel, the candidate coatings will be laboratory tested to provide fretting, wear, fatigue, and other appropriate test data to determine suitability for continued consideration. Actual engine components will be coated to prove applicability and will then be tested either in engines or in engine running conditions. This test data will be used to obtain approval from the controlling Navy office.

PHASE III: Develop specifications and process descriptions to provide the coatings for military and commercial applications.

COMMERCIAL POTENTIAL: These coatings will be suitable for civil aviation applications worldwide and should be commercially attractive to many engine OEM and after market companies.

N96-188TITLE: Multivariable Integrator Windup Protection for Aircraft Fight Control System using Model Predictive Controller

OBJECTIVE: Develop Model Predictive Control (MPC) methods for solving the integrator windup problem of advanced flight control system using numerous control effectors.

DESCRIPTION: The design of advanced flight control systems for high performance aircraft is involving the use of numerous control effectors to satisfy mission requirements. Integrator wind-up protection is particularly critical with the short-take-off-vertical-landing (STOVL) control law design problem because the system is so often operating on limits (thrust and vectoring) in powered-lift flight. Complicating factors are (1) the compensators often have a large number of states and (2) the multivariable control law operates on numerous control effectors. Traditional methods of using single-loop-at-a-time protection by freezing the integrators are impractical when state and output variables are numerous and cross-coupled. This topic will investigate the use of a Model Predictive Control (MPC) approach for the design of a supervisory controller to satisfy the constraints on the input and output variables for Robust Multivariable Control (RMC) design. The MPC approach modifies the command inputs to the RMC controller in an optimal way to keep all the constraints satisfied. Since the disparity between the commanded inputs and the actual inputs to the aircraft are eliminated, no integrator wind-up problem occurs.

PHASE I: Show feasibility for using the Model Predictive Control (MPC) approach in the design of a supervisory controller to satisfy the constraints on the input and output variables for RMC design.

PHASE II: Develop, test and operationally demonstrate the MPC methods formulated under the Phase I SBIR effort.

PHASE III: Produce the MPC methods demonstrated in the Phase II effort. This will be the transition from development to application for major aircraft programs such as the F-18 E/F, V-22 and JAST. High-angle-of-attack control and maneuverability are important concepts for combat effectiveness of the new class of fighters such as F-18, F-22 and JAST.

COMMERCIAL POTENTIAL: The proposed MPC solution to the problem of integrator windup and controller tuning can be applied across-the-board to process control systems in diverse industries such as chemical, automotive, pulp and paper, metallurgy, manufacturing, electronics and biotechnology.

REFERENCES: MIL-STD-8785C and 9490

N96-189TITLE: Development of a High Power Air-Cooled Clutch

OBJECTIVE: Develop and validate advanced concepts for high horsepower, air-cooled clutches.

DESCRIPTION: Air-cooled clutches offer significant weight savings compared to oil-cooled clutch designs as utilized in present and future aircraft propulsion systems. Weight savings directly translate to increased payload and/or range. Presently, risk associated with the use of air-cooled clutches is unacceptably high, due primarily to problems accommodating the high thermal heat loads generated during engagement and disengagement.

PHASE I: The contractor will characterize the state of the art in high horsepower, air-cooled clutch design, performance, and durability. Advanced concepts will be explored for several propulsion system configurations and missions, with special emphasis on thermal management. Preliminary designs will be developed with critical elements identified.

PHASE II: Validation tests will be developed and performed on critical design elements. Selected clutch concepts will undergo detailed design.

PHASE III: Advanced air-cooled clutch technology will be transitioned into existing helicopter component improvement programs or emerging short-take-off-vertical-landing (STOVL) development programs.

COMMERCIAL POTENTIAL: New high-power air-cooled clutch technology has direct applicability to aircraft landing systems.

N96-190TITLE: Viscous Cartesian Unstructured Grid Generation

OBJECTIVE: To develop a computer code that will automatically generate, without user interaction, a viscous cartesian unstructured grid about arbitrary complex 3D geometries.

DESCRIPTION: One approach to generating unstructured grids about complex configurations for use in solving both the inviscid Euler equations of fluid dynamics and Maxwell's equations in electromagnetics, is to use cartesian unstructured grids to make a discrete field. The advantage of this approach is that, although the grid is book-kept as an unstructured grid, there is a high level of implicit structure, making grid generation and adaptation robust and automatic. For example, computational cells in 3D are always cubes, which are easily adapted by splitting a cell into 8 cubes. The adapted cells may be book-kept using an octree data structure, making the resulting data structure very amenable for parallel processing. The disadvantage is that using only cubes does not provide a layered body-conforming grid that would be capable of resolving the boundary layer flow for viscous fluid simulations. A novel approach already being used for the Euler equations is to generate a cartesian unstructured grid over a configuration by clipping the cubes that intersect the body surface, making the grid conform to the body. An extension to this concept, which would be suitable for viscous flow problems, would be to generate layers within the clipped body-conforming cells to resolve the boundary layer flow. This idea is called "level-distance cutting."

PHASE I: Generate a computer code that would be capable of generating a 3D cartesian grid with "level distance cutting" for simple configurations such as a wing. Demonstrate this capability by generating a grid and then solving for the flowfield using an unstructured Navier-Stokes method.

PHASE II: Improve the grid generator so that it is capable of automatically generating a 3D unstructured cartesian grid with level-distance cutting over arbitrary complex configurations such as the F/A-18E. Allow for the code to run in parallel and to be called from a parallel unstructured Navier-Stokes solver, and adapt the cubes in the inviscid portion of the flow as well as the viscous portions in the boundary layer. Include a highly accurate NURBS representation of the body surfaces to insure that adapted cells on the surface stay on the surface.

PHASE III: Develop a Graphical User Interface (GUI) to control the code and assess grid quality. Port the code, and make it efficient in speed and memory and run well on parallel computers.

COMMERCIAL POTENTIAL: The ability to automatically generate field grids over and within complex geometrical shapes would revolutionize aircraft design. Field grids are required to solve the equations of structures, fluids, and electromagnetics. Up to this point, the most demanding part of the process from a human interaction perspective is the handling of the geometry and the generation of the computational grid. It can take up to a full man year to develop a suitable grid over a complete aircraft configuration for a detailed computational fluid dynamic analysis. An automatic grid generator would reduce the time to generate a field grid by an order of magnitude, thereby, allowing highly accurate aerodynamic, structural and stealth data very early in the design phase. Accurate information and for trade studies early in the design phase translates to a potential savings of billions of dollars in the life-cycle of a naval system, as well as marked improvements in system capabilities. In short, any company that would develop the capability to generate field grids automatically would dominate in the world military and commercial aircraft business.

N96-191TITLE: High Lift Aerodynamics Shear Layer Transition Modeling

OBJECTIVE: To identify, incorporate into a Computational Fluid Dynamic (CFD) code, and then calibrate a turbulence model to be capable of accurately modeling laminar to turbulent shear layer transition for high lift military airfoil/wing configurations.

DESCRIPTION: State-of-the-art CFD methods are currently being exercised by industry and government in an attempt to predict the characteristics of high lift aerodynamic configurations. A recurring problem in both commercial and especially new military wing shapes driven by stealth requirements, is the lack of ability to predict the transition from laminar to turbulent flow in viscous shear layers. The result is a poor correlation with wind tunnel and flight data at carrier approach and maneuver conditions. Since wing leading edges for modern military profiles are typically sharp, the character of the resulting free shear layer plays an important role in predicting near stall and post-stall aerodynamic characteristics. Two-equation turbulence models have shown to be capable of modeling laminar to turbulent transition for a limited class of flows, namely, attached shear layers over a flat plate. This promising approach needs to be investigated for potential use on airfoil and wing shapes for attached and free symmetric and asymmetric shear layers.

PHASE I: Identify and incorporate into a 2D incompressible Navier-Stokes flow solver a turbulence model that has the potential of modeling laminar to turbulent shear layer transition. Then, use existing experimental data from recent detailed shear layer wake experiments, and modern military high lift airfoil experiments to calibrate the turbulence model for accurate modeling of attached and free shear layer transition, and turbulent boundary layer and wake development.

PHASE II: Incorporate the turbulence model developed above into a 3D incompressible Navier-Stokes flow solver. Moving from 2D to 3D is not straightforward, since by adding a third dimension, additional 3D fluid dynamic phenomena are introduced such as attachment line transition and re-laminarization, and 3D stretching of shear layers.

PHASE III: Incorporate the turbulence model into a 3D compressible flow solver that would be capable of efficiently modeling a realistic range of flow conditions from carrier approach (low subsonic) to high speed maneuvers in compressible flow regimes.

COMMERCIAL POTENTIAL: Commercial airframe companies working on conventional low speed aircraft as well as High Speed Civil Transport configuration options would benefit directly from any headway made in transition modeling. A tiny improvement in high lift capability is enough to dominate in the international aircraft business.

N96-192TITLE: Aircraft Weapon Bay Turbulent Flow Simulation Model

OBJECTIVE: Develop a computational turbulent flow model to predict the flowfield in the aircraft internal weapon carriage bay area when complemented with the wind tunnel test to ensure the smooth store ejection process.

DESCRIPTION: A need exists to design fighter/attack aircraft which carries the weapon internally due to stealth considerations. In order to deliver these internal-carried weapons smoothly, a methodology has to be developed to predict the complex turbulent flow in the weapon bay area with strong velocity gradient and unstable flow field to reduce very expensive wind tunnel tests. Fortunately, the recent development of numerical algorithms and computer hardware indicates that computational fluid dynamics techniques are mature enough to calculate this complicated flow phenomenon. Nevertheless, a sufficient accurate turbulent model still has to be developed so that the flowfield can be predicted quantitatively for practical design evaluation purposes. The model shall be able to describe the flowfield under the fuselage within the weapon bay area including the imbedded weapons at mach numbers between 2. and 0.2. to ensure clear weapon separation.

PHASE I: Provide a turbulent model with corresponding flow solver to compute the flowfield in the weapon bay area with imbedded weapons.

PHASE II: The method is expected to be extended to include the prediction of transient flowfield during the opening of the bay door for weapon separation.

PHASE III: Model will continue to be extended to predict flowfield of future modifications.

COMMERCIAL POTENTIAL: Modeling/simulation can be used for industrial turbulent flow prediction, for example, aircraft/helicopter noise level reduction prediction, jet flow prediction, etc.

REFERENCES:
1. N.E. Suhs, “Computations of three-dimensional Cavity Flow at Transonic Mach Numbers” AEDC TR 88-30
2. S.M. Dash, H. Sinha, etc., “Progress in the Unsteady Simulation of Jet Flowfields” AIAA-93-1921, AIAA/SAE/ASME/ASEE 29th Joint Propulsion Conference, June 1993, Monterey, CA

N96-193TITLE: SYSTEMS ENGINEERING ENVIRONMENT: Methods and Tools for Collaborative Systems Engineering at Geographically Distributed Sites

OBJECTIVE: To investigate processes, methods, and tools that would improve efficiency and accuratcy of system engineering. It is envisioned that system engineering will be performed in a collaborative manner by personnel located in geographically dispersed sites using a variety of heterogeneous computer resources. This research will investigate the relationships between current system engineering processes and the methods and tools that could be used for improvement. Particular research will be required to explore mechanisms to adapt method-intensive software tools to extant system engineering processes.

DESCRIPTION: DoD has a severe problem with system engineering. The problem is compounded by the increasing complexity of weapon systems and the economic demands for increased productivity in labor-intensive disciplines. This intensive work is done by individuals, single groups, and multiple groups, depending on project requirements. Current approaches use manual, informal, system engineering methods and processes that require large amounts of manpower and yet, at the same time, are subject to error because of the inherent complexity of the systems. Approaches are needed that integrate information processing and communications to support the guiding systems engineering processes while improving overall group productivity. This research delves into system engineering process and explores, devises, and develops useful tools. Of particular interest are solutions that support not only the mode where work groups function at the same time (synchronous mode), but also when the groups function at different times (asynchronous mode).

PHASE I: Research and analysis of prototypical system engineering to determine their potential usefulness. This feasibility investigation will result in a clearly defined direction in which to pursue further system engineering automation.

PHASE II: Analysis and integration of current NAWCAD and TEAM system engineering processes to further research into modifying them to work collaboratively with new methods (locking, security, transport) and computer based tools. Development of requirements for a full scale computer based System Engineering Environment. Coordination and cooperation with Rome Laboratories Advanced System Engineering Automation (ASEA) project, and Dr. David Hsiao's database work at the Naval Postgraduate School (NPS) will be essential.

PHASE III: Complete application of the International Council on System Engineering's (INCOSE) software process concepts to TEAM's distributed system engineering process. Further coordination with other efforts will be initiated and/or continue.

COMMERCIAL POTENTIAL: System Engineering practice is currently supported by very few automated tools. Those that are used are typically single user or single site. Providing distributed automation tailored to specific user domain needs has great potential for most mid-size to large corporations involved with system engineering activities.

N96-194TITLE: Innovative Control Design Impact for Aircraft

OBJECTIVE: Conduct a design impact study on how innovative aircraft control effectors can influence metrics such as cost, size, weight, producability, reliability/maintainability (R&M) and life cycle cost (LCC) of aircraft for both commercial, general aviation and military use.

DESCRIPTION: The necessity for aircraft in all areas of aviation to perform their mission in a cost effective manner while incorporating new and more challenging design requirements has resulted in the need to identify innovative design concepts that could effectively influence the cost, size, weight, producability, R&M and life cycle cost of operating the vehicle. Many design concepts are being explored for more universal implementation such as vortex flaps, thrust vectoring, canards, nose stakes/doors, etc., but have not `earned' their way on aircraft because limited design impact studies have been done to see how these concepts can replace `conventional' controls or downsize the vehicle.

PHASE I: Identify candidate control effectors for aircraft that can have a direct influence on the cost, size, weight, producability, R&M and LCC. Conduct a parametric study showing each of these controls versus each metric and how they influence the design in either a positive or negative way, or how they can be used in combination with other controls to affect the aircraft design. Show examples with existing aircraft of how positive candidate effectors could improve the design metrics without compromising the mission effectiveness of the vehicle. Propose experiments/tests or simulations for Phase II that could quantify these benefits to air vehicles. Consideration must be given to any effected subsystem and how this subsystem will be accounted for in terms of reliability if the supporting system is now a prime control effector. As an example, if thrust vectoring is assessed, show how the reliability of the engine is accounted for now that it supports a primary flight control. Consideration must also be given for vehicles that have low observability requirements and how these innovative controls factor in to a design with this additional challenge. Center of gravity influence on control design and design philosophy must also be addressed. All experiments/tests and/or simulations proposed for Phase II must specify what parts are GFE (i.e. government owned wind tunnel facilities, wind tunnel models, flight simulators, design tools, etc.) and what parts are funded within the $750K Phase II limit. The offeror may not propose a Phase II effort that requires additional government funding to secure the use of non-government owned test resources.

PHASE II: Conduct wind tunnel tests on candidate aircraft (to be supplied GFE or built as part of this effort) to acquire data to validate the parametric study developed in Phase I. This validation shall be done by incorporating the results of these tests into a flight simulation showing the comparison of a baseline flight control effector systems with an innovative design concept. Conduct additional experiments/tests/simulations, as necessary, to fully substantiate the improvements of the innovative design over the baseline aircraft as a function of the design metrics specified in Phase I. Develop software that can be utilized to conduct these parametric studies on any aircraft in order to assist designers in making critical design decisions that will positively influence aircraft design. Provide design recommendations tailored to commercial, general and military aviation.

PHASE III: Produce the software and design parametrics that can be utilized by all areas of aviation to support the aircraft design process. Ensure the product can be readily utilized by commercial, general and military aviation. Ensure the software has flexibility incorporated to accept future innovative design concepts not considered or considered infeasible during this study, but is developed at a later time.

COMMERCIAL POTENTIAL: Significant commercial potential exists since all areas of aviation are challenged to produce an air vehicle that can effectively complete its design mission in a cost effective manner. The incorporation of any innovative control effector will be a direct result of its value when compared to the design metrics of this study. General and commercial aviation designers are always in search of new methods of producing a profitable vehicle. Innovative control effectors can directly influence these potential profits.

N96-195TITLE: <u>Escape System Data Recorder</u>

OBJECTIVE: Design and fabrication of an on-board data recorder applicable to ejection seats.

DESCRIPTION: An on-board data acquisition system is needed to enable quantitative analysis as opposed to qualitative assessments of aircrew mishaps. The resulting data shall begin a detailed engineering data base of aircrew escape mishaps. To fully evaluate the ejection seat performance, full six-degree-of-freedom motion must be measured and stored, from just prior to the ejection until surface impact. The data system should be small, light-weight, and self-contained. Issues such as power supply, sensors, start indicator, storage device, electromagnetic interference, and generic attachment to the seat system shall be considered.

Additionally, this data recorder could be used to accurately determine the acceleration levels to which the aircrew are being exposed, thereby providing accurate human tolerance levels, and enabling a database for the percentage of risk associated with acceleration level.

PHASE I: Provide research, analysis, initial design, and bread-board mockup for the data recorder system.

PHASE II: Detailed design and fabrication of light-weight system prototypes.

PHASE III: Integration of the system in ejection seats.

COMMERCIAL POTENTIAL: Automotive crash systems and commercial aircraft application.

REFERENCES: MIL-S-18471G

N96-196TITLE: Hot Film Sensing of Vortex Shedding and Structural Dynamics

OBJECTIVE: To develop the capability of 1)using hot film sensors for sensing the frequency of vortex shedding and breakdown in vortical flows, and 2) correlating the frequency of vortex shedding with the resulting harmonic structural dynamics of aerodynamic surfaces such as wings, flaps, and vertical or horizontal tails.

DESCRIPTION: The use of hot film sensors and anemometry has recently become available for sensing Critical Aerodynamic Flow Feature Indicators (CAFFI), such as laminar to turbulent transition, and attachment and separation points. This new flow diagnostic technology is non-intrusive to the flowfield and has been demonstrated in wind tunnel and flight tests. Development of a system capable of monitoring the frequency of vortex shedding and breakdown and the structural response of aerodynamic surfaces in real time is the first step in developing a closed loop feedback control system for alleviating undesired structural responses. This approach solves the structural fatigue problem experienced by modern flexible airframes by determining its original fluid dynamic source, as opposed to merely adding strength, and therefore weight, to the airframe.

PHASE I: Test a generic double-delta wing with rigid and flexible vertical tails in a wind tunnel. Instrument the leading edges of the wing, the upper surface, and the vertical tails with multiple arrays of hot film sensors. Acquire real time data to determine the correlation between time dependent leading edge shear layer instabilities, vortex breakdown, and aerodynamic surface structural harmonics.

PHASE II: Conduct a wind tunnel test on a realistic aircraft configuration for which there exists flight data, such as the F/A-18C.

PHASE III: Develop a stand-alone real-time hot film system, consisting of sensors, anemometers, and software and hardware that could be used in wind tunnel testing, flight testing, or as an input to a flight control system on an aircraft.

COMMERCIAL POTENTIAL: The use of vortical flows in commercial designs is increasing. The High Speed Civil Transport (HSCT) configurations and the Space Shuttle all rely solely on vortical flows for low speed maneuvers, take-off (HSCT only) and landing. Improvements in understanding and modeling of these flows will have a direct benefit to the commercial market.

N96-197TITLE: Advanced Scanning Interferometer System for Characterization of Moving Surfaces.

OBJECTIVE: To develop a compact and portable full field interferometer for measuring periodic deformation of surfaces of ultrasonic transducers and other motion sensors and actuators. The unit should be capable of full field imaging at variable resolution (50x, 100x, 200x) with high vertical sensitivity (vertical displacement resolution < 1 nm) at nearly real time (10 sec or less for data acquisition plus around 30 sec or less for data processing). The unit should also image vibrating surfaces at frequencies ranging from 100 Hz too 100 Mhz. The full vibrating surface should be displayed immediately after the imaging process.

DESCRIPTION: With the development of new micro-electro mechanical systems (MEMS), advanced ultrasonic transducers, accelerometers, steering arrays, LED's and other motion transducers, the need for motion inspection is critical for rapid design validation. Present motion inspection systems are slow, large, requiring expensive vibration isolation equipment, with limited spatial and vertical resolution and limited spectral band spatial. This effort will significantly improve the inspection (and therefore the quality) of these new and advanced devices that are of critical importance to present and future DoD needs as well as in the civilian sector.

PHASE I: A proof of concept will be performed. The prototype system will have to image in full field and in near real time (less than a minute for data acquisition, data processing and displaying results) the surface displacement of the sensor or actuator. The prototype system should be capable of imaging surfaces that vibrate from 100 Hz to 10MHz.

PHASE II: In phase II the a complete system will be developed. The system should be desk-top based (preferable portable), with an optional sample vibrating stage for inducing mechanical oscillations in the sensor under study. The optical delivery system should allow for the use of different objective lenses (50x, 100x, 200x) as well as the capability of allowing the operator to view the surface being tested via a TV monitor through a CCD camera.

PHASE III: This inspection tool could be modified for quickly testing other transducers, heat sensors, and sonar applications.

COMMERCIAL POTENTIAL: This device can be used for the development and inspection of various transducers used in the civilian sector such as ultrasonic transducers used in automotive (intelligent damping) and commercial aviation industry.

N96-198TITLE: Wire Bonding Interconnects for High Temperature Silicon Carbide Electronics

OBJECTIVE: Development of a wire bond interconnect for silicon carbide semiconductor devices with survivability at 500 C.

DESCRIPTION: Semiconductor devices are currently being manufactured from a new semiconductor material - single crystal silicon carbide - that can withstand operating temperatures of 500 C. However, present-day wire bonding technology only allows operation up to temperatures of 200 C. Current wire bonding technology (generally consists of gold wire bonds) does not have the capability to survive elevated temperatures (500 C) for extensive periods of time without failure by several mechanisms which include corrosion, oxidation, intermetallic formation and metal creep. The objective of this SBIR will be for a small business to research, formulate and devise a high temperature bonding technology that will survive the rigors of a 500 C environment.

PHASE I: Determine the scientific feasibility of producing a high temperature wire bonded interconnect for SiC semiconductor devices. The study will require a historical and scientific assessment of present high temperature interconnect technology and its potential application to SiC devices. The efforts will also include the conception of new bonding materials/alloys and techniques to be used in high temperature systems. The suggested new wire bonding technology must be targeted specifically for use in new silicon carbide devices and engineered such that material and device operation incompatibility does not exist. The Phase I study will also provide an assessment of conventional wire bonding failure mechanisms and the potential for such mechanisms to cause failure of the conceived bonding technology. Methods to prevent such failure mechanisms from occurring will also be required.

PHASE II: Develop prototype wire bond specimens that will be subjected to high temperature exposure and temperature cycling. Aspects such as material compatibility, corrosion resistance, void formation, intermetallic formation and ohmic contact degradation will be ascertained after exposure to temperature. It is envisioned that, at least three different new high temperature bond wire interconnects will be evaluated.

PHASE III: Incorporate Phase II results in the silicon carbide device manufacturing.

COMMERCIAL POTENTIAL: The wire bond interconnect technology is not limited to military utilization. Silicon carbide devices will be utilized in any systems that demand survivability in high temperature and high power applications. Commercial applications include high temperature automobile sensors, deep well drilling applications, and jet engine/gas turbine applications. Military applications include high-temperature engine sensors and high-power microwave systems as well as power supplies, and radiation hard applications.

REFERENCES: Transactions, Second International High Temperature Conference, June 5-10, 1994, Charlotte North Carolina

N96-199TITLE: System and Algorithm Concepts for Automatic Detection and Classification of Non-Traditional Acoustic Signals

OBJECTIVE: Develop and demonstrate signal processing algorithms and display/MMI concepts which exploit non traditional sound sources in an Airborne ASW platform environment.

DESCRIPTION: The Navy Airborne ASW acoustic detection and classification systems have relied on traditional signal types for passive detection, classification, and tracking of enemy submarines. The change in the projected threat and areas of operation have shifted the primary mode of air ASW to active. This SBIR effort will capitalize on existing non traditional target sources which may be used to complement the primary active modes planned.

PHASE I: Provide innovative signal processing and system concepts which will operate in an adjunct mode for the detection, classification, and tracking of non traditional passive signals. The concepts must demonstrate sufficient performance metrics of detection and false alarm probabilities to add value to the planned airborne ASW systems, as well as feasible system implementation.

PHASE II: Develop, test, and operationally demonstrate the Phase I concepts using actual data in a prototype system. The test and demonstration may include both laboratory and flight tests. The prototype system must be consistent with transition of the concepts to fleet systems.

PHASE III: Implement the system concepts and algorithms in a fleet ASW platform configuration.

COMMERCIAL POTENTIAL: The concepts can be used as adjunct sonar processing in commercial surface craft or special military aircraft for the monitoring of sea life or for detection of water-borne sounds in emergency situations.

N96-200TITLE: Integrated Flight Performance Model for Various Aircraft Platforms

OBJECTIVE: To investigate the feasibility of developing the flight performance models for various aircraft platforms into one integrated system such that the effort of the future insertion of a new aircraft platform into the system is minimized.

DESCRIPTION: Tactical Aircraft Mission Planning System (TAMPS) is an interactive computer graphics system supporting aircrew oriented mission planning for U. S. Navy and Marine Corps airborne weapon systems. In order to support various aircraft platforms and weapon system requirements while maintaining consistent displays, user interfaces, and a common database, a set of core modules satisfies common planning requirements is provided. The core serves as a basis for integration of independently developed Mission Planning Modules (MPMs) supporting unique requirements. Each MPM supports valid flight maneuvers including military power climb, climb/cruise at optimum altitude, cruise/climb at optimum hemispheric altitude, best range cruise at specified altitude, normal descent, etc. There are commonalties in the flight maneuvers that are shared by each MPM. If there is a way to implement a super set of flight maneuvers in the TAMPS core so each MPM is able to use the required flight modes readily provided by the core, it could eliminate the need to design, implement and test the flight maneuvers for each MPM. Certainly this will reduce the cost of producing a MPM for each specific aircraft platform.

PHASE I: Research and analyze of Flight Performance Models for various aircraft platforms to determine their potential commonality and reusability. Initial study should use one aircraft from each type of aircraft platform (fighter, helicopter, cargo, EW, ASW, etc.).

PHASE II: Develop a prototype based on the result of Phase I analysis to demonstrate the feasibility of having one integrated flight performance model that supports many different aircraft platforms.

PHASE III: Incorporate improvements into TAMPS and future aircraft mission planning systems.

COMMERCIAL POTENTIAL: Potential use to other Government agencies, especially Air Force and Navy, as well as to the private sectors who need to reduce the software development cost and explore the reuse technology.

REFERENCE: DoD Flight Performance Module Interface Control Document, Version 2.0.2, September 1994.

N96-201TITLE: Using Multi-media for embedded Training within Application Software

OBJECTIVE: To develop a package that will allow application software developers to easily embed multi-media based training within their products.

DESCRIPTION: One of the major complaints within the Fleet today is insufficient training for the application software that has proliferated into the Fleet. This software is under constant change. Staff personnel are in frequent rotation, and there is a lack of funds and time to keep re-training fleet personnel in the software's operation. This has led to a demand for some kind of embedded software training. Using multi-media to accomplish this training will increase the effectiveness of such training, provide fleet personnel with interactive-feedback training, and enhance utilization of the application software.

PHASE I: Investigate various methods of doing embedded training using multi-media. Develop an approach for a generic embedded training tool that will allow application developers to provide training as a portion of their application. Write a report detailing the methods investigated, the approach developed, and reasons for the choice.

PHASE II: Implement an embedded training tool based on the work in Phase I. Use an X-Windows / Motif based system such as Joint Maritime Command Information System (JMCIS) as a target test platform and application.

PHASE III: Generalize the tool developed in Phase II for multiple Hardware/Software based platforms.

COMMERCIAL POTENTIAL: With the increase in complexity of commercial software products, embedded training would reduce software support costs, eliminate training video production costs, and potential increase sales due to having a more complete software product.

N96-202TITLE: A POSIX Interface for the F-22 Common Integrated Processor Avionics Operating System

OBJECTIVE: To determine the extent to which the Avionics Operating System (AOS) for the F-22 Common Integrated Processor (CIP) can offer a POSIX conforming Application Program Interface (API) for its services.

DESCRIPTION: The Joint Advanced Strike Technology (JAST) program seeks to reap the benefits of open systems technology by utilizing POSIX conforming interfaces to its operating system(s), thereby realizing increased software portability, interoperability, and reusability over the life cycle of the program. However, the program also seeks to maximize software reuse and minimize development cost and risk by using a proven operating system implementation which already provides fault tolerance and security policies appropriate for embedded military avionics software: namely, the AOS produced by Hughes Aircraft Company for use in the CIP aboard the F-22 aircraft.

The AOS provides an Ada-language API to its services, but that API is currently not POSIX conforming. Research is needed to determine the mapping between the services provided by the AOS and a set of POSIX conforming interfaces. The goal of this research would be a modified AOS with complete conformance to an appropriate POSIX profile, yet retaining most of its original design and implementation. Such an operating system implementation would satisfy both JAST program goals in a timely and cost-efficient manner.

PHASE I: Phase I will partition and compare the functionality of the AOS with the underlying functionality implied by POSIX APIs; all POSIX APIs will be considered: those which are already IEEE and/or ISO standards, and those which are still draft standards; regardless of whether or not Ada bindings to those APIs and draft APIs are currently available. Those APIs deemed inappropriate for embedded realtime avionics applications will be eliminated from the profile and from future consideration. The goal is to identify three areas:(1)The intersection: where POSIX interfaces provide access to AOS services in a relatively straightforward manner. This is not likely to be a simple one-to-one mapping; a paradigm shift is anticipated, but the underlying functionality of AOS can generally be utilized to support the POSIX interfaces. (2) Unsupported POSIX APIs: Those POSIX interfaces (appropriate to the specified embedded realtime avionics profile) which are not supported by any underlying AOS functionality. (3) Unsupported AOS functionality: Those AOS services which cannot be accessed through any POSIX conforming interfaces.

A large intersection with minimal unsupported APIs and functionality would justify continuing this effort into Phase II. Unsupported AOS functionality so identified should be transitioned to POSIX as a new Ada Bindings project with the AOS Software User Manual as its base document.

PHASE II: During phase II, proof of concept, the contractor will produce a thin layer of software utilizing existing AOS APIs to provide a POSIX conforming API environment. An representative F-22 subsystem or sub-application will be redesigned and recorded to use the POSIX APIs. For AOS functionality that is inaccessible through the POSIX conforming APIs, existing AOS APIs will be retained, but no AOS API will be used which provides a service accessible via POSIX conforming APIs. The resulting application shall be tested and its performance evaluated while operating with AOS and the contractor developed software layer. Where performance degradation is detected, the contractor will determine if such degradation is merely the result of the redundant software layer, or can be directly attributed to inefficiency caused by using the POSIX APIs. Success will be measured by percentage of the application which can be written as a strictly conforming POSIX application, and the relative performance of the redesigned application with respect to the application interfacing directly to AOS via its native APIs. The contractor will support an Ada Bindings amendment (for APIs to support AOS unique functionality) within the POSIX standards process, and attain the status of a draft standard.

PHASE III: Phase III involves integration of the POSIX conforming interfaces directly into AOS, either completely replacing its native APIs or offering an alternative API set. This phase would eliminate the performance degradation associated with the additional mapping/binding software layer, and yield a production quality implementation of AOS with POSIX bindings. Because this implementation would be required to support the unsupported POSIX APIs identified during Phase I, the implementation may need to be augmented with additional functionality so that other applications (including reusable software components) conforming to the specified POSIX embedded realtime avionics profile would be fully supported. By this phase, a POSIX project to amend the POSIX Ada bindings to support all the AOS functionality should be well underway, there should be little, if any, need for nonstandard APIs.

COMMERCIAL POTENTIAL: By demonstrating that the DoD is serious about its commitment to POSIX interfaces, and that such interfaces are applicable to non-traditional-UNIX applications such as avionics and weapons systems, commercial vendors of realtime kernels and operating systems targeted to other military and non-military application domains would be encouraged to provide implementations with a POSIX conforming interface, thereby increasing the market for their products while expanding support for the open systems concept in the commercial sector.

REFERENCES:

1. Software User Manual for the Avionics Operating System of the F-22 Common Integrated Processor, Hughes Aircraft Company;

2. IEEE PASC standards and draft standards from the POSIX project;

3. POSIX Delta Document for the Next- Generation Computer Resources (NGCR) Operating Systems Interface Standard Baseline, SPAWAR-331.

N96-203TITLE: Incremental Modernization of Legacy Software Systems(IMLSS)

OBJECTIVE: Define processes and develop technology that supports the incremental modernization of large scale legacy software systems.

DESCRIPTION: The DOD has deployed many large scale software systems over the last two decades. Most of these software systems are still in use and have been continuously repaired, enhanced, and maintained since deployment. These software systems are frequently based upon obsolete technologies (e.g., operating systems, languages) and cannot be modernized to current technologies due to cost. If processes and technology existed that allowed modernization in a cost effect manner, the life cycle of these software systems could be significantly extended. Processes and technology are needed that will allow modernization of large scale software systems in smaller, incremental steps. Of special interest are processes and technologies that can handle obsolete operating systems, outdated source code, improve understanding of the software and associated documentation, improve maintenance through reuse libraries, improve testing by use of simulation, and provide new methods for utilization, scheduling and optimization of distributed computer resources.

PHASE I: Identify processes to be established. Show the impact on current development and maintenance processes. Study, analyze, document, and prioritize innovative technologies for incremental modernization of large scale legacy software. Identify benefits and risks of using these technologies.

PHASE II: Provide a prototype demonstration of the feasibility of incrementally modernizing large scale legacy software.

PHASE III: Having shown feasibility, apply the techniques to candidate systems. Examples include but are not limited to the SH-60B and S-3B.

COMMERCIAL POTENTIAL: The commercial potential is high. Many commercial software systems face the problem of converting legacy software to new technologies. IMLSS processes and technology can be used to economically convert existing software systems to improved software systems that use current technology.

N96-204TITLE: Transitioning Embedded Avionics Software from Ada 83 to Ada 95

OBJECTIVES: Conduct research to determine the feasibility, pitfalls and benefits transitioning existing DOD programs to Ada 95.

DESCRIPTION: The introduction of Ada 95 presents the DOD with a powerful new tool for implementing their software systems. The combination of its modern software engineering features, along with the reliability, safety, and maintainability of Ada 83, make the new version of the language a viable technical option for any domain. Even though Ada 95 is designed to be a robust superset of Ada 83, past experience dictates there will be risks in the transition. Experience also dictates that transition is also inevitable as support for Ada 83 dies off.

PHASE I: Phase I will result in the selection of an existing embedded avionics system that meets the following criteria: At least 85% of the code must be written in Ada 83, the system should be of medium size (25 KLOC to 100 KLOC), and the compiler vendor that supplies the Ada 83 compiler system must provide an Ada 95 version of the same compiler system. A set of metrics shall be identified and collected for both the Ada 83 system and the transitioned Ada 95 system. Examples of metrics to be collected are executable code size, system throughput, design, code and test hours, etc. The existing Ada 83 system will be rebuilt in Ada 95, and the Ada 95 code will be tested utilizing the existing test procedures developed for the Ada 83 system. Products of phase I will include Ada 95 source code, a software test report, a technical paper detailing results and lessons learned from the transition, and detailed project plans for Phase II.

PHASE II: Phase II will result in the redesign of the system selected during Phase I. The redesign of the system will be implemented in such a way as to: (1) maximize use of the new Ada 95 features in new/future modifications, (2) maximize the integration between old Ada 83 data structures and new Ada 95 data structures. Metrics identified and collected during phase I will again be collected for the redesigned system, and the new system will be tested utilizing the same test procedures as used for Phase I. Products of phase II will include Ada 95 source code, a software test report, and a technical paper detailing results and lessons learned from the transition.

PHASE III: During phase III, the system will be released for project use and applied to other embedded systems.

COMMERCIAL POTENTIAL: Ada 83 is not strictly a DOD programming language. Both Boeing and Rockwell-Collins use Ada 83 for their commercial avionics applications, and Weirton Steel utilizes Ada 83 in their plant process control system. Ada 83 will be used in NASA's Space Station's Software Support Environment, the on-board data systems, the ground data systems, and all robotics and flight software. Any of the agencies listed above, as well as, any other agency using Ada 83 technology, can benefit from the results of this research.

REFERENCES:
1. Ada 9X Transition Planning Guide, Version 1.0
2. Ada 9X Adoption Handbook
3. Ada 95 Language REFERENCE Manual

N96-205TITLE: Adaptive Optics for Advanced Laser Systems

OBJECTIVE: Provide a correction for laser beam distortion by atmospheric turbulence in airborne, laser-based infrared countermeasures (IRCM) systems laser rangefinders (LRF), and laser target designators (LTD). The goal is to increase the fluence on a target by an order of magnitude under turbulent conditions.

DESCRIPTION: Tri-service efforts are currently under way to develop laser based countermeasures systems to defeat advanced heat seeking missiles. However, atmospheric turbulence in the boundary layer surrounding the aircraft causes a significant reduction in laser radiance (brightness). The laser power must be increased to compensate for the loss in radiance due to atmospheric turbulence. Adaptive optics has been successfully developed for use in large astronomical telescopes to compensate for atmospheric distortions. A decade ago, adaptive optics with deformable mirrors and wavefront sensors, was considered to be an exotic technology. New interest in dynamic beam quality control for industrial applications such as precision laser welding has stimulated interest in developing simpler adaptive optics components and software. This effort seeks to develop innovative adaptive optics components and techniques for use in Navy airborne advanced IRCM systems, LRFs and LTDs.

PHASE I: Conduct a feasibility study which defines practical and affordable system concepts based on adaptive optics technology for correction of laser beam distortion by atmospheric turbulence. The feasibility study will include the following areas: (a) estimate turbulence effects on laser system performance; (b) investigate various beacon options; (c) define an advanced adaptive optic component concept; and (d) define an advanced adaptive optic system configuration. The end product is a technical report describing the adaptive optic concept and estimated performance.

PHASE II: Design, build and test brassboard adaptive optic system based upon the concept defined in Phase I for use in advanced laser based IRCM and precision targeting systems.

PHASE III: Produce a fieldable adaptive optic system, which will be integrated into Navy airborne IRCM and precision targeting systems.

COMMERCIAL POTENTIAL: New affordable adaptive optics components including wavefront sensors can be used in industrial precision laser welding and processing systems.

REFERENCES:
1. L. E. Schmutz, “Adaptive Optics Comes of Age”, Lasers & Optronics, pages 25-26 (Dec 1994);
2. R. Q. Rugate and W. J. Wild, “Untwinkling the Stars - Part I”, Sky & Telescope, pages 24-31 (May 1994)

N96-206TITLE: Laser Beamrider Detection

OBJECTIVE: Develop a fiber optic coupled laser warning sensor capable of detecting and locating laser beamrider (LBR) weapon’s systems targeting Navy aircraft.

DESCRIPTION: Laser warning sensors, such as the AN/AVR-2 have been installed on Navy and Marine Corps helicopters to protect against weapon’s systems using laser rangefinders and laser target designators. Fiber optics coupled laser warning sensors have been developed for use on high performance aircraft. These laser warning sensors (LWS) provide laser detection, angle of arrival, wavelength discrimination and temporal characterization of the laser source. However, these laser warning devices are not sensitive enough to detect and characterize laser beamrider weapon's systems. This effort will develop a fiber optic coupled laser warning sensor for detection of LBR weapon's systems operating in the near infrared spectral range (.75 to 1.1 ìm).

PHASE I: Provide a feasibility study, which demonstrates the sensitivity required for LBR detection in the near infrared spectral range using a fiber optics coupled laser warning sensor. The end product is a report defining the LWS concept, the laboratory demonstration and final system configuration. The LWS shall provide LBR detection and information on angle of arrival, pulse width and pulse repetition frequency (PRF).

PHASE II: Develop and test a brassboard fiber optic coupled LWS based upon the concept demonstrated in the Phase I effort.

PHASE III: Produce the fiber optic coupled LWS demonstrated in Phase II for use on Navy and Marine Corps aircraft.

COMMERCIAL POTENTIAL: There is a need for laser radiation warning devices, especially for “invisible” infrared lasers used in medical diagnostics, surgery, industrial processing and welding, and in research applications. The high power laser market for medical and industrial applications is growing at the rate of 9000 lasers per year.

REFERENCES: S. M. Hardy, “Taking Threats Too Lightly?”, Electronic Defense, Vol. 16, No. 10, pages 47-52 (October 1993).

N96-207TITLE: High Brightness, Wavelength Selectable, Pulsed Solid-State Laser Sources.

OBJECTIVE: Develop, compact, high brightness, pulsed solid state laser sources in the 1.5 to 10 micrometer (ìm) wavelength range.

DESCRIPTION: Current techniques for generating medium-pulse energy eyesafe-radiation use nonlinear-optical processes that can be efficient and compact, but have a poor optical beam quality. For many military applications, medium pulse energy with good beam quality in a simple, compact, rugged package is highly desirable. Some of the applications include airborne surveillance, target tracking and discrimination for theater missile defense, and remote sensing. Innovative approaches for the development of wavelength selectable solid state laser sources in the eye safe wavelength range of 1.4 to 2.5 ìm are sought. The proposed technology should emphasize medium single pulse energy (> 500 milli-joules) with near diffraction limited beam quality. For Navy airborne applications, the proposed technology should lead to laser devices, which are compact, lightweight, efficient and reliable at an affordable cost.

PHASE I: The goal is to determine if the proposed concept is viable for airborne applications in terms of size, efficiency, and wavelength selectivity. If feasible, a breadboard prototype will be built and demonstrated. The end product of Phase I is a report describing the approach to generate > 500 mj laser pulses at a pulse repetition frequency (PRF) of greater than 50 Hz in the eyesafe wavelength range (selectable) with near diffraction limited beam quality.

PHASE II: Develop and test a brassboard high brightness, eye safe laser source with near diffraction limited beam quality.

PHASE III: Produce engineered production models of the laser source developed in Phase II for commercial and military systems.

COMMERCIAL POTENTIAL: Laser sources in the 1.4 to 2.5 ìm range have commercial applications including lidars for wind shear and turbulence detection, gas leak detection, pollution monitoring, surgery and materials processing.

N96-208TITLE: Unmanned Aerial Vehicle(UAV) Low Probability of Intercept (LPI) Communications Relay and Interrogator for the Search and Rescue Beacon Transponder

OBJECTIVE: Develop a low probability of intercept UAV communications relay and interrogator for the search and rescue beacon transponder

DESCRIPTION: Future military operations involving highly mobile forces ashore will require communications that must be flexible and reconfigurable to meet rapidly changing command and control requirements. Deployment time, terrain limitation, distance, responsiveness, and survivability will heavily tax the capabilities of available communication assets. The UAV based communications relay system can provide a cost effective, re-usable and flexible means of connecting widely dispersed tactical units and individuals.

The UAV LPI communications relay/interrogator will be used for range extension between the Services's LPI communications radios in support of the covert operation and highly secure military communications. It will serve a communication range extension assets when satellite communication is not available and when the manned airborne communication asset is not operationally viable.

Through sharing of common hardware and programmability of the embedded software, a combined LPI radios relay and search and rescue beacon transponder interrogator can be built to fit on the UAV. This same communications relay will serve as the airborne interrogator to quickly locate the downed airmen or contact the special forces to ascertain their precise position for rendezvous and pick-up, when they are suitably equipped with the Services' standard survival radios. PHASE I: Investigate the adaptation of LPI communications relay and search and rescue beacon interrogator technology for UAV applications. Conduct a feasibility study and perform architecture definition, technology trades and requirements analysis.

PHASE II: Develop prototype hardware, and demonstrate a UAV based LPI communications relay and search and rescue beacon interrogator system which must be low cost and easy to deploy.

PHASE III: Produce the complete UAV LPI communications relay/interrogator system for operational testing.

COMMERCIAL POTENTIAL: The UAV LPI communications relay/interrogator system can be used by the law enforcement agency and counter narcotic operations.

N96-209TITLE: Unmanned Aerial Vehicle(UAV) Based Magnetic Anomaly Detection (MAD) for Small Submarine Hunting in Shallow Water and Over-the-Land Reconnaissance

OBJECTIVE: Develop a low cost/lightweight UAV MAD sensor suite for shallow water submarine detection and land surveillance

DESCRIPTION: Naval expeditionary warfare requires our amphibious and naval fire support ships to operate ever closer to the hostile shore for extended period. World-wide proliferation of small diesel submarines operating in and out of small inlets and in shallow waters can pose serious threats to our forces. The traditional detection methods against those threats, i.e., periscope detection using inverse synthetic aperture radar, or sonar have inherent shortcomings when operating in a land clutter dominated environment and in shallow water. High valued naval aviation assets used to hunt down those elusive threats suffered undue risks in prolonged exposure while operating very close to the hostile territory. UAV based MAD payload can be a cost effective way to screen and localize the shallow water submarine threats prior to handing off those targets to other combatants for further prosecution.

Another critical aspect of the naval expeditionary warfare problem is the location of high valued concealed targets, i.e., underground reinforced command and control bunkers and concealed aircrafts and missiles concrete shelter which can be hard to locate and kill. Also the extensive use of covered revetments for tanks and artillery evident in the last regional conflict can pose great risk to our ground combat teams upon contact unexpectedly. EO/IR and radar surveillance sensors have inherent limitation in ferreting out these underground threats. UAV MAD payload combined with advanced signal processing techniques can be a powerful adjunct in marking out these high priority targets for later destruction.

UAV sized MAD sensor is expected to be highly sensitive to detecting any local variation of the earth's magnetic field due to the presence of an embedded mass of steel and concrete structure and in locating small submarines in shallow water. Equipped with GPS based navigation, the UAV MAD can map a large area and report the presence of any hidden targets through the enhanced signal processing technique and report the target location.

PHASE I: Investigate the adaptation of a lightweight MAD sensor and signal processing technology for UAV applications. Conduct a feasibility study and perform architecture definition, technology trades and requirements analysis.

PHASE II: Develop prototype hardware/software, and demonstrate a UAV based MAD system which must be low cost and easy to deploy.

PHASE III: Produce the complete UAV MAD sensor suite for operational testing.

COMMERCIAL POTENTIAL: The UAV MAD sensor suite can be used to for commercial geoprospecting and civilian remote sensing applications.

REFERENCES: UAV Master Plan 1994, available from the Naval Air Systems Team Public Affairs Office. (Contact Cathy Nodgaard at 703-604-2437 x6309)

N96-210TITLE: Optical Beam Forming Network

OBJECTIVE: The large volume, weight, power and cooling systems have restricted the full performance of the radar aboard the Navy carrier based aircraft, such as the Airborne Early Warning (AEW) radar. Hence this objective is to replace the cumbersome radar devices with the Optical Beam Forming (OBF) network.

DESCRIPTION: The OBF network operating as an active array with solid state modules is to provide the true time delay. Its design with Photonic phase shifters is to allow for enhanced performance and reduce the cooling system, such as in the AEW radar. The true time delay and beam agility should provide for beneficial Direction Finding (DF) mission, and still utilize fewer DF antennas.

PHASE I: Conduct the OBF array system analysis and tradeoff analysis. Design the OBF active array with critical components necessary for development and demonstration.

PHASE II: Fabricate the airborne OBF active array prototype that will be used for field testing on the ground.

PHASE III: Develop the OBF system that is flight worthy for an initial Unmanned Aerial Vehicle (UAV), and followed by Navy/Marine carrier based aircraft demonstration.

COMMERCIAL POTENTIAL: It will provide for low-cost commercial systems required for the search, detection, and DF tracking of targets. The target could represent a surface vehicle, land or sea, with a survivor(s) who needs to be rescued.

REFERENCES: Mil-Std-1773

N96-211TITLE: Ytterbium Yttrium Orth-Vanadate (Yb^{3+}:YVO_4) Laser Crystals

OBJECTIVE: Grow high optical quality ytterbium yttrium ortho-vanadate (Yb:YVO_4) crystals for use in 1 micrometer (ìm) lasers.

DESCRIPTION: Neodymium (Nd^{3+}) YAG lasers are used in a wide range of both medical industrial and military applications. Navy applications of solid state Nd:YAG lasers include laser rangefinder, laser target designator, airborne target surveillance tracking and discrimination, EO/IR countermeasures, periscope detection, non-acoustic anti-submarine warfare (ASW) and mine detection. Diode pumped, Nd:YAG lasers are now available for use in military systems with improved efficiency and reliability at the expense of increased cost. Recently, researchers have demonstrated efficient laser operation with Yb:YAG lasers with an output at a wavelength of 1.03 ìm versus 1.064 ìm for the Nd:YAG laser. As compared to Nd:YAG laser, the ytterbium laser offers the following improvements (a) reduced thermal heating and optical distortion, (b) reduced number of laser diode pumps and hence lower costs and (c) less thermal control of laser diodes due to wide absorption bands. This effort will further improve the performance of the ytterbium laser by doping the Yb^{3+} ion into the YVO_4 host crystal.

PHASE I: Provide a feasibility demonstration of the growth of Yb:YVO_4 crystals of suitable optical quality and size for conducting spectroscopic studies and laser experiments. Crystal samples of a few millimeter size will be grown at Yb^{3+} dopant levels of 1, 3 and 5 atomic percent. Crystals will be cut and polished for spectroscopic analysis. Spectroscopic measurements will be conducted to determine the crystal absorption and fluorescence emission characteristics.

PHASE II: Grow, develop and test Yb:YVO_4 crystals of high optical quality and large size for use in commercial and military laser systems. Grow and deliver fabricated laser rods suitable for InGaAs diode laser pumping with loss of less than 0.1% per cm, size at least 3 by 30 mm and dopant level selected during the Phase I SBIR program.

PHASE III: Produce Yb:YVO_4 crystals for use in production military and commercial diode pumped, solid state laser systems.

COMMERCIAL POTENTIAL: Ytterbium laser operating at 1 micron output wavelength have commercial application in industrial machining, material processing, medical diagnostics and surgery. With nonlinear optic frequency conversion ytterbium lasers have application in x-ray lithography, remote sensing, optical data processing and storage and other photonics applications.

REFERENCES:
1. D. S. Sumida, CLEO 1995 Technical Digest, 174 (1995)
2. C. D. Marshall, etc., CLEO 1995 Technical Digest, 81 (1995)
3. L. DeShazer, Laser Focus World, February (1994)

N96-212TITLE: Corrected Fiber Optic Laser Beam Delivery

OBJECTIVE: Develop a fiber optic laser beam delivery system with nearly diffraction limited beam quality.

DESCRIPTION: Large core, multimode optical fibers are used with high power lasers for beam delivery in medical and industrial applications. However, the output from these multimode fibers is highly divergent, distorted and depolarized. For Navy airborne systems such as laser target designators (LTG), laser rangefinders (LRF), and electro-optic countermeasure (EOCM) jammers, it is desirable to have a high power laser beam delivery system with nearly diffraction limited beam quality. This effort will provide an innovative concept of a fiber optic laser beam delivery system for use with high power, short pulse width lasers for Navy applications.

PHASE I: Provide a feasibility study, which demonstrates the concept for a high quality fiber optic laser beam delivery system. Proof of principle experiments will be conducted with a nearly diffraction limited Q-switched Nd:YAG laser operated at 1.064 and 0.532 micrometer (ìm) output wavelength. The goal is to transmit at least 70% of the input beam with nearly diffraction limited output beam quality over fiber optic lengths of 5 to 10 meters. For Phase I a fiber optic length of 1 meter is acceptable.

PHASE II: Develop and test a fiber optic laser beam delivery system, which provides the transmission of 1/2 to 1 joule "Q"-switched laser pulses over fiber optic lengths of 10 meters with nearly diffraction limited output beam quality.

PHASE III: Produce the fiber optic beam delivery system demonstrated in Phase II.

COMMERCIAL POTENTIAL: Laser beam delivery systems for high power lasers are used in medical and industrial processing applications.

REFERENCES:
1. G. J. Dunning and R. C. Lind, Opt. Lett. 7, 558 (1982)
2. S. C. Matthews and D. A. Rockwell, Opt. Lett. Vol. 19, No. 21, 1729 (1994)

N96-213TITLE: Engineered Infrared Nonlinear Optical Materials

OBJECTIVE: To develop techniques to construct large nonlinear optical devices for doubling 9.2 and 10.6 micron radiation from a pulsed CO_2 laser or use as an optical parametric oscillator (OPO) for converting 2 or 1 micron laser radiation to the 2-5 micron band. The Navy is interested in materials that can handle high average power input, ~100 watts with PRF in the multi Khz range.

DESCRIPTION: This research approach is directed to examine engineering of non-birefringent, nonlinear optical materials to construct a quasi-phased-matched structure. The materials used in bonding must be commercially available. Materials should be considered that double 9 to 11 microns to 4.5 to 5.5 microns and can also be used as an OPO for generating the 2-5 micron band. Techniques for bonding layers of nonlinear material or growing of quasi-phase-matched (QPM) materials directly are acceptable. Other material can be used in the construction, however the overall device must work considering thermal effects and optical damage thresholds. The approach developed in phase I should lead to QPM nonlinear optical structures which are able to demonstrate efficiencies in excess of 30% by the end of phase II

PHASE I: The awardee should demonstrate the ability to construct IR nonlinear materials without a measurable interface loss.

PHASE II: The awardee must construct a nonlinear device with a 1 x 1 cm aperture, can reach at least 30% efficiency and greater than 30W output power. The vender may use a test system provided by the government (NAWC) to demonstrate the materials performance.

PHASE III: Produce QPM nonlinear optical structures for use in laser systems for industrial, medical and military applications.

COMMERCIAL POTENTIAL: QPM nonlinear optics can be used to frequency down-convert Nd:Yag lasers and frequency up-convert carbon dioxide lasers to the mid infrared spectral range. laser sources emitting in this spectral range have commercial applications which include wind shear detection, pollution monitoring, remote gas leak detection and medical surgery.

REFERENCES:

1. "Analysis of a CdTe and CdMnTe quasi-Phasematched Optical Parametric Oscillator and Amplifier", William J. Scharpf B. P. Boczar, Optics Comm. 103 (1993) 429

2. "Diffusion Bonded Quasi-Phasematched GaAs", L. Gordan, G. L. Woods, R. Route, R.S. Feigelson, R. C. Eckardt, M. M. Fejer, R. L Byer, Conference on Laser and Electro Optics (CLEO), CPD10, (1993)

N96-214TITLE: Image Matrix Merger

OBJECTIVE: To develop a FLIR image frame buffer/processor and required optics to allow multiple sequential images to be merged into a larger image.

DESCRIPTION: FLIR systems need a larger Field Of View (FOV) and increased resolution. This can be achieved by making the FLIR sensor array image a set of adjacent FOVs sequentially and then merge the result. The resulting combined image will have twice the horizontal & vertical FOV if four images are merged and no loss in resolution (or twice the resolution with no change in FOV). However an image processor is required to capture the images, then stretch & shift them to correct for aircraft movement so they all appear as if taken from the same aircraft location/orientation. The merged corrected image is displayed at 60 Hz though the composite update rate is low. The image processor must receive pitch, roll, yaw, altitude & velocity parameters from the aircraft and use it to compute shifting, rotating and stretching of the image at pixel rates. System distortion mapping and anti aliasing should also be included. Transport delay should be minimized.

PHASE I: Show feasibility which identifies fidelity impact, constraints, total system impact & efficiency. Include velocity, roll-pitch-yaw rates, slew rate, altitude above terrain, ratio of terrain/feature height vs altitude, number of images in a set, image overlap, update rate, display update rate, minimum visible slant range, etc. Specific beneficial situations should be identified (E.G. helicopter above 500 feet at 150 knots and roll less than 30 degrees per second may have 9 images in a set for triple resolution improvement). Develop required architecture, develop translation equations. Determine feasibility of algorithms, data rates, memory requirements etc.

PHASE II: Develop and build a prototype to test and operationally demonstrate the methods & system formulated in Phase I. The prototype shall demonstrate all software. The prototype may be a modification to a commercial FLIR.

PHASE III: Incorporate this new technology into new FLIR designs and modify current FLIRs with system upgrades.

COMMERCIAL POTENTIAL: Police surveillance.

REFERENCES: Riner, Bruce & Blair, Browder (1992) Design Guidelines for a Carrier-Based Training System. Proceedings of the 1992 IMAGE VI Conference (pp.65-73).

N96-215TITLE: Innovative Methods for Minimization Glass Bead Abrasive Blasting Hazardous Waste Stream

OBJECTIVE: To develop processes and procedures which use innovative methods for the minimization of glass bead abrasive blasting, creating a hazardous waste stream. The method(s) shall be both economically and technically feasible.

DESCRIPTION: Currently, glass bead abrasive blasting, is one of the highest sources of hazardous waste at Naval Aviation Depots. Because of the way it is handled at some facilities, the cost of deposing of this blasting residue can be less than deposing of media as nonhazardous waste, so there is not an economic penalty for this waste. The NAVAIR 01-1A-509 Aircraft Weapons Systems Cleaning and Corrosion Control Manual contains procedures for glass bead abrasive blasting operation.

PHASE I: Identify and develop innovative method(s) to minimize the glass bead abrasive blasting hazardous waste stream that will meet current environmental laws/regulations. Conduct preliminary laboratory testing to demonstrate the feasibility of the method(s). Conduct an economic analysis of the alternatives.

PHASE II: Further develop the procedures to implement successful method(s) based on Phase I results. Conduct both laboratory testing and field testing. The method(s) shall be prototyped at one of Naval Aviation Depots. The processes and procedures shall be documented in a format that both industry and government facilities can use. The prototype set-up shall be a deliverable.

PHASE III: Once method(s) have been demonstrated and certified in Phase I and II efforts, the method(s) shall be made available for Navy, government, commercial, and/or other use.

COMMERCIAL POTENTIAL: Methodology shall be transferable to commercial aircraft maintenance and overhaul sites utilizing glass bead abrasive blasting. Any minimization techniques identified during this research project will also be applicable to any industries using glass bead abrasive blasting.

REFERENCES:
1. MIL-G-9954
2. Technical Manual NAVAIR 01-1A-509 pages 5-1, -10, -11, -12, and -13. (Contact Cathy Nodgaard at 703-604-2437 x6309)

N96-216TITLE: Single Component Sealant for Watertight Integrity and Corrosion Control

OBJECTIVE: To develop a single component fast curing sealant.

DESCRIPTION: Access panels are routinely and hurriedly removed and replaced during aircraft maintenance while aircraft are parked on aircraft carrier flight decks in-between at sea flight operations. Fasteners are currently sealed with two-component epoxy sealant which in most cases is not cured completely before aircraft are flown. The resultant air flow during flight pushes the soft epoxy sealant away from the fasteners, and corrosion protection is removed. A fast drying single component sealant is needed for corrosion protection that provides adequate sealing and allows easy fastener removal. The NAVAIR 01-1A-509 Corrosion Manual contains approved aircraft sealant applications as well as individual aircraft maintenance instruction manuals (MIMs).

PHASE I: Adapt or develop a single component fast drying sealant for aircraft use with the following characteristics: a 350 degree F. capability (not mandatory), meet all environmental regulations, paint will adhere to, be flexible/malleable, be in liquid form and ambient temperature storage (not mandatory). At the end of Phase I, the contractor will forward a sample of the single component sealant system to the Naval Air Warfare Center, Aircraft Division, Patuxent River, MD for evaluation.

PHASE II: Further develop the new single component sealant system developed under Phase I. Conduct both laboratory testing and field testing. The testing shall demonstrate that the new single component sealant meets all the performance requirements and environmental laws/regulations for target application(s). If necessary, propose amendments to existing military specification or propose new military specifications for this single component sealant.

PHASE III: Produce the single component sealant system demonstrated in the Phase II effort for both the military and commercial market.

COMMERCIAL POTENTIAL: The new single component sealant 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: MIL-S-81733, MIL-S-83430, MIL-S-29574 and MIL-F-7179

N96-217TITLE: Optical Time Domain Reflectometer Development

OBJECTIVE: To develop a time domain reflectometer that is compatible with 100/140/172 micron fiber optic cable.

DESCRIPTION: The Aerospace Industry has developed a 100/140/172 micron fiber optic cable for high speed data transmissions between avionic systems. Connector and splice technologies have followed the cable development, establishing a complete fiber optic interconnect system that is repairable. It is necessary to perform simulated function checks of this system during installation and maintenance. Time domain reflectometry offers excellent diagnostics of the interconnect system when performing the simulated functional analysis. The Aerospace Industry has identified the required functions for an optical time domain reflectometer (OTDR), and they are as follows:

a) No dead zones
b) Functional for short distances
c) User friendly control panel
d) Peculiar system mapping capability
e) Packaged for military maintenance environment
f) Compatible with light transmission characteristics of the subject fiber optic cable
g) Acquisition costs consistent with typical flight line analytical equipment

Currently, commercial OTDRs are available, but fall short of meeting the criterion mentioned above.

PHASE I: The contractor must provide a feasibility study which develops/demonstrates the capabilities of an OTDR design that meet the described characteristics.

PHASE II: The contractor must develop and deliver a functional prototype unit for field analysis and develop and deliver a draft operational manual that instructs the user in the proper function of the OTDR. The customer will identify the final product as the diagnostic tool to locate discrepancies in the fiber optic interconnect system.

PHASE III: Production and deployment to the maintenance community.

COMMERCIAL POTENTIAL: The proposed equipment will be capable of supporting commercial aviation in the installation and maintenance of the fiber optic interconnect systems on commercial aircraft. The Boeing Company is currently utilizing fiber optic interconnect systems on the 757, 767, and new 777 airframes. The configuration of the fiber optic interconnect system utilized by Boeing is similar to the militarized system used by the F-22, RAH-66 and F/A-18 E/F aircraft. The OTDR described here will be capable of performing the same system diagnostics on commercial and military aircraft.

N96-218TITLE: Fiber Optic Microwave Transmission System

OBJECTIVE: Use fiber optics to transfer microwave signals.

DESCRIPTION: Aircraft fuselage shielding to the external electromagnetic environment is critical to their safe operation. The shielding is measured from an instrumentation system which is kept outside the aircraft and probes that are placed inside the aircraft. An investigation of fiber optics as a means to transfer the signals from the probes to the measurement system is required. Current test methods only allow the use of coaxial cables at high microwave frequencies. The cables pick up leakage from the external environment and require holes and bulkhead connectors to be put in the fuselage. Fiber optics do not pick up leakage and can be routed through existing pipes and apertures. Current fiber optic equipment permit signals up to 1 GHz to be transferred. Several developments in fiber optics make it possible to consider that microwave signals from 1 Ghz to 18 Ghz can be transferred while maintaining original signal characteristics (amplitude, phase and modulation) with comparable or better than coaxial cable performance.

PHASE I: Determine the feasibility of using a Fiber Optic Microwave Transmission System to transfer 1 to 18 Ghz signals with better than coaxial cable performance.

PHASE II: Develop and demonstrate the proposed Fiber Optic Microwave Transmission System. The demonstration will involve both characterization of the system and trial application in an aircraft to determine ability to support measurements of internal electric fields.

Phase III Produce Fiber Optic Microwave Transmission Systems for use in weapon system research, development, engineering, test and manufacturing. This will be transition into military and commercial aircraft programs.

COMMERCIAL POTENTIAL: Modern civil aircraft are incorporating fly-by-wire (FBW) and full authority digital engine controls (FADEC). The FAA has established regulations for safety operation of these systems when exposed to high intensity radiated fields (HIRF) seen in civil airways and airports. The industry has recommend the measurement of the aircraft shielding as one requirement to obtaining data necessary to certify civil aircraft safe for operation in HIRF. These Fiber Optic Microwave Transmission Systems would be used to obtain the required data.

REFERENCE: MIL-HBK-235

N96-219TITLE: High Frequency Lossy Line Extension

OBJECTIVE: Extend RF attenuation of Lossy Line down to the HF range.

DESCRIPTION: Aircraft currently use Lossy Line to attenuate unwanted Electromagnetic Interference (EMI) signals from UHF and higher frequencies. Basic research data indicates that Lossy Line could be extended to provide similar attenuation all the way down to the HF range. The HF range is the area where air capable ships produce one of the harshest electromagnetic environments. The currently used heavy overbraided cables are terminated with EMI backshell connectors which impede maintenance. The proposed HF Lossy Line would eliminate the need for the overbraided cables and EMI backshell connectors, thereby decreasing weight and improving maintainability.

PHASE I: Provide a feasibility study which develops methods to increase RF attenuation of lossy line down to the HF range. The study should include consideration to maintain exiting common cable performance aspects. (i.e. corrosion resistance, bend radius, interchangeably with exiting wire types, etc.)

PHASE II: Develop and demonstrate production representative quantities of HF Lossy Line. The test may involve both characterization of the HF Lossy Line and installation in an aircraft to determine system level performance.

Phase III Produce HF Lossy Line for use in weapon system engineering and manufacturing development. This will be the transition into military and commercial aircraft programs.

COMMERCIAL POTENTIAL: Modern civil aircraft are incorporating fly-by-wire (FBW) and full authority digital engine controls (FADEC). The FAA has established regulations for safety operation of these systems when exposed to high intensity radiated fields (HIRF) seen in civil airways and airports. The civil aircraft industry will want to use HF lossy line to attenuates the HIRF protecting their FBW and FADEC systems. In addition electronic systems in cars, truck and other vehicles could benefit from HF Lossy Line.

REFERENCES:
1. MIL-HBK-235
2. FAR-xx.1317
3. MIL-STD-C-85485

N96-220TITLE: Faster High Intensity Radiated Fields (HIRF) Testing from 10 Khz to 40 Ghz

OBJECTIVE: A technique for high-power Electromagnetic Environmental Effects (E3) testing of aircraft systems and subsystems to reduce test time by a factor of two or more.

DESCRIPTION: The Navy currently uses a series of high power RF sources and antennas for HIRF testing of aircraft systems over the frequency range of 10 Khz to 40 Ghz. The capability is not continuous over the 200 MHZ to 40 Ghz range where 11 spot frequencies are used. The test techniques require repositioning of antennas or test objects to achieve HIRF environments on specific systems. The tests are time consuming which tie up aircraft systems as well as test facilities. This effort will provide for HIRF testing using lower power sources over broader frequency ranges while providing acceptable HIRF environments and for more complete illumination of the test objects in order to reduce test time involved with repositioning test equipment or test objects.

PHASE I: Provide a feasibility study which identifies a simulation approach and technique to halve the time required for HIRF testing. The method must be compatible with aircraft systems and subsystems testing using existing instrumentation techniques, and capable of meeting HIRF requirements to provide an RF environment over the frequency range of 10 Khz to 40 Ghz at average power levels of 200 V/m and peak power of 30,000 V/m. The proposed method must be capable of being tested and demonstrated inside the Shielded Hangar, Building #144 at NAWCAD, Patuxent River, MD.

PHASE II: Develop a prototype and demonstrate the approach and technique formulated under the Phase I SBIR effort.

PHASE III: Produce the HIRF test capability prototyped and demonstrated in the Phase II effort. This will provide a self-contained HIRF test facility for the military's E3 capability to test aircraft and aircraft related systems including tactical, recognizance, and strategic aircraft.

COMMERCIAL POTENTIAL: New capability can be used to qualify systems to the new FAA requirements to harden commercial aircraft against HIRF and for providing the coupling data to certify aircraft. This issue is critical to new generations of fly-by-wire and fly-by-light aircraft systems.

REFERENCES:
1. MIL-STD-1818
2. Part 6, Section G of DoD Instruction 5000.2

N96-221TITLE: Electronic Maintenance of Equipment Identification and Configuration Data

OBJECTIVE: To increase the validity and efficiency of equipment identification and configuration data used to manage and control assets by eliminating the manual procedures now in use.

DESCRIPTION: The Navy currently uses a manufacturer's identification plate to display equipment identification data. Equipment configuration data is either stenciled on the side of the equipment or hand written on a sticker that is attached to the equipment. In either case the printed data must be converted from printed to electronic data before it can be used in a computerized data base. The manual conversion of printed data from identification plate, stencil or sticker to electronic data provides the opportunity for human induced errors. Data is often misinterpreted or data elements are transposed during conversion. Damage to identification plates, stencils or stickers can also result in inaccurate data interpolation.

With an ever-shrinking budget the requirement for a more aggressive management system for military assets is imperative. A system that allows electronic collection of equipment identification and configuration data is essential. The accuracy of the input to the computer environment that exists in the military today is critical to equipment identification, tracking and configuration systems. Accuracy of the input to the management data bases of the future will become more critical as the Department Of Defense consolidates the equipment purchased by the different branches of the armed services.

PHASE I: Provide a feasibility study which develops a method(s) to place the equipment identification and configuration data on the equipment in a form that can be retrieved electronically. The method should maintain an open architecture, have input compatibility with standard data collection data bases, have minimal impact on equipment form, fit and function and be cognizant of weight and balance restrictions. Equipment operational environment determination is critical since most military equipment is exposed to a harsh environment (i.e. temperature & pressure extremes, dirt & chemicals, etc.).

PHASE II: Develop, test, evaluate and operationally demonstrate the method(s) developed during Phase I.

PHASE III: Provide the government with the system to implement the method(s) developed in Phase II. This will be the transition into the military's equipment identification and configuration tracking systems.

COMMERCIAL POTENTIAL: The methods developed will have an open architecture and can be used by all military and commercial activities. All users will be able to use this method to identify equipment and allow electronic collection of identification and tracking/configuration data.

REFERENCES:
1. MIL-STD-130
2. MIL-STD-129
NOTE: These are general references and should not restrict the feasibility study. We are looking for new technologies and they should be explored.

N96-222TITLE: Advance Model-Based Reasoning

OBJECTIVE: Develop tools to provide software models of Units Under Test (UUT) for developing Test Program Sets (TPS). To use these models in creating test software utilizing inferred reasoning concepts.

DESCRIPTION: Diagnostic test development for UUTs is the largest cost element involved in creating a Test Program Set (TPS). Diagnostic test procedures must be tested by manually inserting faults on a UUT. Typically only a small fraction of possible faults are actually inserted and verified. A new software tool that can simulate a UUT's diagnostic logic will save the expense of lengthy diagnostic software troubleshooting. The new tool should employ improved diagnostic algorithms to shorten the development time and improve fault diagnostic performance. The new tool should also include a run-time component to provide automated diagnostic capability in run-time.

PHASE I: Define a Re-Engineering TPS Development Process using advanced reasoning technology. Define an implementation strategy for use of the technology across TPS development programs.

PHASE II: Based on successful completion of Phase I, develop and test a sample item and conduct a proof-of-concept demonstration.

PHASE III: Produce the software tools which can be used by the test industry.

COMMERCIAL POTENTIAL: Industries developing Test Programs will benefit from the use of these new tools through reduced engineering costs.

N96-223TITLE: Improved Visual Landing Aids on Air Capable Ships

OBJECTIVE: To improve and modernize the Visual Landing Aids Systems on Aviation Capable Ships by developing and integrating emerging technologies into a synergistic approach to replace current standalone and obsolete components.

DESCRIPTION: Visual Landing Aids (VLA) provides a means for day and night aircraft operations from Aviation Capable Ships. The suite of equipment provides visual cues for accomplishing safe aircraft operations under various mission requirements. This is made possible by providing the approaching aircraft pilot with a well defined glide path and line-up information along with enhanced flight deck illumination, depth perception cues, and obstruction definition. Components of the VLA suite include, but are not limited to, the following: Glide Slope Indicator, Line-Up Lights, Horizon REFERENCE Set, Waveoff Lights, Flight Deck Status and Signaling System, Floodlights, Deck Edge Lights, Rotary Beacons, Lighting Controls, etc. While selected VLAs on Navy aircraft carriers and large deck amphibious assault ships have undergone recent improvements, the VLA suite on Aviation Capable Ships has remained relatively unchanged for the last 25 years. The existing systems are old, obsolete, large, heavy, maintenance intensive and incompatible with other systems such as night vision devices. There is a need to examine the existing VLA suite and transition promising technologies into fieldable systems for the current and next generation of Aviation Capable Ships thus increasing their affordability.

PHASE I: Examine the current generation of Aviation Capable Ships VLA and develop concepts for integrating advanced technologies into their VLA suite. Aviation operations involving night vision devices shall also be included in this study. A top level performance model, based on a single aviation ship platform, shall also be provided.

PHASE II: Develop a detailed performance model(s) for VLAs on a specific current class of Aviation Capable Ship. This model shall interface with the Navy's Manned Flight Simulator. The contractor shall further develop a particular VLA concept using the model and install it in the Manned Flight Simulator and demonstrate/evaluate its capability.

PHASE III: The contractor shall take the approved and verified VLA concept(s) and implement the concept(s) into hardware and software. The new VLA will then be installed on a ship for demonstration and evaluation at sea.

COMMERCIAL POTENTIAL: This technology has application in commercial and private airports as well as off-shore drilling platforms and seabased aviation for the commercial shipping industry or US Coast Guard.

N96-224TITLE: Piloted Approach Decision Aid Logic (PADAL) System

OBJECTIVE: To develop a Piloted Approach Decision Aid Logic (PADAL) system which would identify and monitor potential unsafe operating conditions and trends that would necessitate a waveoff to preclude a ramp strike or other catastrophic landing mishaps while at the same time increasing aircraft boarding rates.

DESCRIPTION: The Landing Signal Officer (LSO) is responsible for the safe and expeditious recovery of all Naval aircraft aboard ship. LSOs, of various types, are deployed with all aviation capable ships. The LSO has many sources of information and data as well as his/her own instincts and training available to enable him/her to fulfill these important responsibilities. Strict application of the `safe recovery' principle encourages the production of very conservative waving strategies and reduced boarding rates. Expeditious recovery of aircraft as a single waving principle could produce a greater incidence of shipboard landing mishaps. Each LSO is challenged to develop their own waving strategy, including a set of waveoff criteria, that allows safety to override expediency in aircraft recovery. However there are many variables which influence the LSO's definition of their waving window. They include: aircraft, ship, environmental, pilot and LSO factors. Certainly, the integration of these models presents a difficult problem. A decision aid system which will allow the LSO to more easily evaluate the approaching aircraft and if necessary, initiate a timely waveoff, is required. Recent developments in the area of knowledge based systems offer the opportunity to provide a means of aiding the LSO in ensuring the safe and expeditious recovery of aircraft.

PHASE I: Determine the feasibility of developing a system that would identify and monitor unsafe aircraft recovery trends and provide information to flight safety personnel. Include the identification of: waveoff criteria, waveoff related variables, aircraft performance models, applicable ship performance models, pilot performance models and LSO performance models. The contractor shall provide the detailed architecture of the decision aid model.

PHASE II: Develop a detailed performance model for the decision aid system. Develop a breadboard system, including hardware and software, which will interface with the Navy's LSO Training Simulator. Install the system into the Training Simulator and demonstrate/evaluate it's capability.

PHASE III: A transition to an advanced development effort by the contractor will provide a full capability system which would be installed on an aircraft carrier for demonstration and evaluation at sea.

COMMERCIAL POTENTIAL: This technology has application in the private and public sector particularly in commercial air traffic control or in any other area where critical decisions based on a set of highly dynamic information must be made.

N96-225TITLE: Hydrogen Fuel Cell for Powering Aviation Support Equipment.

OBJECTIVE: The objective of this topic is to develop an efficient low emitting (both in noise and pollution) form of power for aviation support equipment.

DESCRIPTION: The present support equipment found on naval and marine ships are either powered using diesel type fuels or batteries. Both have short comings do to noisy engines, pollution emissions, toxic gasses during charging, explosive and corrosive conditions, high voltage dangers for personnel, among others. In addition, batteries require recharging often which increases the number of required support equipment. A more efficient power source could potentially increase productivity, decrease fuel consumption and reduce pollution emissions. One possible power source is what is known to be, "Fuel Cell."

PHASE I: Investigate all possible fuel cell forms that could be used in military applications, and develop a study report. The study will compare fuel forms, power efficiencies and densities, emissions, cost, and maintainability. The study will also compare the fuel cell with conventional forms of power and advanced battery concepts. At the conclusion of the report will define a preliminary conceptual design is required to fit the fuel cell to a piece of support equipment that will be selected by navy personnel.

PHASE II: Fully design and develop the fuel cell conceptually designed in phase I. Fit into the support equipment (i.e. spotting dolly) and demonstrate capacity.

PHASE III: Finalize design of the fuel cell and develop transition package for future support equipment.

COMMERCIAL POTENTIAL: The largest commercial application for this technology is transportation and electric power. There are presently a few experiments underway which have been funded by DOE, Canada, General Motor, Allison Gas Turbine Division, and Mazda to name a few using fuel cells to power busses. This is attacking the larger more expensive commuter market. If successful the fuel cell developed in this program will be capable of powering small cars and trucks.

REFERENCES: Proceedings from short course: "Batteries and Fuel Cells." UCLA, Engineering 869.2, E9413, April 27-29, 1994

N96-226TITLE: Fuel Bladder Cell Failure Identification

OBJECTIVE: To develop a system to identify activation of the self-sealing material in self-sealing fuel bladder cells.

DESCRIPTION: The purpose of self-sealing fuel cells is to prevent loss of fuel from ballistic impacts. These cells consist of a multi-layer elastomeric construction, made from the inside out, of a fuel resistant inner ply, a fuel vapor barrier layer, alternate layers of fuel sensitive elastomer sealant (the self-sealing layer), and plies of elastomer coated fabric plus a fuel resistant outer coating. When fuel or fuel vapors come in contact with the self-sealing material, the material swells to seal the hole and stop fuel leakage. There are three basic failure mechanisms that cause activation: the cell is punctured, either by ballistic impact or obvious maintenance induced damage; the fuel vapor barrier is broken, either by natural wear and tear or by non-obvious maintenance induced damage; or by fuel exposure of the outer layer of the fuel cell. Once the material is activated the cell must be removed from the aircraft and repaired or disposed of. If a cell with a small area of activation remains in the aircraft for a extended period of time, the entire self-sealing layer will activate. A fully activated cell does not provide ballistic protection, will eventually leak and may fail catastrophically. Unfortunately, there is usually no immediate indication of activation while the cell is installed in the aircraft. Given time, fuel will start leaking out of the aircraft cavity drains. Navy Depot personnel estimate approximately 10 to 40% of the self-sealing fuel cell in the Navy's fleet are currently activated. With current technology the only way to detect activation is to inspect the inside of the fuel cell. On most aircraft, gaining access to the inside of the fuel cell is a costly and time consuming maintenance action. The benefits of this effort will include reduced aircraft down time, improved reliability/maintainability and reduced replacement costs.

PHASE I: The primary activities during Phase I will be to identify a potential technology and/or system to detect fuel cell activation without requiring maintenance personnel to enter the fuel cell. Also identify a technology to detect/isolate fuel leaks originating from the fittings or bladder wall. The system may be passive or active. The system should be lightweight, reliable, and utilize commercially available material. The system should not decrease the reliability of the fuel cell. The contractor will be required to perform lab test to show the potential for the technology and/or system to detect activation.

PHASE II: During Phase II the contractor will be required to demonstrate the technology and/or system on self-sealing test cubes. The performance, effectiveness, sensitivity, weight, reliability and maintainability of the technology will be evaluated and quantified. The contractor must separately evaluate the system when activation is caused by a failure of the vapor barrier and fuel exposure of a damaged outer liner.

PHASE III: During Phase III, the contractor will propose his design concept in a new aircraft system to be implemented.

COMMERCIAL POTENTIAL: This system could be utilized in aircraft that use self-sealing fuel bladder cells.

REFERENCES: MIL-T-5578, MIL-T-6396 and NAVAIR 01-1A-35 (Contact Cathy Nodgaard at 703-604-2437 x6309)

N96-227TITLE: Determine the State of State of Stress in Non-Ferromagnetic Metals and Composite Structures.

OBJECTIVE: Develop a portable user friendly nondestructive inspection method (hardware/software) capable of performing residual stress measurements in non-ferromagnetic metals and nonmetallic composite materials.

DESCRIPTION: As the Navy's aircraft and engines age, the need exists to determine residual stresses in structures manufactured from non-ferromagnetic materials (hastelloy, inconel, stainless steels, titanium, and aluminum alloys) and nonmetallic composite materials. These residual stresses could be imparted to these structures by in-service operation, manufacturing, assembly, or rework.

PHASE I: Identify a new, or modify an existing NDT method capable of detecting and measuring the state of stress in non-ferromagnetic metals and nonmetallic composite materials. Develop a test plan and conduct preliminary laboratory testing to determine the feasibility of the potential NDT method, to correlate the state of stress to remaining fatigue life and document on final report for evaluation.

PHASE II: Develop the selected NDI method, and design a prototype portable inspection system. Test the prototype system as determined by the Phase I feasibility study. Produce and deliver the prototype system.

PHASE III: Develop equipment specifications upon successful completion of Phase II for military and industrial applications.

COMMERCIAL POTENTIAL: The developed NDI method and inspection system will provide the aerospace, automotive, marine, and construction industry the ability to not only produce a better product, but to have the ability for true life cycle monitoring of their products.

REFERENCES: NAVAIR O1-1A-16 (Contact Cathy Nodgaard at 703-604-2437 x6309)

N96-228TITLE: Comprehensive Electrical Evaluation of Polyalphaolefin Dielectric Coolant

OBJECTIVE: To develop a test method (hardware/software) for evaluation of the electrical properties of polyalphaolefin dielectric coolant and determine whether a different routine method should be developed to verify the fluid's ability to withstand an electrical stress.

DESCRIPTION: The Navy has converted several of its aircraft weapon systems and ground support equipment to a polyalphaolefin dielectric coolant. Routine testing indicates a lowering of the fluid dielectric breakdown strength. This test is utilized to determine how the fluid responds to an electrical stress. Limits were set based on aircraft requirements. Cumulative data suggests an increase in the fluid's failure rate; however, a correlation with hardware failures has not been demonstrated. Limited studies indicate that a different test method/methods is required and electrical properties testing necessary.

PHASE I: Provide a feasibility study which develops a different method to test the electrical properties of polyalphaolefin dielectric coolant. Feasibility should also include any trade-off noted in the OBJECTIVE of this topic.

PHASE II: Develop, test and demonstrate the test method(s) formulated under Phase I SBIR efforts. Demonstrate correlation with associated hardware.

Phase III: Prototype necessary test equipment and transition into the Navy's Liquid Coolant Program.

COMMERCIAL POTENTIAL: Polyalphaolefins are utilized in many commercial applications. Verification of the stability of the fluids and their ability to withstand high voltage will be beneficial to commercial uses.

REFERENCES: MIL-C-87252 and ASTM D877

N96-229TITLE: Open Systems to Legacy Systems Communications Bridge

OBJECTIVE: Identify and develop a hardware and software interface technology permitting legacy Navy systems (with their military-unique interfaces) to be "plug-and-play" with COTS systems supporting Open System interface standards.

DESCRIPTION: One of the most difficult problems faced when upgrading existing Navy systems is their use of military unique I/O interfaces (e.g. MIL-STD-1553, NTDS, PDC, etc.) The emphasis on new acquisitions is to use Commercial-Off-The-Shelf (COTS) hardware and software. However, COTS hardware rarely supports the required military interfaces, opting rather for open systems interfaces such as: FDDI/Safenet, Scaleable Coherent Interface (SCI), High Speed Data Transfer Network, SCSI, and IEEE Parallel Bus. This requires system integrators to develop elaborate work-arounds to connect the new sub-system with the existing system. These work-arounds are difficult to maintain as the COTS components are continually upgraded.

If an adaptable, configurable communications bridge existed which could link the military-specific interfaces to open systems interfaces, new sub-systems could be more easily developed and integrated that would be less impacted by changes to other parts of the weapons system. This would also facilitate easier upgrades to the new COTS system components.

Although in most cases, the upgrade path involves replacing all military-unique components with COTS components, there will always be some cases where an existing military sub-system is so well tested and proven that there is no desire to replace it, or where there is no equivalent commercial product. Also, due to limited funds available for upgrades, it is likely that most major system upgrades will be done incrementally. The communications bridge will be an invaluable, re-usable tool to facilitate both of these scenarios.

It should be noted that the communications bridge can link systems with I/O devices or systems with other sub-systems. The bridge can link commercial interfaces with military interfaces or even link multiple commercial interfaces. It may be easier to conceptualize the communications bridge as a data router on a Wide Area Network (WAN). The router, among other things, handles conversions between multiple protocols as well as determining packet destinations and the most efficient data path.

PHASE I: Investigate and identify both the military-unique as well as open systems communications protocols and interfaces. Select those interfaces most likely to be required in upcoming major weapon systems upgrades.   Design a multi-protocol data communications bridge that is configurable, extensible, and adaptable to new commercial interface standards.

PHASE II: Develop a software simulation of the communications bridge and determine the design and underlying hardware required for acceptable data throughput under different loading conditions. Incorporate the concept of differing data packet priorities.

PHASE III: Build a communications bridge that supports a minimum of: FDDI, 1553, NTDS-B, HSC, PDC, and SCSI interfaces and integrate it with the AN/UYS-2A(V) hardware and software development facility.

COMMERCIAL POTENTIAL: By extending this concept slightly, it would be possible to develop an adaptable high-capacity communications bridge that would allow companies to upgrade their legacy systems that rely on obsolete commercial interfaces as well as develop new systems that use the data bridge to isolate the system from multiple I/O interfaces. For example, an SCI could connect the system to the communications bridge. The communications bridge could then disseminate the information to other sub-systems via a combination of FDDI, SCSI, and serial channels.

N96-230TITLE: Design Assistant for Application of System Identification and Adaptive Control to Aircraft Flight Systems

OBJECTIVE: Develop system identification algorithms and software for complete nonlinear analysis of aircraft high angle of attack dynamics.

DESCRIPTION: The demands for increasing performance from defense and commercial systems combined with the phenomenal jump in the computational speeds of computers have opened up a number of opportunities for the application of System Identification (SI) and Adaptive Control (AC) technologies. However, rapid progress in this area is hindered by a lack of design guidelines and user-oriented software tools to assist, guide and train the end user in the proper application of these technologies. Recent advances in Expert System and Computer Based Training (CBT) technologies make it feasible to develop Design Assistants (DA) and CBT packages for applications of SI and AC to control problems in aerospace and other industries.

Phase I of the SBIR effort will (I) perform state-of-the-art survey of on-line and off-line SI techniques for linear and nonlinear dynamic systems (ii) select a set of design challenge problems related to aircraft flight testing, self-repairing flight control and on-board system diagnostics (iii) develop design guidelines and (iv) perform top level conceptual design of DA and CBT packages.

Phase II will involve software product development, testing and validation, delivery and commercialization planning for both SI and AC packages.

PHASE III: Will provide for the production, delivery and commercialization planning for both SI and AC packages..

COMMERCIAL POTENTIAL: System Identification and Adaptive Control technologies are being applied across a wide spectrum of applications including power, aerospace, manufacturing, communication, transportation and process control. The products of this SBIR project will benefit designers of control and signal processing systems in these industries.

RFERENCES: MIL-STD-8785C, MIL-STD-9490

N96-231TITLE: Image Generator Frame to Frame Update Post Processor

OBJECTIVE: To develop an Image Generator(IG) post processor which computes updated images exploiting frame to frame coherence in the 2-D and pseudo 3-D domain.

DESCRIPTION: A tradeoff exists between the image quality and update rate of an IG for training simulators. As the IG is allocated more time to compute a higher quality image, the update rate decreases causing increased transport delay and stepping. Current post processing technology is limited to horizontal and vertical shifting of the image as discussed in the REFERENCE and takes only limited advantage of possible savings. An effective IG post processor could increase system performance by 1.5 to 5 times by allowing the IG to run at a lower update rate. The post processor stores a high resolution over sized image from the IG and outputs a high resolution image at video display rates. It should receive pitch, roll, yaw, elevation & velocity information at the video display rate and use it to compute shifting, rotating and stretching of the image at pixel rates. A non-moving image should be overlaid after shifting. System distortion correction, brightness correction and anti aliasing should also be included. Transport delay should be minimized.

PHASE I: Provide feasibility study which identifies fidelity impact, constraints, total system impact & efficiency. Include velocity, roll-pitch-yaw rates, altitude above terrain, ratio of terrain/feature height vs altitude, IG update rate, display update rate, minimum visible slant range, etc. Specific categories of feasible post processor applications should be identified (E.G. fixed wing aircraft above 1000 feet, less than 900 knots and roll less than 180 degrees per second may be updated at 15 Hz IG rate). Develop required architecture, develop translation equations. Determine feasibility of algorithms, data rates, memory requirements etc. Possibly include a non-real-time demonstration.

PHASE II: Develop and build a prototype to test and operationally demonstrate the methods & system formulated in Phase I. The prototype shall demonstrate all software and be driven with a real time training simulator IG and database.

PHASE III: Incorporate this new COTS into new training simulators and visual system upgrades.

COMMERCIAL POTENTIAL: Commercial flight simulators.

REFERENCES: Riner, Bruce & Blair, Browder (1992) Design Guidelines for a Carrier-Based Training System. Proceedings of the 1992 IMAGE VI Conference (pp.65-73).

N96-232TITLE: Enhanced/Operator Machine Interface

OBJECTIVE: The objective of this topic is to demonstrate the feasibility of providing a method for improving system performance by enhancing the operator machine interface taking into account the diverse and changing skill levels of avionics sensor operators.

DESCRIPTION: The Air avionics sensor operator (SENSO) requirements pose a major challenge in complexity, quantity of data and real time constraints. The increasing importance of littoral warfare with potentially dense contact and dynamic threat environments further exacerbates these problems. SENSO's with varying experience and skill levels must make real time decisions involving system configuration and contact detection and evaluation for multiple sensor systems. The lack of real missions often results ins reduced skill in areas not practiced. Providing an ability to diagnose the skill level and provide appropriate OMI enhancements will significantly benefit the mission. In order to achieve the desired performance gains the skill level of individual operators must be accurately assessed and upgraded so that compatibility with the OMI is maintained before and during system deployment. The proposed techniques should provide the ability to diagnose and improve operator skill levels and utilize the improving skill levels to enhance the OMI for improved system performance.

PHASE I: Provide a proof of concept through a limited demonstration of OMI performance improvements for a selected subset of generic operator tasks related to the LAMPS SH-60R Multi-Mission Helicopter Upgrade (MMHU) SENSO's OMI. A plan will be provided that extends the Phase I concepts to the operator tasks associated with a selected sensor system's operational modes.

PHASE II: Generate software hosted on COTS hardware for diagnostic skill level evaluation and enhanced OMI for a selected SENSO mode. A demonstration with Phase II software/hardware with selected operators will quantify system performance improvements.

PHASE III: Develop diagnostic skill level and OMI enhancement packages for remaining SENSO modes of the LAMPS SH-60R MMHU sensor suite. Integrate the software packages into the host system.

COMMERCIAL POTENTIAL: This technology has dual use applicability to all commercial and businesses computer based systems who's performance depends on real time operator skill levels. These applications include, Air Traffic Control, Production Line Control, Emergency Service Dispatching. Stock Trading and many different kinds of computerized learning software.

REFERENCES:
1. Williams, K.E. (1993a). Knowledge acquisition: A review of manual, machine aided and machine learning methodologies. Office of Naval Research Technical Report Contract N00014-91-J5-1500.

2. Williams, K.E. (1993b) The development of an automated cognitive task analysis and modeling process for intelligent tutoring system development. Technical Report: Contract No. N00014-91-J-5-1500. Office of Naval Research, Cognitive Sciences Program, Arlington, VA.

N96-233TITLE: Trade-Off Techniques for Training Using Multimedia

OBJECTIVE: Develop trade-off techniques to determine the most effective combination of media to maximize learning.

DESCRIPTION: Multimedia technology is advancing rapidly and is prevalent in the marketplace. For training, multimedia provides the ability to generate captivating graphics, and relatively inexpensive animations and simulations. The exciting presentation of materials directly involves the learner in the instructional experience and is highly motivating. Multimedia is clearly a valuable tool for learning. The challenge is in determining how to best use multimedia to promote learning.

PHASE I: Develop trade-off analysis techniques based on a combination of analysis of existing applications and experimentation.

PHASE II: Develop a prototype multimedia system using trade-off analysis techniques and validate the effectiveness of the prototype and the trade-off tool.

PHASE III: The trade-off analysis can be marketed to commercial developers and consumers of multimedia training. In the military, the trade-off analysis will be integrated into the media selection model.

COMMERCIAL POTENTIAL: Multimedia is being used in commercial training and a trade-off analysis would be useful.

REFERENCES:
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2. Developing Multimedia for Technology Education. Stier, Kenneth. Technology Teacher, v54 n1 p17-20 Sep 1994.
3. Evaluating Interactive Multimedia. Reeves Thomas C. "Educational Technology", v32 n5 p47-53 May 1992.
4. Factors to Consider in Evaluating Multimedia Platforms for Widespread Curricular Adoption. Knight, Pam. "Educational Technology," v32 n5 p25-27 May 1992.
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7. Learning with Media. Kozma, Robert B. "Review of Educational Research" v61 n2 p179-211, 1991.
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9. Multimedia Sandbox: Teaching, Learning, and the Transfer of Knowledge. D'Ignazio, Fred Computing Teacher, v20 n2 p54-55 Oct 1992.
10. Planning for Multimedia. Trotter, Andrew. Executive Educator. v15 n6 p18-21 Jun 1993.
11. "Reinvesting Schools: The Technology Is Now" National Academy of Science and National Academy of Engineering convocation, May 10-12, 1993.
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13. Towards the Architecture of an Instructional Multimedia Database. Verhagen, Plin W., Bestebreurtje, R. Journal of Computer Assisted Learning. v10 n2 p81-92 Jun 1994.

N96-234TITLE: Improved Missile Positioning, Attitude Sensing and Targeting (IMPAST) Using the Global Positioning System (GPS)

OBJECTIVE: Improve the probability of kill (Pk) of a 5-inch air-to-surface defense suppression missile by utilizing advances in GPS and processing technology.

DESCRIPTION: Air-to-surface defense suppression weapons that prosecute radiating threats (such as the SideARM missile) are often subjected to emitter shutdown or other countermeasure techniques that cause the weapon to proceed inertially based on the last known position of the emitter. The use of sophisticated receivers and processing technology to locate an emitter based on its radio emissions becomes useless if the target stops emitting. IMPAST will provide a 5-inch defense suppression missile with highly precise GPS information to eliminate the need for an autopilot and inertial navigation system and greatly improve the chance that the missile will strike the target even if shutdown occurs.

PHASE I: Provide a feasibility study to assess the potential increase in effectiveness of a 5-inch missile using IMPAST. The contractor will also create a notional design of IMPAST that will consider the advantages and limitations of GPS and the constraints of a 5-inch missile.

PHASE II: Develop, test and demonstrate the IMPAST system in a missile hardware-in-the-loop configuration.

PHASE III: Produce the IMPAST system demonstrated in Phases I and II and retrofit existing missiles. The transition will be to the SideARM missile program.

COMMERCIAL POTENTIAL: Navigation and autopilot systems in commercial aircraft.

N96-235TITLE: Optimal Resource Allocation in a Distributed Computing Environment.

OBJECTIVE: A methodology is sought for performing optimal computing resource allocation in a distributed computing environment and reconfiguration for fault tolerance.

DESCRIPTION: In an environment where computing resources are plentiful and not all being used all the time, it is possible to distribute processes so that they complete faster and a better utilization of the computing resources is accomplished (most resources are used most of the time, instead of a few all the time). Assuming a Common Object Request Brocker Architecture (CORBA) environment, the desire is to, effectively and with as little overhead as possible, automatically assign processes to the least used resources.

PHASE I: Conduct a feasibility study and identify the system requirements and necessary technologies for performing the resource allocation. Study the potential performance improvements within a simulation environment and provide approaches for implementations in a networked workstation environment.

PHASE II: Implement a prototype that demonstrates the concept, utilizing the latest CORBA release and a number of networked UNIX workstations.

PHASE III: Implement the prototype to operate in a shipboard environment, addressing the necessary security issues.

COMMERCIAL POTENTIAL: Commercial applications of this technology would be used for weather prediction computations, stock market prediction, risk analysis, and modeling and training simulations.

REFERENCES:
1. "Universal Networked Objects", OMG TC Document 94.9.32, September 28, 1994.
2. Umar, A., "Distributed Computing and Client-Server Systems", Prentice Hall, 1993.

N96-236TITLE: Enhanced Target Movement Prediction.

OBJECTIVE: A methodology is sought for predicting enemy units movement/actions based upon the past behavior of the units and actions of correlated units.

DESCRIPTION: A proof-of-concept is sought for developing state-of-the-art algorithms capable of learning an internal representation of an enemy asset through observation of historical movements/actions. This internal model should then be used to predict enemy asset movement and actions (or intentions). Since several courses of action could be probable, a set of movement/actions with associated probabilities should be calculated. This involves the development of a model of a highly non-linear system (enemy asset), highly correlated with an external highly complex system (other units and terrain) based on relatively few observations. This work will involve learning internal representations of simple agents followed by terrain interaction and correlated multi-agent movements. A prototype system would be developed in C or C++ (commercial requirement) that would run on equipment consistent with Navy combatant computing architectures.

PHASE I: Conduct a feasibility study and identify requirements and technologies necessary for performing movement prediction. Study the time-performance requirements and provide approaches for obtaining real-time performance.

PHASE II: Implement a prototype that demonstrates the concept and provide a graphical user interface based on X11 and Motif for demonstrating the concept.

PHASE III: Examine the potential for enhancing the prototype by interfacing it with existing and under development military systems and test it using data where past, present, and future actions are known, so the predictions obtained can be compared with a real-life scenario.

COMMERCIAL POTENTIAL: Search and rescue operations, distributed interactive video games, entertainment, law enforcement.

REFERENCES: "The Tactical Movement Analyzer", NSWCDD/TR-94/99.

N96-237TITLE: Object Recognition and Tracking at Video Rates

OBJECTIVE: A methodology is sought for performing object recognition and tracking, in real-time, using video imagery at 30 frames per second.

DESCRIPTION: Object/Target recognition is important and has many applications. Much effort is currently being put into recognizing objects in still images and some solutions are surfacing. The idea of using video for object recognition is not new, but is much more complicated due to the motion of the camera and of the object. In addition, the number of frames that must be processed in real-time present a huge processing task. However, the use of video has certain advantages in image processing that can be exploited.

PHASE I: Devise a method for detecting and tracking objects in video sequences. After an object is detected it is classified with regard to a set of known object types. In addition the capability to update this list of object types during operations should be provided.

PHASE II: Implement the method and demonstrate the capabilities, by operating on video sequences. The equipment to be used will be standard off the shelf products, compatible with the Navy tactical computer equipment. Software will be developed in C and C++, with X-window and Motif user interfaces and following all the ANSI standards. Following these standards will make porting to different UNIX systems easier.

PHASE III: Integrate the prototype into a fielded system.

COMMERCIAL POTENTIAL: Commercial applications of this technology could be used in security systems, automated product inspection, intelligent vehicles, video database querying.

REFERENCES:
1. A. Murat Telcalp, "Digital Video Processing," Prentice Hall, 1995.

2. Makoto Nagao and Takashi Matsuyama, "A Structural Analysis of Complex Aerial Photographs," Plenum Publishing Corporation, 1980.

N96-238TITLE: More Effective Employment of Precision Guided Missiles (PGMs) with the inclusion of Weather Data

OBJECTIVE: Increase effectiveness of PGMs by including forecasted and insitu weather data integrated with aircraft sensed weather. Understand the availability, confidence of existing weather data and translate this scientific data to formats and displays easily understood and applied to weapons planning.

DESCRIPTION: Over 47% of the sorties in Desert Storm were effected by weather. PGMs must be more accurate, and minimize collateral damage. Historically the weapons community and the Meteorology and Oceanographic (METOC) community have been independent, resulting in very good meteorological models and weapons; however a lack of understanding exists on the relation between the two and how to best exploit the large amount of weather data to better employ PGMs. The worst case is degradation in weapons performance (Tomahawk Anti-Ship Missile degraded by 50% in rain) to unnecessary restrictions due to mission planning artifacts (Tomahawk Land Attack Missile day types). Although we cannot change the weather, we believe we can decrease the amount of sorties lost to weather by using weather data in the planning process. By applying confidence factors to weather data, PGMs can be planned more confidently. Finally data enroute and over the target can greatly enhance the planning process if this data can be processed timely.

PHASE I: Design and implement a study which determines how weather data can be used; estimates increase in effectiveness of PGMs; outlines simulations and models to verify effectiveness; and outlines how forecasted, real-time and aircraft sensed weather data can be translated into a format which can be used by weapons planning. Outline how weather data could be efficiently transmitted into existing mission planning systems. This effort can be applied to all PGMs; however, to scope this project Joint Stand Off Weapon (JSOW) has been chosen.

PHASE II: Develop algorithms and modeling for integration of weather data into JSOW mission planning. Develop scenarios and conduct simulations (possibly reanalyzing Desert Storm) to determine increased effectiveness by incorporation of weather information into PGM planning.

PHASE III: Integration into a JSOW Mission Planning Module hosted on the Tactical Aircraft Mission Planning System.

COMMERCIAL POTENTIAL: Point specific forecasts for civil use.

N96-239TITLE: New Polymeric Material for Propulsion Systems

OBJECTIVE: The objective of this program is to synthesize and scale-up polymers useful in propellant formulation or case liner material. These polymers will provide performance, insensitivity, and demilitarization advantages for the next generation of propulsion systems.

DESCRIPTION: This project involves polymer synthesis and scale-up, process optimization, propellant formulation, and motor demonstration.

PHASE I: The first part of the program will involve the design and synthesis of new polymeric materials for use in propellants. These materials will provide good compatibility with new oxidizers (i.e., CL-20,ADN, etc), superior mechanical strength, and good bonding properties. The materials should be scaled up to 5-lb quantities for preliminary evaluation in propellant formulations.

PHASE II: The second phase of the program will involve manufacturing/production technology of this new family of polymers, including synthesis process optimization, waste minimization, and cost reduction. The best candidate will be screened, and those that exhibit the desired properties in propellant formulation will be selected.

PHASE III: During the third phase, large production capability of these polymers will be demonstrated through a safe, low cost, and environmentally clean process; the merit of using this polymer in two full-scale propulsion systems will also be demonstrated. Motor firing and full-scale IM tests of these systems will be conducted.

COMMERCIAL POTENTIAL: These new polymers can be applied to space shuttle solid boosters and satellite launcher booster systems. The synthesis methodology and manufacturing technology can be applied to other industrial applications such as adhesive and paint/coating materials.

REFERENCE:

1. Navy lM Instruction 2105
2. Richard S. Miller. "Advancing Technologies: Oxidizers, Polymers, and Processing," published in the proceedings of AIAA 30th Joint Propulsion Conference and Exhibit, July l994.

N96-240TITLE: GPS Based Formation Control

OBJECTIVE: Develop a Global Positioning System (GPS) based implementation for formation control in vehicles.

DESCRIPTION: The Global Positioning System (GPS) provides precise location information to properly equipped vehicles. The intent of this proposal is to develop an application of GPS technology which will provide a real time method of determining the relative location of two GPS equipped vehicles such that the vehicles are able to maneuver relative to each other without reference to additional positioning data. The effort includes a study of the architecture and requirements of a system which will allow relative maneuvering with confidence with separations (of the nearest points on the two vehicles) as low as one meter.

PHASE I: Phase I should result in a detailed conceptual design, analysis and proof of concept.

PHASE II: Phase II consists of prototype development, demonstration, validation and hardware delivery.

PHASE III: A Navy funded Phase III is expected.

COMMERCIAL POTENTIAL: For commercial use, the current aircraft collision avoidance systems could be improved by an accurate method of determining real time relative position and rates of closure. Any operation of multiple vehicles in proximity, could be automated, producing gains in efficiency. As the use of GPS for location expands into automobiles, a similar system could be developed to assist in ground collision avoidance.

N96-241TITLE: Interdigital Deposition of Highly Conducting Polymers for Electrochromic Window Application

OBJECTIVE: Improve the switching speed and contrast ratio of the electrochromic switch by incorporating via interdigital electrochemical deposition very highly conducting polymer onto an area consisting of gold grid lines on a poly (tetrafluoroethylene) (PTFE) based substrate.

DESCRIPTION: Electrically conducting polymers show great promise for the use as electrochromic windows in many regions of the electromagnetic spectrum. The particular application being studied is based upon the conducting polymer’s ability to switch from a conducting to a non-conducting state.

PHASE I: Provide a feasibility study to carry out selected interdigital electrodeposition onto model gold/PTFE model substrates and incorporate the deposition of these materials into the electrochromic switch.

PHASE II: Provide a prototype/demonstration based on the results of Phase I and specifications which will be provided.

PHASE III: Transition electrochromic switches to fleet and industry.

COMMERCIAL POTENTIAL: Polymers with higher conductivity will be available for electrochromic window applications, both military and civilian.

N96-242TITLE: Ability to Predict Scene Based Algorithm/System Performance

OBJECTIVE: To develop a methodology and metrics which enable estimation of the maximum performance that a suite of algorithms used for automatic target recognition (ATR) can achieve for a given scene, as well as to be able to predict the maximum performance of individual algorithms in the ATR suite.

DESCRIPTION: Autonomous surveillance and weapon applications require the ability to perform ATR on data obtained from a number of sources including imaging infrared, synthetic aperture radar, and inverse synthetic aperture. At present ATR systems have been built which rely upon physics models of the targets, templates, and a number of other schemes. Techniques used to implement ATR range from neural network classification directly from the data to systems as complicated as building edge detectors, segmenters, boundary completion algorithms, feature extractors, pattern classifiers, and finally identification. The algorithms generally employ tuning parameters and it is not evident given the non-linear and feedback aspects associated with ATR suites that optimization of individual algorithms within an ATR suite is equivalent to optimization of the ATR suite itself. it is also desirable to be able to assess the maximum expected performance of the ATR suite given a particular scene. Adequate metrics to describe the performance of individual algorithms within an ATR suite not been identified. For example, in a given scene whose signal to clutter and signal to noise levels are known with a restricted class of targets which are to be identified what is the preferred implementation of edge detection in general, and in the context of the suite itself.

PHASE I: Contractor is to use an existing ATR suite which they have developed or can be obtained from sources including the government. Contractor is to develop a methodology which enables identification of metrics which can be used to assess individual algorithms in the ATR suite as well as system performance.

PHASE II: Contractor is to use algorithm suite in conjunction with data to implement, assess, and refine the methodology they have developed. Key products to be demonstrated shall include assessment of individual algorithms within the suite, tuning of algorithms based upon scene content, assessment of the expected performance of the ATR system itself given current scene content, tuning of the overall system given scene based information, and the ability to dynamically configure the ATR suite given scene based information. In addition, the methodology and the metrics used must be documented. Deliverables shall also include functional computer code which implements the methodology.

PHASE III: A number of programs exist within the government which rely on ATR including Cruise Missile, Real Time Retargeting, Integrated Air Deployed Strike Surveillance, Combat Idea, Wide Area Surveillance, and Model Driven ATR.

COMMERCIAL POTENTIAL: ATR like systems are required in production facilities for rapidly identifying faulty parts and diagnosis of failures in the manufacturing process. The techniques developed for military ATR applications are rapidly identifying faulty parts and diagnosis of failures in the manufacturing process. The techniques developed for military ATR applications are directly applicable to manufacturing. The methodology developed here is closely related to the methodology required to achieve real time planning and optimization for flexible manufacturing applications.

REFERENCES: Robert M. Haralick, "Performance Characterization in Computer Vision", CVGIP: Image Understanding, Vol. 60, Number 2, pp 245-249, September 1994.

N96-243TITLE: Improve Thermal Shock Resistance of Sapphire

OBJECTIVE: Develop crystal growth modifications and/or surface treatments to improve the thermal shock resistance of sapphire without degrading infrared optical quality.

DESCRIPTION: Sapphire is desired as an infrared-transmitting window or dome on high speed missiles because of its excellent optical and mechanical properties. However, currently available sapphire cannot withstand the thermal shock associated with certain high speed missile flights. It is believed that the critical weakness in sapphire is loss of strength at elevated temperature during compression on the c-axis of the crystal. The purpose of this effort is to improve the ability of sapphire to withstand high heating rates without fracturing. This will enable sapphire to be used in more demanding missile applications. Possible methods for increasing the thermal shock resistance of the sapphire crystal include solid solution hardening, second phase hardening, surface modifications, and thermal treatments that affect crystal perfection. A successful treatment must not degrade the optical properties of sapphire and should not substantially decrease the thermal conductivity.

PHASE I: Demonstrate the feasibility of selected methods to improve the thermal shock resistance of sapphire. Work in this phase must include an experimental demonstration of improvement of the strength of sapphire at elevated temperature.

PHASE II: Thoroughly evaluate methods identified in Phase I. Prepare a sufficient number of coupons and conduct a statistically significant number of tests to measure key properties of improved sapphire. Properties include flexure and compressive strength of sapphire at 20, 300 and 600 C, and measurement of thermal conductivity over this range. Infrared optical measurements are required to demonstrate the effects of crystal modifications on transmission, emission and scatter. Conduct a sufficient number of growth runs to demonstrate that the proposed modification process can be accomplished in an industrial environment.

PHASE III: Transition improved growth and/or fabrication technology into a production facility. Build domes for wind tunnel testing and conduct such tests to verify increase in thermal shock resistance. Integrate dome into Standard Missile II Block IV airframe and conduct flight tests. The Standard Missile program is currently seeking such an improvement.

COMMERCIAL POTENTIAL: Improved sapphire will be available for military and civilian applications (such as process monitoring) involving high thermal loads on optical windows.

N96-244TITLE: Nanometer Metal Powder Production

OBJECTIVE: Develop technology for industrial-scale production of nanometer metal and metal alloy powders.

DESCRIPTION: Nanometer (nm) powders are customarily defined as powders with particle sizes below 100 nm. Nanometer powders of carbon and metal oxides have found applications in a variety of commercial products: however, due to fabrication difficulties, nanoscale particle size metal and metal alloy powders have not been utilized in significant quantities. The primary reason for this low utilization is the lack of high quality powders at a reasonable cost. The desired outcome of this effort would be the development of a production technology with the ability of producing a wide range of nanometer metal and metal alloy powders. These powders would have a narrow particle size distribution and a low level of contamination. The goals for production technology would include a tunable mean particle size between 100 and 5 nanometers with 90% of the particles within $\pm$3 nanometers of the mean. While minimal contamination of these powders is critical to many of their potential applications, others may require a passivated form of the material, and significant attention should be focused on this aspect of nanosize powder production.

PHASE I: The awardee will demonstrate an ability to produce at least three nanometer metal powders, one of which will be aluminum. As part of this demonstration, particle size and distribution control should be exhibited, along with the ability to passivate the aluminum powder. Additionally, a design and plan for the construction of a small-scale production unit (batch or continuous) with the capability to produce between 1 and 2 kilograms of powder per day shall be prepared. This plan and design will be implemented during Phase II.

PHASE II: Implementation of the plan developed in Phase I should be accomplished within the first 9 months, with the remaining time used preparing powders of various metal and metal alloys to demonstrate the capability and evaluate scale-up considerations while providing materials for characterization, experimentation, and market development. Furthermore, during this phase, both should be developed for the third and last phase of this effort. These plans should include a market analysis, industrial plant design, and potential non-federal sources of funding.

PHASE III: The financial and technical plans developed in Phase II should be implemented during this phase, along with construction of an industrial capability. The plant constructed during Phase II will continue to produce powders for further experimentation, and market and product development.

COMMERCIAL POTENTIAL: The commercial applications for materials produced from these powders include: electrically-conductive adhesives and polymers, powder metallurgical products, wear-resistant materials, superconductors, high temperature materials, etc. According to a study by BUSINESS COMMUNICATIONS CO. INC. entitled "Advanced Ceramic Powders & Nano-Sized Ceramic Powders," by the year 2000, the US market for advanced ceramic powders will reach $1.1 billion. While this may not correlate directly to nanometer metal powders, it could serve as an indication of the commercial market potential.

REFERENCES: "Nanopowders may extend PM parts' function" MPR Feb. 1995 pg 18-20. "Nano-Sized Ceramic Powders" Journal of Thermal Spray Technology, Vol 4(1), March 1995, pg. 15.

SPACE and NAVAL WARFARE SYSTEMS COMMAND

N96-245TITLE: UHF-SHF Flat Panel (Planar) Antenna Arrays

OBJECTIVE: To design, develop, and demonstrate the capability of reconfigurable, Flat Panel Antenna Arrays to provide the submarine with a steerable, highly directive radiation pattern to support HDR (High Data Rate) UHF-SHF COMMS (ultra-high thru super-high frequency satellite communications) links.

DESCRIPTION: The submarine navy is currently investigating the feasibility of adding several additional communication bands to its present COMMS suite. Included in this review are such bands as VHF (very high frequency), VHF/UHF SATCOM CEL TEL 9 cellular telephone), JTIDS (Joint Tactical Information Distribution System), and numerous microwave SATCOM bands requiring HDR performance. Specifically, existing, Flat Panel, Antenna Array technology shall be applied to provide the above functions via an antenna assembly package adaptable to the submarine mast (preferable) or sail. The development may utilize a sandwich construction of frequency selective surfaces (FSS) for enhanced performance.

PHASE I: Develop several designs that approach meeting the objectives with different performance emphasis. Select one antenna design and deliver Level I (conceptual) drawings and schematics for a Phase II development that will optimize the link performance to be achieved within the limited submarine space available. Additional steering via mechanical means is an option.

PHASE II: Develop and build a feasibility/brass board model of the selected Flat Panel Antenna design. The resulting structure shall be sufficiently robust to withstand RF performance testing on outdoor antenna ranges, including the measurement of array pattern, gain, and impedance.

PHASE III: Build a Flat Panel Array for mechanical, as well as electrical, evaluation. The array shall be housed in a pressure proof package and shall be suitable for submarine installation and sea test evaluation.

COMMERCIAL POTENTIAL: The frequency range and flat configuration of the Flat Panel Array (as opposed to conformal array) make the design appropriate and adaptable to many mobile platforms.

REFERENCES: Kummer, Wolfgang H., Basic Array Theory, Proceedings of the IEEE, January 1992, p. 127-140.

N96-246TITLE: Electro-Optics Window for Shipboard Application

OBJECTIVE: Develop large (>20" diameter) optical laser windows capable of operating in the harsh marine environment as part of a Naval weapon system and with the potential for other commercial maritime and space applications.

DESCRIPTION: The US Navy has identified a number of missions for which electro-optics, lasers and directed energy (DE) weapons are considered to add significant value to the conduct of prompt and sustained operation at sea. The beam director of such systems requires an external window. The window material to be developed must have the following properties: High optical transmission from Ultra Violet (UV) to the Mid-Infrared (MIR) and possibly in the Long Wave Infrared (LWIR) spectral range; an absorption coefficient < 0.04 CM-1 from 0.4 micron to 6 microns and 8 to 12 microns; high mechanical strength (

young's modulus > 60 Gpa, rupture modulus > 6000 psi); a high resistance to water attack; and High material homogeneity, free from internal defects i.e. bubbles, seeds, and striae with low internal scattering. This program should also demonstrate the manufacturing technology necessary to produce window blanks up to one meter in diameter.

PHASE I: Demonstrate sub-scale window technical feasibility.

PHASE II: Develop the casting capability and cast a large (about one meter in diameter) window.

PHASE III: Demonstrate cost effective manufacturing approach.

COMMERCIAL APPLICATION: NASA and the private sectors are in contact with SPAWAR regarding the application of this window material in satellites, commercial aircraft and other high heat with no image distortion applications.

N96-247TITLE: Enchanced Infrared Images of Pop-up Targets

OBJECTIVE: Develop low cost compact adaptive optics system to correct atmospheric aberrations by integrating such a system with existing infrared focal plane array cameras for mast mounted ship board application.

DESCRIPTION: Cruise missiles flying close to the surface of the ocean, un-detectable by the radars, can be seen by infrared and visible cameras. The images of such observation are severely hampered by the atmospheric turbulence, particularly for targets cruising only a few feet above the ocean waves. Turbulence and local temperature and humidity variations cause air density variation and consequently changes of index of refraction of the air. The index of refraction variations strongly influence the imaging wavefront. The random motion of a camera image is a direct result of intensity fluctuations (Scintillation). The time integrated images of existing camera systems are blurred because of time varying random intensity concentrations in the viewing media. Modest wavefront corrections would alleviate the scintillation and provide crisp clear view of the target. This program should also lead to the demonstration of this enhanced imaging system at sea.

PHASE I: Demonstrate technical feasibility.

PHASE II: Develop adaptive optics system capable of correcting the atmospheric effects.

PHASE III: Develop a plan for production and demonstrate cost effective manufacturing approach.

COMMERCIAL APPLICATION: Once developed, this system can be used by the Police and law enforcement officials, coast guards, NASA, and other commercial application.

REFERENCES: Focal plane array infrared and visible cameras exist. Development and integration of an adaptive system with the cameras are envisioned which allow for scintillation corrections.

N96-248TITLE: All-Software Global Positioning System (GPS) Receiver

OBJECTIVE: Concept design and demonstration of a digital GPS receiver which processes GPS Satellite measurements non-real time providing a minimal time-to-first-fix all in view capability GPS receiver.

DESCRIPTION: GPS applications which require either direct Y encrypted signal acquisition or to minimize acquisition times, utilize highly accurate time information or will require receivers with thousands of correlators per channel. An all software design could utilize optimal tracking and navigation strategies which are difficult to implement in existing hardware based designs. The proposed receiver design would process GPS measurements in non-real time and would significantly improve GPS AJ performance. An all in view satellite approach would be used to maximize measurement availability and provide measurement integrity.

PHASE I: Design trade-offs will be necessary to determine the optimal tracking and navigation strategy for use in a non-real time processing environment. The benefits of matching tracking loop and navigation Kalman filters bandwidth will be considered. Coherent data demo modulation techniques will be utilized to provide optimal signal to noise ratios; trade-offs in terms of performance gains versus computational burden will be assessed. System level design requirements will be formulated and translated into software requirements. A survey of off the shelf digital receiver front end processors will be conducted and a module selected which meets system requirements. Processing algorithms will be coded and tested.

PHASE II: The receiver front end processor will be integrated with the processing algorithms. A concept demonstration using GPS satellite simulators in a controlled, laboratory environment will be performed

PHASE III: System will be ruggedized and tested aboard an operation platform.

COMMERCIAL POTENTIAL: Can be directly used in low power and cost GPS applications.

N96-249TITLE: High Resolution Time-Frequency Representations

OBJECTIVE: The objective is to determine the feasibility of increasing classification capability for signals of interest to IUSS by using high resolution time-frequency.

DESCRIPTION: The standard displays for detecting and classifying targets in IUSS are the Lofargram and the Correlogram. These images are based on the Fourier transform and must trade off resolution in the time and frequency directions. Improved time-frequency displays have been shown to allow better classification, although they may not have merit as detectors. This work is concerned with further improving the resolution of time-frequency displays to achieve the maximum classification capability possible. Enchancements of existing time-frequency displays, or entirely new techniques, are desired. Prospective offerors should propose enhance approaches to display data and develop the metric for Phase I.

PHASE I: Investigate the feasibility of one or more high resolution time-frequency displays by processing data sets of interest to IUSS. Appropriate IUSS data will be provided. Develop a metric to evaluate these displays.

PHASE II: Implement one or more high resolution time-frequency displays in hardware and software suitable for an IUSS site.

PHASE III: Installation at an IUSS site.

COMMERCIAL POTENTIAL: The chosen technique can be used to resolve, classify and characterize interfering signals in seismology, medicine and ultrasonic non-destructive evaluation as well as in IUSS.

REFERENCES: IEEE Signal Processing Proceedings.

N96-250TITLE: Automatic Feature Combined Track-Detect-Localize Technique

OBJECTIVE: The objective is to define and evaluate innovative technique for surveillance systems that combine tracking, detection and clustering/localization functions into a single near optimum contact localization capability that establishes feature contact formation in the presence of clutter signals. This includes algorithms which combine contact signature and kinematic characteristics to support classification.

DESCRIPTION: The increasing emphasis on shallow water, near land theaters of operation has introduced a dense and dynamic active and passive acoustic directional interference environment. This environment requires multimode acoustic feature extraction on large quantities of data. The success of contact classification and multi-platform/scene (contact) data fusion will depend on the ability of sensor systems to automatically detect, extract and associate large quantities of acoustic (passive and active) features into contact data clusters localized at time intervals in three dimensional scene coordinates. In the past localization analysis has been applied to a small subset of detected and at least partially classified data. The approaches to this topic should consider optimal approaches to automatically localize acoustic source features or events as part of the track/detect and contact formation process prior to classification decisions. The approaches should consider but need not be limited to Bayesian techniques for combining contact frequency, bearing and time robust tracking techniques with field information. Maximum use should be made of all available environmental parameters and their associated statistical uncertainties along with deterministic information. Proposals should address prototyping tools and other productivity tools to be used by the offerors.

Classification of source specific background acoustic signals will enhance the ability to distinguish between signals of interest and those signals which naturally or normally occur in a region. Such analysis will significantly reduce the false alarm rates. Clutter signals include those generated from biological sources (i.e. snapping shrimp and migratory whales) and from man-made sources (i.e. drilling rigs and fishing fleets). Specific processing such as DEMON processing can be used to classify contact on non-interest. Specific approaches are required that consider all components. Proposals must consider all components of the signal received from dynamic contacts wherein bearing, frequency and signature content vary significantly. The contact track must be exploited to support both classification and localization.

PHASE I: Define and develop an algorithic processing flow (chain) of proposed techniques. Implement a software simulation of critical algorithm functions to prove the concept with recorded sea data. Provide preliminary test results demonstrating the feasibility of the proposed algorithm. A rapid protyping software development environment is encouraged.

PHASE II: Develop a complete software processing chain suitable for testing large quantities of recorded sea data on a Navy selected sensor system and validate the approach. Develop the software processing chain as a prototype laboratory based system. Provide a detailed algorithm and software description and user's manual.

PHASE III: The successful topic results of this research will be transitioned to SURTASS/LFA and ADS programs.

COMMERCIAL POTENTIAL: Automatic Tracking/Detection/Localization for improved feature association and contact classification of merchant ships, fishing vessels, contraband shipping and biological sources.

REFERENCES:
1. IEEE Signal Processing Proceedings.
2. Mission Needs Statement for Undersea Surveillance in Littoral water of 18 March 1993.
3. RIPPEN for rapid prototyping.
4. GMP for rapid prototyping (alpha version with minimal documentation available from SPAWAR PMW 182).

N96-251TITLE: Passive Acoustic Transient Detection and Analysis of Mine Operations

OBJECTIVE: Develop a software tool using statistically based signal processing methods for signal feature extraction to detect and analyze the acoustic signature of airborne and surface mine deployment operations.

DESCRIPTION: Mine deployment operations, whether by ship, boat, aircraft or submarine, have characteristic acoustic signatures (i.e., water entry, chain payout, and bottom strike). Signatures can be recognized through the extraction of features from a waveform or image. Proper distinction between mining operations, mine fields, mines, and background noises can lead to fast response by covering forces and possible neutralization of the mining force.

Methods are needed to automatically detect and analyze mine deployment operations, mine fields, and mines. A method to consider is the Karhunen-Loeve Expansion eigenfunctions and eigenvalues from a series of sample waveforms and/or images. Examination of alternative algorithms besides the Karhunen-Loeve Expansion is encouraged.

PHASE I: Identify characteristics and features of transient acoustic signal characteristic with respect to type of mine, laying method, depth, distance from surf zone, mine fields, mine laying craft signatures, and stage of the mine deployment evolution. If using the Karhunen-Loeve Expansion eigenfunctions and eigenvalues, then develop and analyze alternative algorithms to statistically generate the Karhunen-Loeve Expansion from sample waveforms and images. Rapidly prototype and demonstrate a software tool using the best of the identified algorithms.

PHASE II: Develop the acoustic model of mine deployment operations to analyze the Phase I algorithms. In addition, design, build, and demonstrate signal processing algorithms as based on the Phase I model. This effort will be hosted on a SPARC C/Unix system with required special processing boards. The prototype and model will be tested using appropriate active or passive data sets.

PHASE III: Design and build an advanced development model. Conduct laboratory and field tests.

COMMERCIAL POTENTIAL: Techniques and equipment developed in this effort could be applied to other passive monitoring activities, such as coastal surveillance for drug interdiction and for detection of illegal commercial fishing activities.

There are also a wide range of commercial applications in the fields of education, medical image processing, diagnostic systems and automated image compression for high definition transmission and data networks.

REFERENCES: IEEE Signal Processing Proceedings.

N96-252TITLE: Development of Performance and Traffic Adaptive Management Tool for High Performance Communications Networks

OBJECTIVE: Develop a computer software based prototype network-management tool which dynamically and adaptively allocates the resources of a communications network and adjusts the parameters of the network access and control algorithms to ensure continuous high-performance command and control operation even when abrupt changes take place in the network traffic/ service loading and distribution scenarios.

DESCRIPTION: Modern Navy local area networks and associated multi-access radio channels are configured to operate in a distributed application environment and to support a wide range of real-time and non-real-time services in an integrated fashion. Such networks must also carry Navy command and control messages through the effective assignment of message priorities. The shared communications network resources must be effectively allocated to ensure that each service class is guaranteed its required quality of service measures. It is essential that high performance tactical (real time) networks used for mission critical applications provide each service class its required performance guarantees even under dramatic changes in the system traffic/service loading, mixture and distribution scenarios. Currently, the existing network management system engages in monitoring and collecting traffic, utilization and performance data and in its display. It also at times allows the user to reconfigure the system, change flow control parameters, and reallocate channel resources, based on manual inputs provided by the user. No tool is currently employed to automatically mediate between the monitored state information and the ensuing action required. As network systems become more geographically distributed, supporting a constantly varying distributed real-time operation in an integrated-services environment, it is critical that the network management system employs a performance and traffic management tool which is used to dynamically allocate system resources and adjust the parameters of the network control algorithms. Communications networks to be controlled involve local area networks and associated multi-access radio links. Included are connectionless networks (such as interconnected and switched Ethernet, FDDI, TCP/IP router based networks), connection oriented architectures (such as Frame Relay and ATM), and multi-access radio channels (such as those using TDMA, DA/TDMA, random access, polling and other hybrid multiple access protocols). Such management processes can affect simultaneously different network layers and sublayers (such as physical, MAC, link, network, Internet work, transport, session layers) and different control mechanisms within each layer (such as flow control, congestion control, access control, error control, multiplexing, etc). The prototype tool to be developed should make effective use of existing analytically oriented tools and techniques for distributed real-time computer communications networks.

PHASE I: Develop the models and the analysis and synthesis techniques, to be implemented in Phase II, for the proposed adaptive network management tool. Through the consideration of a number of different Navy network systems which include local area networks and their interconnections, and multi access radio links, demonstrate the effectiveness of the proposed management and control schemes and algorithms. To ensure a high performance tactical operation, it is critical that real-time services are accommodated at minimal message delay latencies and jitters.

PHASE II: Develop the computer software for the tool prototype, incorporating the dynamically adaptive algorithms and analytical models, using effective object oriented program structure and graphical user interface. Use simulations and analyses to demonstrate the ability of the tool to interact with network management systems to adjust system parameters and make resource allocations in an efficient and real time manner.

PHASE III: Anticipated future use in high speed Navy shipboard networks and multi-access radio links. Applications include: LHA upgrade; JMCIS; CVN78; SC21; Tactical Intelligence links; LPD 17; range operation centers; interconnected LAN shipboard and ground installations.

COMMERCIAL POTENTIAL: The tool sought should have commercial application to integrated communications systems that are either satellite based, local area network based or both.

REFERENCES: Copernicus...Forward, Naval C4I Implementation, SPAWAR, Arlington, VA 22245-5200

N96-253TITLE: Requirements Management Assistant

OBJECTIVE: Develop and test a Requirements Management
Assistant (computer based tool) which manages, updates and traces system level requirements for program managers.

DESCRIPTION: Design, develop, and test a Requirements management assistant which dynamically links MNS, ORD andA-Level specification requirements and corresponding test requirements. The requirements management assistant should have the following capabilities and features: Recognize requirements based on their lexical specification. Identify potentially linked (subordinate or superior) requirements in different specifications. (An engineer will review and validate potential requirements linkages) Allow one to one, one to many, or many to one, linkages between requirements. Linkages should allow both simple or quantitative relationships between requirements Allow different types of information to be associated with each requirement and linkage. (e.g. Importance of the requirement, basis for goal and threshold values, risk, etc.) Allow specifications to be input from any popular word processing program and provide lexical based searches on requirements and associated information. Maintain version histories and flag potential requirements changes in one specification resulting from requirements changes in another specification. Be able to import and export data and to be integrated with system, hardware and software development tools like RASSP, CASE tools, etc.

PHASE I: Design and prepare a detailed performance specification for the requirements management assistant and propose scenario for testing the assistant. Provide cost and schedule estimates for building and testing the assistant.

PHASE II: Build, beta test and deliver a stand-alone requirements management assistant.

PHASE III: Integrate the assistant with RASSP and designated COTS-based systems engineering design automation tools for use in ADS, FDS, and SURTASS. Develop assistant upgrades identified by beta tests.

COMMERCIAL POTENTIAL: If this SBIR is successful, the requirements management assistant will probably be enhanced and marketed as a commercial product. Even if the assistant is not commercialized the technology developed under this SBIR will transition directly into other system engineering design automation tools.

REFERENCES:
1) Experience with the Application of Systems Engineering Tools Paper presented by John E. Cox at the 26-28 July Symposium of the National Council on Systems Engineering
2) A Survey of Systems Engineering Design Automation Tools presented by Dorothy Kuhn and Mark Sampson at the 26-28 July Symposium of the National Council on Systems Engineering.

N96-254TITLE: Image Information Preserving Compression for LOFARGRAMs

OBJECTIVE: Develop an innovative information preserving compression metric for LOFARGRAMs and other IUSS image products and apply the metric to compression algorithms using IUSS data.

DESCRIPTION: The undersea surveillance systems operated by the Navy provide a wealth of acoustic data. One system for collecting and displaying this data is the Integrated Undersea Surveillance System (IUSS). IUSS produces an invaluable analysis tool commonly known as a LOFARGRAM as well as other products. The LOFARGRAM has its counterparts in all acoustic systems which can be used to correlate commonly held targets. Presently, these LOFARGRAMs are only distributed within the individual acoustic communities. Therefore, the purpose of this topic is to investigate image compression algorithms for LOFARGRAMs and other IUSS products (CORRELOGRAMs, etc.) which can dramatically reduce the size of the image files while preserving critical contact classification information thus making it practical to distribute these images to the fleet. Compression ratios (with minimal informational loss but completely preserved classification information) on the order of 1000 to 1 are required. This type of signal processing has not been attempted before on IUSS
image products. There are several display/analysis/correlation systems within the Navy and other services that could also benefit from this acoustic data. Unfortunately, a single acoustic image can be fairly large (on the order of 500 KBytes or larger). In addition, the communications paths through which this imagery might be distributed to the fleet are extremely bandwidth limited. Prospective bidders should propose specific approaches to developing a classification information preserving metric and select specific candidate algorithmic approaches for the Phase I.

PHASE I: Develop a metric to evaluate the preserved information content of the compressed data. At this point, we are only interested in qualitative results. Review all current image compression algorithms, techniques, and technologies to determine their suitability on representative LOFARGRAMs and CORRELOGRAMs. If a new algorithm needs to be developed, develop the algorithm and test it. IUSS data will be supplied for this testing. If the Phase I results are promising, refinement can be done in Phase II. Produce a final report documenting the Phase I results plus example of compressed and decompressed images for Navy evaluation.

PHASE II: Using the results obtained in Phase I, continue to refine and produce a metric with quantitative parameters. Apply metric to the selected/developed algorithm(s). Work with Navy acoustic analysts to verify that the compression/expansion process has not degraded key classification features of the image. Appropriate IUSS data will be provided. Implement a standalone software package within the National Image Transfer File format for use with the Joint Maritime Command Information System (JMCIS). In addition, perform the compression/expansion process and produce documentation for this package and test over established Fleet Communication Circuits to a variety of acoustic users afloat and ashore.

PHASE III: Apply the compression algorithms developed here to commercial image processing and IUSS systems acoustic images such as FDS, ADS, and SURTASS.

COMMERCIAL POTENTIAL: This topic has significant potential for commercial applications in the area of image processing since generalizing the information preserving metric to other data images types provides a needed capability that is not currently available. With the growth of electronic commerce and communications, large, digital images are increasingly being transmitted from one location to another. Compressing these images while preserving certain data/image information would save considerable time and money.

REFERENCES:

1. SBIR 94-094 Digital Compression and Error Correction for Video Images.
2. National Imagery Transmission Format (Version 2.0), MIL- STD-2500, 18 June 1993.
3. Principles of Underwater Sound/3rd edition , Robert J. Urick.
4. Digital Image Processing, by Raphael C. Gonzalez and Riochard E. Woods, Addision-Wesley, 1992.
5. Scientific Visualization, Techniques and Applications, K. W. Brooke et al., Springer-Verlag, 1992.
6. Jain, Anil K., Fundamentals of Digital Image Processing, 1989, Prentice Hall.
7. Mission Needs Statement for Undersea Surveillance in Littoral water of 18 March 1993.

N96-255TITLE: <u>Development of Adaptive Security and Software Applications for Programmable Intelligent Digital Equipment</u>

OBJECTIVE: Develop an adaptive security module that can be integrated with future multifunctional, multiband programmable intelligent digital equipment. The adaptive concept of programmable digital radios needs to be extended to include image processing, fax, data and word processing applications such that military radio capabilities can be more integrated into secure information processing. The security module should include data separation, multiple algorithm manipulation, multiple hardware platform capability (PCMCIA, others), support current COMSEC and other general cryptographic algorithms and a key management overlay which includes symmetrical and asymmetrical capabilities.

DESCRIPTION: Develop an information security concept appropriate for multifunctional, multiband programmable intelligent digital equipment, develop an implementable design, demonstrate the feasibility of the design and demonstrate an integrated secure information processing capability in hardware and software that can be hosted in programmable intelligent digital equipment.

PHASE I: Develop an information security concept and a functional allocation design that shows how the concept could be implemented. The design should include a security module that can be demonstrated with information processing applications for programmable intelligent digital radios. The design must include interoperable COMSEC and be adaptive to differing access and confidentiality levels as found in the classified and unclassified but sensitive environments.

PHASE II: Complete the design, develop and test a prototype implementation of the security module that can be demonstrated in a programmable intelligent digital radio. Demonstrate the integrated prototype in Navy fixed and mobile environments. The demonstration environment could be a part of a Joint Warfare Interoperability Demonstration (JWID).

PHASE III: A successful prototype is expected to be incorporated into the new generation of Navy programmable intelligent digital equipment. Accordingly, develop a detailed commercialization plan that addresses how the product will be developed and marketed. The plan should include a realistic market analysis and assessment and the resources required to bring the product to market. The plan should also address how and when the resources required will be marshaled to bring the product to market.

COMMERCIAL POTENTIAL: This technology would have application for commercial privacy and information processing needs as an integrated module in commercial programmable digital radios and equipment.

N96-256TITLE: A Mission Planning Trainer Module for IUSS Deployable Systems

OBJECTIVE: The objective of this topic is to demonstrate the feasibility of a low cost, method for rapidly training fleet operators in deploying Deployable systems. using software that will be portable across generations of Navy TAC computers.

DESCRIPTION: The Navy has recently taken great advantage of commercial computer technology to produce a standard family of COTS desktop workstations and Command & Control software applications. Considerable cost savings have been realized in application program development through the use of pre-defined Application Program Interfaces (API) and a large library of general purpose routines. Innovative use of these techniques could provide a highly productive method of developing integrated computer-based training for these applications. Such an approach could use the application software itself to eliminate the need for expensive stand-alone trainer developments and classroom training. For deployables there is no time available in the time line for class room training of fleet mission planners.

PHASE I: Develop a design specification for the training module. Prototype a simple training example to demonstrate the use of cursors, charts, database manager, communications, acoustic models etc. to implement interactive training exercises for a student user.

PHASE II: Develop a full-featured interactive module for the deployables application. Demonstrate and document the software reuse and cost avoidance potential of this approach.

PHASE III: Develop a prototype and provide user documentation for deployable system users such as ADS and SURTASS.

COMMERCIAL POTENTIAL: This technology has vast applicability to the increasing number of commercial businesses which require extensive employee computer use. Examples include airlines, car rental companies, delivery services, banks and investment firms. There is increasing commonalty throughout the industry in operating system interfaces, windowing systems and database interfaces. These provide an excellent basis for integrated computer-based training for many applications both commercial and DoD.

REFERENCES: Mission Needs Statement for Undersea Surveillance in Littoral water of 18 March 1993.

N96-257TITLE: Adaptive Beamforming for Littoral Waters

OBJECTIVE: The objective of this topic is to develop sonar signal processing which is suitable for the littoral environment which is characterized by heavy shipping and near-field acoustic propagation effects.

DESCRIPTION: The recent change in operational emphasis to focus on littoral scenarios has caused Navy ASW ships to operate in acoustic scenarios for which their sensors were not designed. A specific problem of interest is the detection scenario in which loud, nearby contacts obscure the targets of interest. The well known techniques of adaptive beamforming are effective in these scenarios, but only when ranges are great enough for the plane wave assumption to be valid, or when detailed range information is available. Techniques are required which achieve the noise rejection benefits of adaptive beamforming without requiring detailed positional knowledge of contacts in the field.

PHASE I: Develop an algorithm description for proposed near-field processing techniques. Demonstrate and quantify noise rejection and signal preservation behavior on simulated signals.

PHASE II: Implement a laboratory version of the processing techniques which can process real ocean acoustic data from a suitable sensor system. Develop performance measures and quantify the behavior of the near-field algorithms. Identify the important variables and sensitivities which are critical to algorithm performance.

PHASE III: Implement the developed algorithms for a selected Navy sonar system and conduct at-sea tests.

COMMERCIAL POTENTIAL: These processing techniques would be of interest to the seismic exploration and geophysics communities, which routinely encounter near-field effects. The techniques may also be applied to commercial fishfinding and object location sonars. Adaptive techniques are also widely applied to medical sensor systems in which near-field effects can be important.

REFERENCES: Cox, H. JASA, 1973 "Adaptive Mismatch..."

N96-258TITLE: Robust Coding Scheme for Satellites (ROCSS)

OBJECTIVE: Prevent sudden losses of Direct Broadcast Satellite (DBS) signals due to small degradations in link performance.

DESCRIPTION: Information obtained from DBS systems currently in operation indicates higher than expected implementation loss when compared to theoretical performance. Examination of theoretical coding implementation shows a sharp dropoff which in actual operation results in a nearly total loss of signal for small degradations in link performance.

PHASE I: Determine potential coding schemes and rates which could be implemented in a DBS application and demonstrate theoretical performance using computer simulation, working specifically on the Pe versus Eb/No rolloff slope to identify the source(s) of loss.

PHASE II: Using the results of Phase I, execute a prototype model to demonstrate an optimum, robust coding scheme with linkage to live DBS data. Solicit the interest of potential commercial phase III partners/sponsors.

PHASE III: Proceed to production with applications suitable for military or commercial DBS sysytems.

COMMERCIAL POTENTIAL: Military applications will, by policy, use commercial DBS to the extent practicable, therefore commercial interest is inherent in any breakthroughs in performance and potential improvement in customer satisfaction.

N96-259TITLE: Dynamic Selection of Reallocated Timeslots

OBJECTIVE: The objective of this topic is to improve the efficiency and effectiveness of operational TDMA networks

DESCRIPTION: Certain TDMA communications systems utilize networks that are designed from pre-planned operational scenarios. These scenarios estimate the number of potential users, user types, and individual/collective communication requirements. Estimated values are used by the TDMA network designer to preallocate system capacity to individual users by assigning them network time slots. Assigned time slots are used to transmit users own data over the network. Prior to activating a TDMA communications system, a network is selected from a library of networks which most closely reflects the current operation. Mismatches between estimated and actual network user values can result in unused time slots, over/under subscribed time slots among network participants, and less than optimal network operation.

PHASE I: Perform a feasibility study for development of a real-time system to perform a network loading analysis which has
the potential for use in dynamic time slot reassignment.

PHASE II: Use Phase I feasibility study results to develop application software and processes. Host software on VME hardware, and test prototype system. Conduct the test in a laboratory environment using a TDMA communications network.

PHASE III: Full development and production for commercial and military TDMA communication systems is envisioned.

COMMERCIAL POTENTIAL: Any commercial communications system which employs a networked TDMA architecture could benefit from this technology. Potential markets include satellite communications, cellular communications, and other wireless systems.

NAVAL SEA SYSTEMS COMMAND

N96-260TITLE: Virtual Prototyping

OBJECTIVE: The OBJECTIVE of this topic is to develop a simulation system that replicates CAD/CAM/CAT tools for the sole purpose of synthesizing an engineering manufacturing development (EMD) model into a prototype that will simulate test parameters for stressing the system to both performance characteristics and environmental requirements preceding actual fabrication of hardware.

DESCRIPTION: Today's defense manufacturing uses prototypes and initial production units from limited production quantities to demonstrate design integrity and performance. This transition from EMD to full production phase offers opportunities to mitigate production risks and can be achieved through a synthesis of developing a virtual manufacturing environment that will reduce both risk and cycle time in arriving at a decision for production. The concept must address simulation of tests to stress the design. The virtual prototyping concept can significantly reduce management risk and reduce the number of engineering changes so costly in the production of weapons systems.

PHASE I: Design a system that offers the potential to be integrated into a virtual prototyping theory and sufficiently model it in order to demonstrate proof of concept.

PHASE II: Develop and demonstrate the Phase I design simulation model that can create the virtual prototyping for multiple applications.

PHASE III: Integrate the above demonstrated Phase II into AEGIS/NAVSEA efforts. Develop the standards and product specification, and use these standards to build one unit.

N96-261TITLE: Oceanic Environmental Control

OBJECTIVE: The objective of this topic is to develop a system of sensors and readout capability to assess ocean plankton density used in determining marine life concentration to assist the Fleet in selecting test sites involving ordnance and or shock trials.

DESCRIPTION: Today the Fleet does not possess a reliable and independent method for determining environmentally safe exercise and test areas in U.S. coastal waters without the assistance of other Government agencies. Prior to proceeding with any development effort the project must be preceded by a market survey as well as a literature search of laboratory studies in order to optimize the engineering solutions for this project. Ultimately the system must be capable of sensing plankton that can be related to the identifiable species most likely to be feeding on these plankton.

PHASE I: Show feasibility through review of available data collected by government agencies and non-government entities regarding marine life migration and oeanic variables influencing marine life populations, sensors, etc. A literature search of science research projects is to be conducted concurrently. Design a simulation model that can create virtual environmental states.

PHASE II: Construct a proof of concept engineering model and demonstrate aboard ship.

PHASE III: Produce and market a viable product.

COMMERCIAL POTENTIAL: The technology can be implemented in the commercial sector in several management applications related to the fish industry, EPA regulations, and protection of endangered species.

N96-262TITLE: Advanced Technology Information Interconnectivity

OBJECTIVE: The objective of this topic is to develop a set of licensed systems of controls and protocols interconnected to provide reliable and "user friendly" connectivity to both the Defense Information Infrastructure (DII) and the numerous information services unique to the DON sponsored initiatives.

DESCRIPTION: Industry has spent in excess of $1 trillion on information technology since the early 1980s. Today the National Information Infrastructure (NII) Act attempts to leverage the information that resides in various technology service organizations and provide greater access to the Public. In addition, the Defense Information Infrastructure and the Global Information Infrastructure provide opportunities to make accessible information in technological advances that can only be managed with a system of tools that will lend focus to the desired data. The selective data will advance the decision making process to mitigate risks. Ultimately the system must demonstrate the capacity to be applied in an environment that can capture large volumes of both literature and numeric information.

PHASE I: Conduct an investigation of current technological advances in information processing and management that will assist in the contractors ability to develop software and peripheral equipment requirements in an open architecture environment. Design a user friendly system to create tailored information searches.

PHASE II: Develop a prototype that demonstrates how DON (Department of Navy) users can be served by a user friendly system with the capability to create tailored information searches based on DON RD&A (DON Research, Development and Acquisition) requirements.

PHASE III: Develop the specifications for use by both the government and industry for the potential application of this user friendly system inclusive of security and protocols in a global network environment. Integrate into DON system.

N96-263TITLE: Fast Room Temperature Cure Adhesives for Fiber Optic Connectors

OBJECTIVE: The OBJECTIVE of this topic is to develop an adhesive for fiber optic connector applications that meets all of the Navy fiber optic connector adhesive requirements and that cures at room temperature in less than 3 minutes.

DESCRIPTION: Navy standard fiber optic use a heat cured adhesive (per MIL-A-24792) to hold the fiber within the connector. The current cure cycle for this type of adhesive is 20 minutes at 120 degrees Celsius. An adhesive is desired that meets the same minimum levels of performance as the current adhesives, but does not require a heat source and which cures in a relatively short time (less than 3 minutes).

PHASE I: Perform a trade-off analysis comparing the potential and actual performances of adhesives from the different adhesive families. Provide a recommendation for the most likely adhesive family for which a product could be formulated to meet all of the Navy requirements. Develop several different adhesive formulations from the recommended adhesive family and perform initial testing to characterize critical parameters of the different formulations.

PHASE II: Completely characterize each of the different formulations developed in Phase I and any additional formulations that could more closely meet the Navy requirements. Based on characterizations, develop an optimum formulation for the adhesive for Navy fiber optic material for compliance with MIL-A-24792. Provide adhesive samples to Bellcore and major U.S. connector manufacturers for evaluation.

PHASE III: Begin production of the adhesive material and sale to the U.S. Navy and commercial users.

COMMERCIAL POTENTIAL: The largest application of this product is in the commercial fiber optic connector market. Most of the connectors currently installed within the U.S. are fabricated with adhesives that require heat curing for 10 to 15 minutes. The fast room temperature cure adhesive will result in labor savings during connector installation in commercial applications as well as in Navy applications.

REFERENCES: MIL-A-24792

N96-264TITLE: Develop Techniques for Use of Open System Architectures for Commercial Off-the-Shelf-Components

OBJECTIVE: Develop innovative methods, techniques and tools for
the system engineering of large complex computer-based systems using open system architectures for commercial off the shelf (COTS) components.

DESCRIPTION: Integrate the innovative methods, techniques, and tools with existing system engineering techniques to provide an seamless product. Capabilities addressed should include specification, capture, analysis, assessment, and system-level optimization. System engineering to insert COTS and open system architectures into existing systems should be emphasized.
However, many challenges exist in using COTS and open system architectures. The system engineering must be able to make intelligent design/implementation decisions. These challenges include: (1) determining the correct system partitioning for an open system architecture, (2) detailed definition of open system interfaces, (3) selection of components (including trade off assessments), and (4) assessment of non-functional system attributes (timing, reliability, security) within system with open system components,. In an evolving system, the system engineering must ensure top-level requirements continue to be met as open system architecture and COTS components are inserted into the system. The effort should augment existing system engineering techniques, methods, and tools wherever feasible.

PHASE I: The methods proposed should be demonstrated to show feasibility. The requirements and design of all tools should be presented. Additionally, critical risk areas of the design should be prototyped to show feasibility of the total approach.

PHASE II: Full scale development of the automated capability should be completed. Usefulness of the method and tool should be demonstrated on a sample test case to facilitate the transition of the products into Navy systems development.

PHASE III: Transitions into a current large-scale Navy programs for which the requirement (for either new development or system modification) are under development.

COMMERCIAL POTENTIAL: Since large systems in the commercial sector are made of many COTS components, the methods and tools developed will have high commercialization potential.

REFERENCES:
(1) MIL-STD-499B (Draft) System Engineering
(2) Open System Environment (OSE) Profile for Imminent Acquisitions (Draft), Developed by Information Processing Directorate, DISA.
(3) DoD Directive 5000.1, Defense Acquisition, 23 February 1991.
(4) DoD Instruction 5000.2, Defense Acquisition Management Policies and Procedures, 23 February 1991.

N96-265TITLE: Three Dimensional Target Location from Video Images

OBJECTIVE: Develop algorithms to support the use of a video camera to establish the locations of objects in three dimensions.

DESCRIPTION: The Naval Surface Fire Support program sees great value in the use of low-cost video cameras to locate targets on the battlefield. Images would be gathered from cameras mounted on unmanned aircraft, dropped by parachutes, fired in projectiles, carried by Marines, or placed in key positions. (If the camera is not moving, two cameras will be used to provide perspective to measure the third dimension.) These cameras will have their position and angles established with the Global Positioning System and a low cost inertial navigator. The inertial navigator will be calibrated by the GPS and receive its initial conditions from GPS, so it will not be any more accurate than the information GPS provides. The GPS will be operating in P(Y) code operation, but not in kinematic or other carrier-phase sensing mode. Within these constraints, frames of the video images will be tagged with the camera's position and orientation.

The SBIR effort must develop a system to deal with two problems: extraction of targets from the video frames, and conversion of the extracted target's 2-D position in the video frames into a 3-D position in GPS coordinates. Initially an operator will select a target from a video frame, and the system will then have to analyze subsequent images to locate the same target, extract a consistent position, and feed that position into the conversion algorithm. If the conversion algorithms also require positions of background points in the image, the extraction algorithm must select these background points automatically.

We want to locate both fixed and moving targets. For moving targets, velocity as well as position is needed.

The accuracy desired is 2 meters CEP location of the target with respect to a camera position, when operating at a range of 2 kilometers from the target. Achieving this accuracy will require more than simple triangulation because of errors in alignment of the low cost inertial navigator.

We expect to use compressed images and narrow communications bandwidth, so techniques that deal with individual snapshots preferred to those that require full motion video. The locating system can specify which frames it wants (that is, the frame timing is flexible, with 1/30 of a second or many seconds between frames). In some applications, the locating system will be able to specify the motion of the camera, but that will not be guaranteed. (For example, a camera on an unsteered parachute will not be controllable. In cases like this, the locating system should perform well unless the situation is degenerate and three dimensions can not be calculated mathematically.)

PHASE I: Develop algorithms for target extraction and position location, and demonstrate their performance on synthetic imagery of stationary targets.

PHASE II: Demonstrate the algorithms with real-world imagery, and extend them to moving targets.

PHASE III: Integrate the algorithms into a shipboard video workstation.

COMMERCIAL POTENTIAL: These techniques are directly applicable to geodesy and mapping, which currently relies on manual techniques with aerial photographs, referenced to high cost inertial navigators. There is particular demand in the area of site surveying at commercial properties, which require accurate location of all structures and elements, including landscaping, for zoning purposes and for environmental remediation. A similar need is in architecture and industrial design, which requires the surveying of existing conditions inside a building, for example equipment locations on a factory floor. These techniques also apply to factory automation and machine vision systems.

REFERENCES:

1. *"Longlook" Accurate Target Location with Low-Cost Gun-Launched Aircraft,* FY98 Advanced Technology Demonstration Proposal. (Available from NAVSEA PMS 429D, Mr. David L. Liese.)

2. Thomas S. Juang, "Determining Three Dimensional Motion and Structure from Two Perspective Images," in *Handbook of Pattern Recognition and Image Processing,* pp 334–354, (Eds) Tzay Y. Young and K. S. Fu, Academic Press, 1989.

3. Guna Seetharaman, "Dimensional Perception of Image Sequences", Chapter Three in *Handbook of Computer Vision,* edited by Tzay Y. Young. Academic Press, FL, 1994.

N96-266TITLE: <u>Develop Uplink Channels Within Military GPS Receivers</u>

OBJECTIVE: Develop a method to communicate to a GPS equipped weapon through its GPS receiver.

DESCRIPTION: GPS equipped weapons are entering development and employment, but are currently not retargetable after launch, except through an external data link. We desire a way of communicating with a GPS guided weapon through its GPS receiver. An approach is desired that minimizes the additional equipment on the weapon, that takes advantage of the crypto-secure P(Y) code, and that does not undermine the GPS receiver's navigation and housekeeping functions. Data rates in the range of 500–5000 bits/second are needed, and reception of multiple channels by the weapon would be desired (for example, to support retargeting from the firing platform along with differential GPS corrections from a differential base station). The technique should not interfere with the firing platform's own GPS or use of GPS service by other users, and the technique should permit multiple users to communicate with their own weapons simultaneously.

PHASE I: Develop an approach to achieve this capability, along with estimates of cost impact to the weapon and to the firing platform.

PHASE II: Implement and demonstrate the data link.

PHASE III: Phase III transition is possible to many GPS-guided weapons, such as ATACMS, SLAM, or JSOW, but the most immediate transition would be to the NSFS five-inch guided projectile.

COMMERCIAL POTENTIAL: The techniques developed for this topic will be applicable to the many commercial GPS applications now emerging, particularly the Wide Area Augmentation System (planned to be implemented by 1997) and the FAA GPS Category III precision landing system. It will be applicable to any application where a system with a GPS receiver also requires other data: differential GPS navigation and surveying, Intelligent Vehicle-Highway Systems, and telemetry. The commercial GPS market is predicted to reach $2 to $6 billion annually in 1996. Additionally, more general applications of this SBIR topic exist in Code-Division Multiple Access techniques for cellular telephones, pagers, and mobile data applications

REFERENCES: *NAVSTAR GPS Space Segment/Navigation User Interfaces (ICD-GPS200)*, NAVSTAR GPS Joint Program Office, July 1991.

N96-267TITLE: Electronically Stabilized and Deblurred Camera

OBJECTIVE: Produce a video camera that provides a stabilized, deblurred image electronically, in a highly integrated design that includes the imager, its support circuitry and the stabilizing and deblurring circuitry on one chip.

DESCRIPTION: The Naval Surface Fire Support program sees great value in the use of low-cost video cameras to locate targets on the battlefield. The cameras could be carried on a variety of platforms, including unmanned aircraft or parachutes; or carried by Marines, or mounted on their vehicles. In these environments, the quality of the camera imagery will suffer from blurring and image motion as the camera tilts. However, these platforms have lowcost inertial navigators that can provide angle rate information that can be used to stabilize the image.

This SBIR topic seeks a low cost, all-electronic solution to stabilizing and deblurring the video produced by the camera. We believe that new developments in imagers, such as the NASA Jet Propulsion Laboratory's Active Pixel Sensor, make it possible to produce an imager chip with a large number of pixels (for example, 1024 x 1024) within which a smaller image frame (for example, 640 x 400) could be steered to follow the image as the camera moves. For deblurring, a series of high-shutter-speed images would be adjusted into alignment based on the inertial navigator's angle rates and summed. The same process carried out over a longer time frame would enhance the low-light performance of the camera. If two frames were aligned and differenced, the camera would provide moving target indication. Additionally, the CMOS process used in the Active Pixel Sensor allows the support circuitry to be included on the same silicon substrate, which would allow tight integration of the stabilization circuitry with the imager's analog-to digital conversion and row and column readout process. (In its ultimate configuration, the camera would incorporate the low-cost silicon micromachined gyros, to provide the rate sensors on the same silicon chip, but that effort is outside the scope of this topic.)

PHASE I: Develop a design for a stabilized, deblurred camera with image integration and moving target indication, and demonstrate a brass board. A goal for the deblurring function is to provide an effective shutter speed ten times the frame rate. (That is, a $^{1}€_{300}$ second shutter speed in a $^{1}€_{30}$ second total exposure time.) Demonstrate its stabilization, deblurring, and moving target indication functions.

PHASE II: Fabricate an imager chip containing the light sensor and all support circuitry.

PHASE III: Produce a camera incorporating the stabilized imager chip, and demonstrate its performance on a live vehicle.

COMMERCIAL POTENTIAL: The commercial market for stabilized cameras is filled by the Steadycam (a heavy and expensive gyroscopically-stabilized film camera), Steadycam Jr. (a pendulum-stabilized rig for video or film cameras), and by moving-prism based stabilizers for the optics of video cameras. The electronically stabilized camera will be able to take a large portion of this market, in the home market as well as professional video, particularly news coverage. The camera's integration and moving target indicator functions are particularly valuable for remote security applications, to enhance performance in low light conditions and reduce data transmission needs and storage requirements for archiving. (Many security cameras observe empty hallways.) The very small size and low power consumption of an electronically-steered camera also make it suitable for boom and wire-flown application in coverage of live events and to achieve coverage from an otherwise inaccessible angle.

REFERENCES:
1. *"Longlook" Accurate Target Location with Low-Cost Gun-Launched Aircraft,* FY98 Advanced Technology Demonstration Proposal. (Available from NAVSEA PMS 429D, Mr. David L. Liese)
2. Sunetra K. Mendis, Bedabrata Pain, Robert H. Nixon, and Eric R Fossum "Design of a Low-Light-Level Image Sensor with On-Chip Sigma-Delta Analog-to-Digital Conversion" *Proceedings of the SPIE vol 1900, Charge Coupled Devices and SolidState Optical Sensors III* (1993).
3. California Institute of Technology Jet Propulsion Laboratory, *New Technology Report—Design of a Low-Light-Level Image Sensor with On-Chip Sigma-Delta Analog-to-Digital Conversion, JPL and NASA* Case No. NPO-19117. (Includes REFERENCE 2)
4. California Institute of Technology Jet Propulsion Laboratory, *New Technology Report—CMOS Active Pixel Sensor,* JPL and NASA Case No. NPO-19246.
5. "JPL Squeezes Camera onto Chip," *Military and Aerospace Electronics,* Nov 1995,-

N96-268TITLE: Innovative Gun, Chamber, Breech Designs

OBJECTIVE: To develop an all-new gun, chamber, and breech concept that is consistent with large caliber, high rate-of-fire, short recoil gun systems that are likely to be fielded on future ships.

DESCRIPTION: Because of recent gun concepts for launching guided projectiles vertically without train and elevation control, additional design flexibility is available by which to optimize the remaining gun components for this mission. One of the primary design requirements is that of maximizing barrel length within a fixed packaging dimension. This requirement would imply short recoil strokes and side loading chambers so as not to take away from the barrel length. These design implications have implications themselves. A shorter recoil means higher recoil forces. Higher forces mean potentially higher stresses in components. All these implications are consistent with a new, high technology design, positioned vertically against the lower members of the ship's structure.
Such a system must also be compatible with the high rate-of-fire requirement of a large caliber gun such as 155 mm and the fully automated multiple-rammed concept of loading. Any required recoil, chamber, breech motions must be compatible with the loader function—most likely a rotating drum type which facilitates side loading also.

PHASE I: Explore a range of chamber, breech, recoil designs that are compatible with length constrained systems and define the scope of its operation.

PHASE II: Using the design requirements from Phase I and supplied loader design, develop a basic barrel, chamber, breech, and recoil design for a generic large caliber gun system.

PHASE III: Integrate the Phase II design with specific requirements of the entire gun system

COMMERCIAL POTENTIAL: Development of such a design has application to advancement of metallurgy for very large components, advances in production techniques, high pressure dynamic sealing techniques for the chemical industry, and high speed automation and operation for large components. A particular large-market application is active crash protection in vehicles.

REFERENCES: *VGAS—Vertical Guns for Advanced Ships,* FY98 Advanced Technology Demonstration Proposal. (Available from NAVSEA PMS 429D, Mr. David L. Liese)

N96-269TITLE: Very Low Structure Borne Noise Unit Enclosure for COTS Modules

OBJECTIVE: Develop a unit enclosure with very low structure borne noise (SBN) characteristics that provides adequate cooling and supports installation of COTS (Commercial Off The Shelf) modules in the submarine hard deck sphere mounting environment where shock isolation and very stringent low level structure borne noise levels are required.

DESCRIPTION: COTS modules are used in today's military systems as a rule rather than an exception. Overall, designing a unit structure to package these types of modules in an isolated deck environment is not a challenge because of the relaxed environmental specification, especially the structure borne noise requirement. In the hard deck environment, the structure borne noise requirement typically is just a few dBs above the ambient noise level. This is a very hard specification to meet if the COTS modules are the air cooled type because fans are needed to force air circulation within the enclosure. Fans generate spikes in the structure borne noise spectrum that are very hard to suppress. The use of conduction cool COTS modules is a solution but negates the low costs and technology refreshment associated with COTS air cooled cards. Conduction cooling is not a best value answer because this type of module is not widely accepted by the commercial industry, and the cost of the module is significantly higher and is not typically updated as technology advances.

The solution calls for innovative ways to suppress the large noise spikes generated by the fans. There are various approaches to be considered, one way would be to lower the fan speed required and have chill plates near the modules to facilitate cooling. A second method would be to provide active noise cancellation to measure the frequencies of the noise spikes and then use active noise cancellation techniques to suppress the noises.

PHASE I: Perform tradeoff study different approaches to solve the very low level SBN problem. Based on lab test results and analysis, one approach will be selected for further investigation.

PHASE II: Design and build a prototype of the enclosure. Perform environmental testing on the design.

PHASE III: Design and build the production enclosure. Integrate the design into the military programs.

COMMERCIAL POTENTIAL: Sound abatement technologies for equipments that cohabited with humans in their relative work space will afford the practical use of such machines. More efficient methods proposed under this SBIR Topic may offer the commercial industry an opportunity to reduce costs or dimensional volume associated with sound isolation technology.-

N96-270TITLE: Generic Electronic Card Chassis & Power Supply Enclosure

OBJECTIVE: Develop a low cost, reliable common card enclosure to support new COTS electronic card formats across multiple platforms

DESCRIPTION: The current adoption of using COTS VME card technology in military applications is most cost effective when selection of vendors commercial products are made without any modifications for ruggedization or conduction cooling to the electronics. Since most vendors products are designed for forced air cooling in laboratory environments there are several factors required to permit usage in naval ship borne environments. The most important factors are listed below:

A.) Develop a cooling approach to provide adequate cooling for a maximum population of twenty one (21) cards per chassis that also limits the structure borne and airborne noise levels to requirements imposed on naval ship borne systems.

B.) The cooling approach should be modular such that is easily reconfigured to support either a forced air cooling environment such as found on surface ships or a water cooled environment as found on a submarine platform.

C.) The Power Supply approach used to power the card cage should be highly reliable since access to the supplies will typically be limited in a ship borne environment. The Power
design also must consider various electromagnetic interference and input power requirements imposed on naval ship borne systems. The approach to solve this problem would be to compile a list of all desired requirements for the candidate chassis and to develop a plug-n-play modular design that would allow maximum selection of COTS products (chassis, power supplies and cooling devices, etc.) to build the desired chassis to fit the environment. The Chassis could be used in various configurations such as a standard 6 Ft Rack, a standalone single chassis enclosure or a multi-chassis enclosure such as being proposed for the SIE enclosure on NSSN. The power and cooling design should be adequate to support a fully populated 21 slot chassis.

PHASE I: Generate a requirements matrix that cross references all desired mechanical, electrical and environmental requirements for various naval ship borne environments. Develop a conceptual design of a candidate chassis that is modular and can be used to meet these requirements by minimal reconfiguration. Compile a list of COTS vendor components and candidate suppliers.

PHASE II: Complete design and build of a prototype chassis and perform environmental qualification testing of the prototype chassis.

PHASE III: Provide complete documentation including chassis and power specification and drawings adequate to allow contractors to select desired chassis design, procure necessary components and integrate the chassis into the intended system with minimal cost and schedule.

COMMERCIAL POTENTIAL: The ability to use commercial grade electronic circuit cards in hostile environments provides industry with the opportunity to apply COTS technologies to on board shipping, aviation, and other transport applications.

N96-271TITLE: Core Based ASIC Signal Processor

OBJECTIVE: Design and develop an ultra high performance low cost core-based ASIC signal processor to meet the Navy's future processing requirements. The goal is to develop an 8 mm .5 micron chip with the performance in excess of one billion operations per second. This goal shall be to develop a high performance signal processing chip dissipating less than five watts and very low development cost.

DESCRIPTION: The advances in VHSIC technology have reached the point where Digital Signal Processing (DSP) chips can be used to perform many intense signal processing tasks such as beamforming and sensor processing which traditionally required custom hardware. The advantages of this type of system are low N.E. cost, COTS based DSP processors, and support of industry standard software. Due to the inefficiency of most commercially developed general purpose DSPs, such systems tend to have high recurring cost and utilize significant space and power. A solution is needed that has the advantages of COTS DSP but none of its drawbacks. The emerging core-based ASIC technology provides a potentially best value solution for the Navy's future signal processing requirements. The DSP coreis a COTS design of third party vendors and can be used by numerous companies. A core-based ASIC design will be very efficient since it can be modified to meet the specific needs of individual systems and applications. Furthermore, the N.E. to develop the ASIC is low because the majority of the design is done by the core vendor. The footprint of the system can be reduced further by integrating multiple DSP cores into a single chip.

PHASE I: Survey and evaluate all commercially available ASIC core designs. The core designs will be evaluated based on the applicability of the designs to the Navy's signal processing requirements, cost vs performance, manufacturability, portability, and acceptance of the designs by the industry. At the end of the Phase I study, a single ASIC core design will be selected for further testing.

PHASE II: Obtain evaluation chips from the vendor and perform functional tests to verify the performance and applicability of this design to Navy's signal processing requirements. Evaluate the manufacturability of this design and also negotiate licensing agreements with the vendor.

PHASE III: Design and test the core-based signal processor ASIC chip. Demonstrate the applicability of this chip to the Navy's signal processing requirements.

COMMERCIAL POTENTIAL: Core based ASIC designs for signal processing may provide low cost solutions for industry applications in radar, sonogram, CT scan, MRI and numerous other measurement and analysis systems.

N96-272TITLE: Expanded Data Link Throughput for Submarines

OBJECTIVE: Improve Submarine radio frequency data communications rates, accuracy and bandwidth requirements.

DESCRIPTION: Submarines have a need to be able to support communications with the rest of the Fleet. However, due to shipboard constraints, the antennae available require significant time at the surface to receive and transmit the growing volume of communication traffic. Solutions which can increase data throughput, minimize time on the surface and retain the data integrity are solicited.

PHASE I: Explore concepts which can solve the problem. Validate the concept through modeling and analysis.

PHASE II: Demonstrate the concept works using a prototype system in a laboratory or at sea.

PHASE III: Dependent upon the concept selected and successfully demonstrated, it is contemplated the contractor may either produce the product or assist the Navy as a Technical Agent in engineering the concept into larger systems or into existing systems.

COMMERCIAL POTENTIAL: The increasing volume of information being passed by the communications industry shows no signs of stopping. The need to get information transferred rapidly to remote sites is analogous to the submarine problem. More efficient methods proposed and validated under this SBIR Topic may offer the commercial industry an opportunity to reduce costs or transfer more information at the same cost.

N96-273TITLE: Interactive Acoustic Analysis Processor

OBJECTIVE: Improved operator tools to guide and facilitate automated recognition of complex acoustic signatures in complex environments

DESCRIPTION: Many recent attempts to automatically recognize complex acoustic signatures have worked fairly well in controlled simulations but failed in realistic environments. Many of the failures can be explained with even casual human intervention. For example, the presence of an interfering signal or the effects of multi-path distortion which are readily recognized by experienced operators often confuse neural networks and other classifiers. The human auditory system is capable of many feats unmatched by neural networks, expert systems, or pattern recognition technology. In particular, experienced sonar operators can recognize subtle distinctions which seem to be otherwise indistinguishable, while they also recognize vastly different sounds as being from the same source. Consequently, tools which allow an operator to visually and aurally inspect data; and to interactively guide automated classification algorithms in creating artificial hypotheses concerning the partitioning and generation of composite acoustic data sources, are valuable in developing the signal analysis.

PHASE I: Identify modifications to existing analysis systems required, if any, to allow interaction with both trained and untrained operators. Develop an organized test procedure for system evaluation and demonstrate it using limited data recordings.

PHASE II: Implement critical components of the system into a prototype and quantify their performance using both trained and untrained operators.

PHASE III: Integrate system into an existing Tactical or Support Combat System.

COMMERCIAL POTENTIAL: The need for human interaction to recognize, inspect and classify automated acoustic data can readily be translated into failure prediction, detection, and analysis of mechanical systems in commercial industries as well as marine animal and aviary research venues.

N96-274TITLE: Signal Processing Platform-Independent Code Generation from Software Specifications

OBJECTIVE: Migration of hardware and software functions from legacy architecture sonar signal processors to modern DSP (COTS) architectures.

DESCRIPTION: A wealth of modern Sonar algorithms are currently implemented on old technology, expensive-to-maintain, digital signal processor (DSP) architectures. End-of-life issues and other logistic problems often force low-productivity development efforts on these legacy architectures. Eventually, it is life-cycle cost effective to "Migrate" the algorithms to modern DSP architectures that are available via Commercial-off-the-shelf (COTS) technology.

Even though the performance increases in the recent DSP modules and the corresponding extensive common library routines available for signal processing application provide the means to design, implement, and test software with a high productivity relative to legacy systems, the cost of this legacy-to-COTS migration effort is still considerably high. The design, code, and test portion of DSP algorithm migration should not require repetition of traditional methods, but should be able to take advantage of the preliminary phases of legacy software development of these same algorithms that were successfully completed.

Because DSP algorithm software requirement specifications closely match the actual code design, and resulting modular code implementation, it is possible to use automated code generation tools to translate the modular software requirements specification for signal processing algorithms into code design, which can then be then compiled and linked into existing DSP architectures.

PHASE I: Identify several signal processing strings that could be candidates for migration to a COTS based processing architecture. Prototype a single string on an automated signal processing code generation tool to prove that the requirements can be converted to design and implemented in a non-real time emulation system. Project productivity and resource requirements for the automated development of the prototype string.

PHASE II: Expand the prototype effort for the single string from Phase I to generate the code necessary to implement the string in real-time on a COTS DSP architecture. Generate all processing excitation data necessary to verify that the implementation meets the intended requirements. Perform detailed performance testing on the signal processing string to formally certify that it performs well enough to be implemented on a tactical platform.

PHASE III: Migrate Sonar digital processing algorithms in a full system development effort. Produce all test verification data and excitation required for formal certification.

COMMERCIAL POTENTIAL: The use of new tools and techniques to automatically generate software code from software specifications has potential application and cost-savings for all commercial marine and aircraft industries as well as entertainment industries such as audio and stereophonic businesses.

N96-275TITLE: Mine Localization and Registration

OBJECTIVE: Mine threat database to support Submarine Combat System detection and logging and access to mine threat information.

DESCRIPTION: Mine detection sensors on board the SSN platform are designed to detect the presence of mines for the purpose of avoidance during transit through mined regions. In the course of detection, mine threats are implicitly localized. The logging and archiving of threat locations would be very useful in situations where rapid ingress and egress is needed. It has become necessary to link the mine detection subsystem into a database that is readily accessible to the combat system for future reference.

PHASE I: Perform the conceptual design and select a suitable sensor for concept validation.

PHASE II: Implement a scaled down prototype and do limited testing in the laboratory. Develop plan for a full prototype to be tested at sea.

PHASE III: Complete and test full prototype implementation and provide plan and documentation for ultimate incorporation in an operational platform.

COMMERCIAL POTENTIAL: This topic has potential commercial application in the areas of underwater search and rescue, marine mapping and research, undersea telecommunications and off-shore oil drilling activities.

N96-276TITLE: Plastic/Elastomeric Sensor Outer Heads/Housings

OBJECTIVE: The objective of this work is to initiate and investigate the use of castable structural polyurethanes for the manufacture of sensor outer heads/housings planned for advanced submarine (NSSN) systems such as the Photonics Mast and Integrated ESM Mast.

DESCRIPTION: The problem to be solved is the structural design and manufacture of low-cost sensor outer head/housings for advanced systems preferably using high structural performance castable polyurethane materials.

PHASE I: Based on GFI the contractor will 1) Prepare a structural design methodology for government review and approval; 2) With government approval, conduct a structural analysis based on GFI configuration data; 3) Conduct uniaxial load tensile tests of selected plastic/elastomer materials to validate structural/mechanical property data used in structural analysis; 4) Prepare a detailed, step-by-step, methodical breakdown and contextual DESCRIPTION of the approach to be used to manufacture a sensor outer head/housing in accordance with the provided GFI and items 1, 2 and 3 above.

PHASE II: Based on GFI the contractor will update Phase I results and prepare to initiate an engineering/development effort to manufacture at least two specimens each of three different outer head/housing configurations. The contractor is expected to provide manufacturing drawings for all parts to be manufactured as well as all tooling and other hardware to complete manufacture. Upon government approval of the contractor's approach and documentation, the contractor will execute the manufacturing effort mentioned previously.

PHASE III: The contractor will produce a series of production version of selected outer head/housing using castable structural polyurethane material, GFI and the technology and documentation produced in Phase I and II.

COMMERCIAL POTENTIAL: Improve access by plastics industry to Submarine market while obtaining performance and cost benefits. Aircraft, automobile, marine and chemical industries would benefit from the improved technology and larger industry capacity and revenue.

N96-277TITLE: Advanced Spatial Filtering

OBJECTIVE: Design and develop an open architecture very high bandwidth integrated sonar signal distribution system for application aboard submarines.

DESCRIPTION: A problem encountered in the integration of acoustic systems with multiple sensor arrays is the ability to gracefully increase the bandwidth of the network interconnecting the respective processing engines. The combination of high performance chip technology and the increasingly high performance COTS technology are limited, in the scope of the task that they can support, by the inability to effectively connect the respective processors with adequate bandwidth to meet the demand of the application.

The contemporary sonar applications that are designed to address the difficult littoral environment must rely upon multiple arrays in order to support a wide variety of needs associated with littoral operation. For example, arrays with very high bandwidth demands create a very high load on the sensor signal distribution system while other lower bandwidth arrays do not.

In order to achieve the most cost effective realization of the acoustic front end it is necessary to implement an integrated signal distribution system. However, such a system must not only support very high bandwidth signal distribution but must be a truly open architecture system in order to permit future system growth and evolutionary development.

PHASE I: Evaluate a representative system, and assess the total system bandwidth necessary, taking into account potential growth features and the open architecture requirement. Perform the conceptual design of a 'generic' front-end. Identify components and equipment necessary to implement the improved bandwidth and open architecture, and develop list of parts to be procured.

PHASE II: Implement the design of Phase I in a scaled down prototype, and develop preliminary design for full prototype implementation.

PHASE III: Complete and test full prototype implementation and provide plan and documentation for ultimate incorporation in an operational platform.

COMMERCIAL POTENTIAL: Commercial industries that would benefit from this research topic include undersea telecommunications, commercial radars (marine and land-based), undersea acoustics research and oil industry exploration.

N96-278TITLE: Technology Infusion Methodology for COTS-based Systems

OBJECTIVE: Define and develop ground rules, along with accompanying metrics and benchmarks, for the design and development of COTS-based embedded systems. The rules and metrics will facilitate the infusion of module level technology for upgrade and cost reduction purposes.

DESCRIPTION: The shift by the military from full-Mil developments to Commercial-Off-The-Shelf approaches using best commercial practices (i.e., ISO9000) and COTS products has resulted in a need to leverage the commercial market's investment in development. Along with the gains of decreased cycle time and cost reduction, comes a dependency on fast moving, uncontrollable benefactors. Effort is required to ensure that design and development practices employed in previous Mil systems are migrating to best exploit this area. Military practices of requiring high percentages of Performance Monitoring and Fault Localization detection and dedicated hardware and software to achieve this end conflicts with the COTS culture by defeating technology upgrades and forcing endof-life redesigns. Techniques which target other key migration parameters (i.e., software protocols, operating system linkages, integration and cycle time reductions, etc.) should be identified and a business case should be developed which defines when and where measures should be applied.-

PHASE I: Evaluate (in addition to survey) typical design and development phases and identify critical parameters. At the end of the phase I, a single design will be selected for further testing.

PHASE II: A test case employing the techniques identified in Phase I will be implemented & measured against the predictions developed in Phase I.

PHASE III: A full system design will be developed using the principles generated in the previous phases applied to it.

COMMERCIAL POTENTIAL: This SBIR topic would have potential commercial applications to any computerized hardware manufacturer which uses diagnostics (i.e. automotive and medical use equipment) as well as the general microcomputer industry.

N96-279TITLE: Low Light Level Color Imaging with Image Processing (readvertised).-

OBJECTIVE: Improve the capabilities of low-light level color imaging using either special image intensification techniques or application specific image processing algorithms or other suitable technology.

DESCRIPTION: Color cameras have shown dramatic improvements in image quality, resolution, and dynamic range. However, very little improvement has been made in the area of image intensification. Under moderate to low light level conditions, these cameras generally perform very poorly. This poor performance has greatly limited the use of color cameras in system that operate in dusk/dawn environments. Because of the obvious advantages of color over monochrome (i.e. realism, better object recognition, ship navigation, intelligence operation, and etc.), systems with lowlight level requirements could be dramatically improved if a color camera could be used in place of the existing monochrome (visible or FLIR) camera. This imagery could then be further improved if real-time (or near real-time) application-specific image processing algorithms could be used to reconstruct the imagery and provide good color rendition from the poor raw imagery.-

PHASE I: The contractor must develop an image processing system that will provide good color rendition from imagery obtained from intensified and non-intensified color cameras. It is a goal for the contractor's image processing system to provide good color rendition of imagery in an environment where the light levels vary from 1000 lux to 1E-4 lux. The image processing system may be used to enhance imagery such that one could be able to distinguish common shipboard (military and commercial) light; i.e., red, white, green, and yellow, given typical commercial (source) luminosities taken at appropriate ranges. It is also a goal for this processing to be accomplished in as close as possible to real-time.

PHASE II: Methodologies used to design and develop this system should include but not be limited by performance trade-off analyses of adaptive image painting and/or image contrast/color stretching of intensified and non-intensified color

CCDs, or Silicon Injected Target sensors. Other more exotic designs are also encouraged. Using the chosen design, the contractor will manufacture three systems. All three systems will be provided to the government for further T&E. The contractor will provide monthly technical progress reports and a final comprehensive technical report of Phase II efforts.

PHASE III: Develop the system for use in a new or existing program.

COMMERCIAL POTENTIAL: The largest commercial application for this technology would be the camcorder market. The best low-light capability of today's commercial camcorders is about 1 LUX. This still results in snowy video under some typical video recording conditions. In addition, recording in some dusk/dawn conditions and at night is not possible. Improvements in low-light capability would greatly enhance the quality and usefulness of these commercial products. Also this could be used in the commercial shipping industry to aid in collision avoidance.

N96-280TITLE: Integrated Fuzzy Control Systems for Missiles

OBJECTIVE: To develop the fuzzy control design methodology and algorithms for the integrated (blended) control of a missile that uses multiple, non-collocated actuators, control effectors an sensors.

DESCRIPTION: Future tactical guided missiles will require higher speed and greater maneuverability, hence they will need more sophisticated control methods. The multiple, non-collocated control effectors in current use are not utilized as effectively as possible. Conventional systems use one set of control effectors, or only use the second set if the first set saturates and cannot provide adequate control. An example is a missile that utilizes aerodynamic control surfaces (fins) and attitude control (side lateral) thrusters (references 1 and 2). Higher performance missiles must use more efficient techniques for the integration and blending of the control system assets which exist or are added. One potential approach for the efficient blending of multiple control effectors is fuzzy control. Fuzzy system theory was introduced in 1965 by Lofti Zadeh (Ref. 3) as a means for describing and controlling imprecise systems (I.e., systems that cannot be described as a definite 0 or 1 bit or as on or off). Since then, fuzzy theory has been further developed (references 4,5) and been widely applied, such as in the control of aircraft, helicopters, torpedoes (Ref. 6), automobiles, radar systems, manufacturing processes, etc.-

PHASE I: Explore the application of fuzzy logic control for the blending control of a system with multiple, non-collocated actuators, control effectors and sensors. Design an integrated control system for a generic high speed tactical missile. Show feasibility through simulation of its effectiveness in intercepting missile/aircraft targets.

PHASE II: Develop on advanced control system for a Navy missile. This will include development of the control algorithm, a detailed nonlinear six degree-of-freedom simulation of the missile, and an analysis of performance in comparison with existing methods.

PHASE III: Design, build and transition an advanced control system to an Advanced Technology Demonstration (ATD) or to a planned product improvement of the STANDARD Missile 2 block IV.

COMMERCIAL POTENTIAL: The aerospace industry with applications in aircraft, satellites, missiles and the space station would benefit. Also, the research and methodology developed could be applied to other systems requiring multiple control devices and sensors.

REFERENCES:
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5. "Fuzzy Logic in control systems: Fuzzy Logic Controller," C.C. Lee, IEEE Transactions on Systems, Man, and Cybernetics, Vol. 20, No. 2, March/April 1990.
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N96-281TITLE: A High Doppler IR Target

OBJECTIVE: Develop innovative technology to provide calibration sources for Ship Self Defense.

DESCRIPTION: The Navy is placing an increased emphasis on systems to detect sophisticated anti-ship weapons. A cost effective means of designing, developing, testing and analyzing the performance of new detection systems requires the development of a low cost high doppler IR target. Due to the inherent complexities of the detection systems they are testing, it is extremely important that the target source produce accurate indications. Innovative techniques are required that provide the user a measure of accuracy for the results of these complex tests.

PHASE I: Conduct an analytic feasibility study, propose a system design, implementation approach and a demonstration plan.

PHASE II: Accomplish system design, develop the prototype technology and demonstrate the proposed technology as part of the PEO TAD Ship Self Defense infrastructure.

PHASE III: Transition to ongoing and planned PEO TAD, and DOD test ranges.

COMMERCIAL POTENTIAL: Advanced detection systems are not unique to the DOD. The aerospace industry is just one example of where advanced IR and doppler technologies are used heavily in the design and development of products. This new technology would be directly transferable to any industry using IR and doppler signatures to track objects.

N96-282TITLE: Electronic Support (ES)-Radar Track Correlation

OBJECTIVE: Define and develop robust algorithms for combining tracks produced by passive electronic support (ES) receivers with those of other onboard and offboard ship sensors. Use the information measured or associated with a track by the ES system to improve track correlation, and thus permit data from other sensors concerning correlated tracks to be shared with the ES system. The algorithm should support incremental correlation, since additional and more accurate sensor data concerning a track will arrive over time. The goal is high probability of correct association (along with low probability of false association) against anti-ship missiles using typical current 2-D radar(s) and the AN/SLQ-32A ES. The algorithm must be applicable to the complete range of existing ship sensor suites and light to heavy target environments, as well as to near-term future systems.

DESCRIPTION: A variety of sensors exist aboard ships, each excelling in certain target aspects. Radars can detect and locate a target well, but have limited identification capabilities. ES systems can classify or identify targets, but cannot localize precisely. Overall combat system effectiveness could be improved by sharing data from all sensors, but an essential precondition is reliable correlation of the sensor tracks. The traditional approach to fusing radar and ES tracks uses only bearing, and has limited utility unless the environment is sparse. What is needed is a means for better correlation of tracks by leveraging all the available radar and ES data and basing a decision on multiple parameters.

PHASE I: Identify and analyze potential correlation algorithms within a current, moderate capability shipboard combat system. These would use the capabilities, and reflect the inherent performance and accuracy, of the ES and radar systems to measure parameters about the targets. In addition, the algorithm can use suitable estimated values that the ES system can assign as part of the DECM/Decoy Integration (DDI) effort, such as range and velocity, to help correlate the tracks. Perform, and report on, limited simulation and analysis to show proof of concept.

PHASE II: Support more detailed investigations of and refinements to the correlation algorithms. These may take advantage of expected sensor enhancements (such as AIEWS Phase I and AN/SPY-1D) and more extensive combat system integration. Design and participate in a realistic testbed implementation, to demonstrate the algorithm fully. The Phase II report will document all analysis and results, any special software documentation, and high-level software source code. Propose and investigate enhancements to ES and radar processing, if needed to increase the range of applicability and robustness of the correlation algorithms.

PHASE III: Further extend the algorithms to take advantage of AIEWS Phase II and similar expected improvements. Prepare specifications to guide development of operational software implementing the algorithms. Determine preferred location(s) of the correlation software. Participate in algorithm implementation and test.

COMMERCIAL POTENTIAL: There is potential applicability to air traffic control, especially to the tracking of aircraft while on the ground or in the takeoff/landing phases, where radio communications are intense and radar coverage is sometimes incomplete.

N96-283TITLE: Thin Cell Thermal Battery

OBJECTIVE: Improve the energy density of thermal batteries.

DESCRIPTION: Present manufacturing techniques for thermal batteries involve the use of pressed powders to form anode, cathode and electrolyte ‘pellets’. This technique places inherent limits on the minimum thickness obtainable due to the fragility of the pellets. This limit translates into limitations on the form-factor of the overall battery. If alternative techniques for forming the anode, cathode and electrolyte could be developed which overcome the thickness limitation then smaller batteries could be manufactured.

PHASE I: Explore alternative methods for formation of thermal battery anode, cathode and/or electrolyte utilizing existing electrochemical couples.

PHASE II: Produce thermal battery cells and batteries using method(s) selected in Phase I for evaluation against existing technology for physical size, energy density, activation time, current density, safety, etc.

PHASE III: Development of battery meeting requirements of existing weapon system.

COMMERCIAL POTENTIAL: This technology would have application to the commercial sector in areas concerned with emergency power such as for aircraft, emergency evacuation equipments, etc. Where high power is required for a short period of time.

REFERENCES: Linden, David, "Handbook of Batteries and Fuel Cells" 2ed

N96-284TITLE: Advanced Hot Gas Valve and Manifold Technologies for Shipboard Missiles

OBJECTIVE: To demonstrate advanced high temperature (3500F) valve concepts, materials and fabrication technologies. Emphasis will be placed on the following characteristics: high temperature survival (I.e. Exposure to 3500F exhaust gases) for long duration (100 seconds), reduced weight while maintaining thermal/structural durability, innovative/low cost material processing and costing technologies, ability to provide precision control, fast response valve concepts, and ability to operate in oxidizing environments of elevated temperatures. This SBIR pertains to valves, valve bodies and hot gas manifolds.

DESCRIPTION: Demonstrated advanced high temperature valve concepts as follows:

PHASE I: Conduct critical experiments to demonstrate that selected valve component, material, or manufacturing approach meets the objectives of the SBIR topic. Testing can be conducted on nonoptional technology demonstration hardware, such as subscale of benchweight components, material test coupons, or static valve assemblies. High temperature static testing of materials or cold gas testing of moving valve components are example tests. Phase I represents technology proof-of-principle experiments - i.e., technology has good potential of meeting objectives.-

PHASE II: Identify and define specific requirements for valve technology end item use (e.g., thrust level, duty cycle, etc.). Scale desired propulsion system or component technology to desired size, weight or operating level. Demonstrate component operation under intended high temperature gas environment and with representative operational duty cycles and mass flows. Design and conduct critical experiments to demonstrate that the technology selected can meet performance, weight, cost and/or operational goals when tested if the scale proposed for end use.

PHASE III: Once demonstrated, the technology will be applicable to supporting Navy ATD programs, BMDO core technology efforts and future Area and Theater-wide TBMD programs.

COMMERCIAL POTENTIAL: The technology proposed in this SBIR topic has application to commercial space launch vehicle and satellite propulsion control systems.

N96-285TITLE: Smart Sensor Technology for Sonar Systems

OBJECTIVE: Develop improvements and enhancements to sonar system sensors and associated signal processing.

DESCRIPTION: Innovative approaches for the design, development and implementation of integrated sonar sensors and associated signal conditioning electronics are required in response to changing operational needs and costs. This topic solicits development of smart sonar sensor technologies which emphasize low per-channel cost, high reliability, high performance and commonality across multiple applications, including towed, deployed, expendable and hull mounted sonar arrays. Requirements for enhancement to technologies for sonar systems include: performance optimization of the combination of the sensor and signal acquisition electronics; improvement in the sonar signal to electronic noise ratio, particularly at frequencies up to 100 kHz; improvement in long term reliability, particularly for hull-mounted, embedded sensor systems where the system cannot be maintained for periods of 5 years or more; and development of programmable, adaptable sonar sensors (i.e. common hardware components) that can be used on a variety of platforms. Sensed acoustic parameters can include sound pressure level, particle displacement, velocity, and acceleration. Other measured parameters can include magnetic heading, pressure, and temperature. Desirable characteristics of smart sonar sensor systems include: high signal to noise ratio; high dynamic range; the ability to form extended sensors in one or two dimensions for the rejection of turbulent noise; high reliability with redundant sensors, electronics, and wiring; and low unit production cost. Innovative combinations of sensors and electronics are sought which can include analog signal conditioning, analog-to-digital conversion, and bi-directional digital communication over standard data links. A new government design for monolithic analog signal conditioning (MASC) of a sensor output prior to A/D conversion has been implemented as a custom integrated circuit. MASCs will be furnished upon request to offerers to whom contracts are awarded. The government will consider altering the MASC design in order to optimize it for various applications. In addition, the government will consider a joint development effort wherein the MASC is included on the same integrated circuit with the offerers circuitry such as an analog-to-digital converter.

PHASE I: Develop sufficient data to demonstrate feasibility of the proposed sensor-signal conditioner. Provide a preliminary design for the proposed sensor-signal conditioner.

PHASE II: Fabrication and performance demonstration of the prototype sensor-signal conditioner.

PHASE III: Transition fully developed products and technologies to applicable sonar programs.

COMMERCIAL POTENTIAL: The results of this SBIR will be applicable to commercial technologies such as oil exploration, underwater inspection services, process control, and medical acoustic imaging.

REFERENCES: "MASC Functional and Physical DESCRIPTION, Rev. A," Naval Undersea Warfare Center Division, Newport Technical Memorandum, TM 951128.

N96-286TITLE: Innovative Broadband Transducer Technologies

OBJECTIVE: Develop innovative, compact, lightweight, broadband transducers for use as acoustic sources on Navy surface combatants in littoral environments.

DESCRIPTION: Current active sonar systems require increased performance to support new mission areas in the shallow waters of coastal environments. Broadband (approximately two octaves), lightweight sources currently under development promise major improvements to surface ship sonar systems. This topic addresses the next goal: development of active acoustic sources that provide the ability to transmit broadband signals substantially in excess of two octaves.

PHASE I: Based on research into state of the art, develop an initial design for an active acoustic source able to transmit broadband signals substantially in excess of two octaves. Breadboard feasibility demonstration. Justify potential of design in terms of performance enhancements.

PHASE II: Design, fabricate and demonstrate a prototype broadband source to evaluate source level, bandwidth, energy density, coupling coefficient, performance, etc., using Government furnished support assets as available.

PHASE III: Transition the source into an advanced development sonar system designed for surface combatants.

COMMERCIAL POTENTIAL: Applications of broadband source technology exist in: geophysical areas (for example, offshore petroleum exploration); underwater environmental assessment (for example, detection of dumped waste containers); and enhancement of underwater speech communication (for example, for divers involved in salvage work).

N96-287TITLE: Passive Processing Technology

OBJECTIVE: Develop algorithms for tactical passive broadband processing.

DESCRIPTION: Innovative signal processing algorithms are required in response to changing operational requirements. Algorithm development is sought to handle the passive processing problem. Potential problems the algorithms solve may include but are not limited to: passive broadband; beamforming; full spectrum processing; trackers; data fusion; clutter reduction; acoustic contact correlation; detection; classification; and localization. Algorithms may function in real-time or non-real time, and may address one area of the passive processing problem or many.

PHASE I: Develop mathematics of algorithm. Provide full DESCRIPTION of processing algorithm and plans for demonstration. Provide performance on simulated data that supports the theory.

PHASE II: Implementation and demonstration of algorithm using Navy provided data.

PHASE III: Products and technologies of this SBIR will be evaluated for applicability to passive processing programs.

COMMERCIAL POTENTIAL: Commercial potential for algorithms developed under this SBIR are dependent on specific problem addressed but may include: oil exploration, underwater inspection services, and medical imaging technology.

N96-288TITLE: Improved Undersea Towing Cable

OBJECTIVE: Develop and test the application of a new synthetic material to an undersea towing cable with the capability to continuously measure water column temperature.

DESCRIPTION: This topic addresses two applications of innovative technology to undersea tow cables: (a) use of a new material in cable fabrication; (b) development of temperature sensors embedded in undersea tow cables. Offerers' proposals may address either or both of these challenges. Kevlar¿ is generally used to fabricate tow cables requiring high strength and low weight. Recently, Dow Chemical developed a new synthetic material, poly(p-phenylene benzobisoxazole) (PBO). PBO, with higher strength and lower stretch properties than Kevlar¿ at the same weight, could significantly improve cables used to tow Navy sonar systems. Potential improvements include: reduced diameters resulting in smaller handling systems; lower weight for equivalent strength for improved performance in shallow water areas; improved protection of elongation-sensitive components such as optical fibers. Temperature sensing of the water column is important for maintaining optimum sonar performance, especially in the shallow water environment. Replacing currently used expendable bathythermographs with sensors, such as microelectronic thermistors, embedded in the tow cable jacket would permit continuous temperature monitoring while operating a towed or tethered sonar array.

Phase I: Develop sufficient data to demonstrate the feasibility of: fabricating tow cable using PBO and/or providing tow cables with temperature sensing capability. Data should include affordability issues. Breadboard and test the product(s) proposed. Provide sufficient design(s) of proposed product(s) to allow for an informed decision on requesting a Phase II proposal.

Phase II: Fabricate and test prototype of product(s).
Phase III: Transition prototype into production system for Navy and/or civilian markets.

COMMERCIAL POTENTIAL: An improved strength for weight. lower stretch tow cable has use in any applications involving cables, tethers, or ropes containing synthetic material, including: oil exploration, remotely operated underwater vehicles, radar balloons, hoisting and rigging. Temperature sensors embedded in an towed or tethered system would benefit various applications such as oil exploration and environmental monitoring, including power plant discharge and biological research.

REFERENCES:
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2. Debell, Timothy S, "Feasibility Study for a Tow Cable Temperature Profiler," (unpublished), Naval Undersea Warfare Center Detachment, New London, CT. August, 1995.

N96-289TITLE: Affordable, Low Energy, Nanoscale Transistorless Static RAM

OBJECTIVE: This work seeks new approaches to memory for computers and digital signal processing wherein access speed is faster than current SRAMs, size is smaller than current DRAMs, readout is non-destructive, and refresh is not required so as to significantly drive down manufacturing cost and energy and cooling requirements for satellite and avionic applications.

DESCRIPTION: Current DRAMS are vulnerable to radiation, require a minimum of 3 clock cycles to read or write and require both a transistor and a capacitor. Current SRAMs are much faster than DRAMS, but require seven transistor and 3 times the area. Energy to refresh DRAMS is excessive for many DoD applications. Simple new, non-linear device concepts have recently appeared wherein memory latching can be obtained at ultra low power dissipation and readout "on-off" ratios of up to 10,000 have been demonstrated.

PHASE I: Investigate and further develop non-linear device concepts and materials sufficient to demonstrate a 16 bit transistorless static random access memory (TSRAM) wherein no refresh is required and readout is non-destructive.

PHASE II: Investigate and further develop non-linear memory concepts sufficient to demonstrate a 1 kByte TSRAM wherein no refresh is required, readout is non-destructive, and access time is no greater than 1 nanosecond.

PHASE III: Develop a 64 bit wide (word wide) 1 Mbit or greater version of PHASE II above and addressable from 0 to 16,384 or greater wherein quiescent standby power dissipation density is no greater than 1 watt/cm^2. Demonstrate 10^{14} read-write operations without failure.

COMMERCIAL POTENTIAL: This is expected to lead to microprocessor chips wherein 16 MByte or greater word-wide memories are an integral part of the CPU and power dissipation of computers with large memories is less than half the current state of the art. This memory concept provides for viable USA re-entry into a field currently dominated by foreign competition.

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