NAVY DUAL USE SCIENCE & TECHNOLOGY
FY 99 TOPIC AREAS

General questions concerning the Navy's DUS&T program may be posed to Cathy Nodgaard, (703) 696-0289, email: nodgaac@onr.navy.mil. Technical questions and white papers should be directed to the Government technical point of contact (TPOC) identified under the specific topic area. Additionally, this Commerce Business Daily notice can be accessed by clicking on Business Opportunities on the ONR homepage (Internet address: www.onr.navy.mil/02/BAA). You are encouraged to contact Susan Vilello, the ONR Business POC, (703) 696-2605, email: vilells@onr.navy.mil to receive a copy of the ONR model agreement prior to submitting your proposal. If you are proposing in a topic area with a TPOC other than ONR, their model agreement may vary slightly from the ONR model.

Affordable Sensor Technology

TITLE: BROADBAND SENSORS AND PROCESSING

OBJECTIVE: Develop broadband acoustic sensors and signal processing for guidance and control of torpedoes in shallow water. The acoustic environment of shallow water is complicated by high noise reverberation due to high sea-states, single and multiple-boundary scattering, false targets, and false alarms consisting of biologic, geologic, and boundary features. The combined broadband sensors and processing system has to be robust to provide target detection, countermeasure resistance, target resolution, and classification. As a spin-off, this sensors and processing technology can be used to design diagnostic tools to detect and classify fault features in noisy environment, and guidance & control systems for unmanned undersea vehicles.

DESCRIPTION: Technical thrusts aim at design and development of broadband acoustic transducers, associated electronics, and advanced signal processing algorithms. Broadband processing may include simultaneously multi-component, frequency agility, and coherent broadband techniques. High bandwidth, high volume search rate, Signal-to-Noise Ratio (SNR) enhancement, self-noise suppression, robustness of processing algorithms, and low cost are emphasized.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $3000K

TITLE: WIDEBAND TACTICAL COMMUNICATIONS

OBJECTIVE: Provide reliable, interoperable, voice/data wide band next generation tactical communications. It has been long recognized that information transfer/tactical communications have been a major obstacle in conducting Command and Control. The approach utilized for execution of this task is centered around the leverage of other Services/DOD developments and leverage of commercial communications technology. The developments to be leveraged such as the Navy Slice radio or the Army's FDR will be modified/adapted to meet USMC requirements utilizing COTS (Commercial Off the Shelf) technology incorporating new waveforms as necessary, LPI (Low Probability Intercept), interoperability, digital transfer capabilities, wideband, antenna, co-site interference, etc. Those adaptations will be analyzed, prototyped tested, evaluated and demonstrated to be followed by transition into the USMC acquisition system. An additional component of this task will be involved in taking the technical lead in tactical beyond line of sight comms and provide solutions and recommendations to the Marine Corps in pursuit of technological and acquisition investment strategies. All commercial radio systems currently available have the limitations discussed below. The further development of radio technology will have a broad base effect on the communications industry.

DESCRIPTION: Reliable, wideband tactical communications is a major deficiency at all echelons of the Marine Corps. Systems presently being utilized such as SINCGARS (Single Channel Ground and Airborne Radios), lack range, usable bandwidth for data transfer, reliability and interoperability with other radios and tactical systems. Due to the enormous cost of radio development, the Marine Corps must partner with other services and industry.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $8000K

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disadvantages. Large spare parts inventories must be kept; maintenance technicians must be trained on a wide range of equipment (its testing, assembly/disassembly, adjustment, tuning, etc.); integration of these servo-actuators into larger systems is difficult, time-consuming and expensive; and tech-mods are discouraged (leading to rapid obsolescence of the whole system).

The Navy faces a crucial question of force reduction while still maintaining operational readiness. Industry faces a similar need; i.e., how to open up the architecture of their manufacturing systems to reduce cost and to enhance performance (in the same manner as has been achieved for the architecture of our rapidly evolving computer systems). The Navy is evaluating what steps are necessary to achieve an "at sea" force reduction of 50% to 70%. Industry is concerned that the productivity growth in manufacturing systems (production machines) has remained stagnant over the past four decades (a growth rate of only 0.4% over that period).

A proposed solution to these stated needs is to open up the architecture of machine systems in general (just as it has been done for computers). The basic building block for these systems would be a class of advanced standardized intelligent actuator modules (exactly equivalent to the electronics chip for computers). These standardized actuator modules *(standardized interfaces, self-contained postage stamp sized sensors, embedded electronics controller, communications links, prime movers, brakes, clutches, gear trains etc. with local intelligence for enhanced performance, condition-based maintenance, and some features for fault tolerance)* would then become a standard for infusion of technology from a broad collection of global component suppliers who would continuously update their contribution to these standard modules in order to preserve their place in the worldwide market.

DESCRIPTION: A relatively small set of these standard modules would enable the development of a very large population of dexterous machines suitable not only for many shipboard operations but to meet the needs for open architecture manufacturing cells (of say 40 degrees of freedom) delivered on demand to meet a customer's requirements. The benefits to the Navy include a significant reduction in spare parts inventories and their associated space and cost, a reduction in the number of trained maintenance personnel, and the opportunity to use automation to reduce crew levels to the point which reduces the life cycle costs of future surface combatants. Almost identical benefits would occur in industry where a special emphasis on reduced costs, enhanced performance, and ease of maintenance are critical.

- Networked, digital data busses for minimal wiring, communications, high configuration flexibility, and the ability to be controlled with open architecture system controllers.
- The integration of motors, gear-trains, brakes, sensors, bearings, power electronics and communications controllers in a sealed housing. This shields the repair technician from complexity and reduces the required inventory to a small set of robust modules of lower cost and higher performance.
- Utilization of 10 distinct sensors to allow for a modern digital control of the actuator to maximize performance (reduced weight, lower-volume, higher reliability, etc.).
- A functional map (either analytical or experimental) of the actuator to predict the actuator's performance (in terms of a series of criteria) to meet a very broad range of objectives (rapid response, disturbance rejection, high accuracy, high load, etc.). Operational software for the control (even with some human intervention) of these actuators based on as-built parameters obtained from a series of tests of each actuator (metrology, endurance, non-linear maps, fault tolerance, etc.).
- An embedded software structure based on a residual (difference between predicted performance and sensed performance) to analytically provide condition-based maintenance to identify failure of components within the actuator and to plan for repairs and tech mods (including some elements of fault tolerance).

These steps should not only substantially reduce the cost of these standardized actuators (in the same way the cost of computer chips go down while their performance goes up) but also dramatically reduce the life cycle cost based on a planned avenue for internal tech mods (components supplied from multiple sources) and also due to the application of a unique form of condition-based maintenance to eliminate false alarms and to enable a two year technician to rapidly replace these modules on a timely basis.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $6,000K

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(RCS). Crew members have even been injured at high speeds and in rough waters with whip type antennas. This concept was driven by the needs of military programs like combatant craft, Army Water Craft, AAAV's, and Coast Guard, but the result would have broad use on various craft and vehicles.

DESCRIPTION: Low profile antennas can be manufactured using advanced and developing techniques such as printed/embedded circuitry. The application of millimeter/microwave low profile antenna R&D to the HF/VHF ranges could overcome reliability, performance, and other problems. Bandwidth would be increased without introducing excessively thick substrates. Computer modeling would be a key tool.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $2,000K

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TITLE: HIGH SPEED RESOLUTION OF ACTIVE PIXEL IMAGERS

OBJECTIVE: Develop high speed resolution imagers using CMOS active pixel technology suitable for on-line detection and identification of failure related debris particles in gear boxes, engines and other oil wetted rotating and reciprocating machinery. Realization of such systems requires imagers with approximately 1000 x 1000 pixel arrays capable of operating at speeds up to 1000 frames/sec. These performance requirements exceed conventional TV formats. Although large ccd arrays are available
(up to 2000 x 2000) they are slower than required, are expensive to fabricate and are difficult to miniaturize. CMOS active pixel technology, in contrast, is less costly to fabricate, consume less power and can be miniaturized to a greater extent.

DESCRIPTION: This technology is urgently needed to improve safety and operational availability military aircraft and shipboard systems, while reducing maintenance operations and cost. Similar applications reside in the civilian sector, along with

offer the advantage over ccd imagers of lower fabrication cost, more compact packaging and lower power dissipation. They offer the potential of compact, affordable, high resolution imagers that can operate at speeds and resolution that would make many real time imaging applications practical. In addition, on-chip processing can be incorporated to reduce data flow requirements, contributing further to increased speeds of image processing and miniaturization potential. Successful proposals in this topic area will develop and demonstrate active pixel CMOS imagers in the high speed, high resolution regime of approximately 1000 x 1000 pixels at frame rates on the order of 1000 Hz.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $2,000K

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TITLE: ULTRA WIDE BANDWIDTH HIGH POWER AMPLIFIERS

OBJECTIVE: Demonstrate solid state power amplifiers (> 100 W, 4-20 GHz bandwidth, >10 dB gain) based on AlGaN/GaN transistors that have greater then five times the power density of comparable GaAs-based transistors to substantially reduce the cost and increase the performance of radar, electronic warfare, and communication systems.

DESCRIPTION: Future military electromagnetic systems (radar, electronic warfare, and communications) will require power amplifiers able to operate over a wide instantaneous bandwidth. Conventional power amplifier transistors have limited dielectric breakdown strength thereby limiting their power handling capability. This means that in order to maximize the output power conventional solid state power amplifiers are operated very close to the transistor breakdown condition thereby putting tight tolerances on the manufacturing process. Furthermore, to achieve the required power levels, extremely large transistor widths (L_w) are employed. The large L_w significantly limits production yield and thus increases amplifier cost. In addition, employing transistors with large L_w limits the transistor operating frequency (f), and thereby the amplifier bandwidth, due to

seeker or to increased range in a communications system). For commercial applications the increased transistor performance translates to greater range for mobile communications systems thereby requiring fewer repeater stations and lowering systems cost.

Under this program, a high power amplifier will be developed capable of delivering greater than 100 Watts of CW output power over a bandwidth of 4 to 20 GHz with 10 dB of associated gain. Instantaneous (non-tuned) bandwidths exceeding 2 GHz in the 4-20 GHz amplifier and power added efficiencies of 50% or greater are sought. Even order harmonic output shall be at least 40 dB below fundamental signal output at rated power. All other linearity shall be characterized such that cross modulation, inter-modulation, and odd order harmonic content shall be at least 30 dB below that of two equal signals spaced 100 MHz apart and at rated power. Bandwidth, linearity, power, and efficiency specifications are simultaneous. For a commercial applications, the wide bandwidth could be traded-off for higher gain over a narrower or lower frequency band.

[1] S. T. Sheppard, et al., "High Power Microwave GaN/AlGaN HEMTs on Silicon Carbide," 56th Device Research Conference, Charlottesville, VA, June 22-24, 1998.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1,100K

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TITLE: PASSIVE MILLIMETER WAVE IMAGING TECHNOLOGY (PMMWIT)

OBJECTIVE: Develop technologies that improve U.S. capabilities to perform real-time passive millimeter wave (PMMW) imaging. Specifically, improve the resolution of real time PMMW imagery by developing and demonstrating synthetic aperture PMMW imaging. Achieving this objective will draw from multiple technologies: Monolithic Microwave Integrated Circuit (MMIC) chip fabrication & receiver designs, wideband

technology enables the realization of one and two-dimensional arrays of low-cost reliable receivers with enough sensitivity to provide real-time imagery at video rates. The images resulting from this passive angle-angle sensor are similar to visible optical images and can be interpreted similarly to infrared images. However, the sensor phenomenology associated with the longer millimeter wavelengths allows for imaging in low-visibility conditions such as fog, clouds, smoke, dust, snow and light rain. In addition, PMMW array sensors are very sensitive to the emissivity differences between materials; this causes metal objects to stand out dramatically from most natural and man-made backgrounds (grass, roads, dirt, etc.), and recent data collections (Jan 98) indicate the ability to image ship wakes, inflatable rubber inflatable boats, and missile plumes associated with various fuel/propellant combinations.

The significance of this imaging technology to the U.S.N. and U.S.M.C. is just now being established. In summary, it provides the capability to use low visibility conditions as a tactical asset rather than a liability by covertly producing visual-like imagery under many reduced visibility conditions. Missions that can be addressed include airborne reconnaissance and targeting, sea and land navigation in fog and maritime inversion layers, low-visibility aircraft landing systems for carriers and runways, landing zone surveillance, ship self defense, and search & rescue operations. The *single* PMMW focal plane array camera that exists in the U.S., resulting from a DARPA TRP program and designed specifically for commercial aircraft landing in fog, was built by TRW. This camera was used, as part of an ONR contract, in data collections during Jan-Feb 98 aboard a helicopter and a Navy PC boat to evaluate the potential of PMMW imaging to Navy/Marine Corps. Missions in littoral environments. Positive customer response to imagery resulting from these data collections have resulted in an ONR FY: 99-02 project that will produce another prototype array designed for airborne reconnaissance and support for U.S.N. Special Warfare (SEALS) operations. This array will use the same basic MMIC technology but will have considerably different sensor parameters (pushbroom configuration, dimensionality, angular resolution, weight, etc.).

Civilian applications of this technology are emerging, however there has been no real-time imaging demonstration of a civilian application. One of the goals of this proposal is to stimulate the U.S. industry to provide multiple sources of this technology. Potential applications include detection of oil slicks, aircraft landings in fog, hidden object detection at security checkpoints, etc..

Following the recent initial demonstration of real-time PMMW imaging, as discussed above, and preliminary evaluation of the ONR sponsored data collections, various

limitations imposed by MMIC chip packaging, super-resolution processing of sub- or sparsely sampled imagery, etc.

It is expected that proposals responding to this topic will be multi-disciplinary, encompassing receiver (MMIC) fabrication technology, signal processing hardware and software, image processing, and sensor system integration.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $3M

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TITLE: MACHINERY PROGNOSTICS THROUGH OPEN SYSTEM ARCHITECTURE CONDITION BASED MONITORING TECHNOLOGY FUSION

OBJECTIVE: Develop an integrated, condition based monitoring system that provides full machinery prediction capabilities to allow the accurate and reliable determination of the remaining useful life of equipment. Multiple equipment types, that exhibit various different failure modes, will be monitored, diagnosed and predicted. The system must have an open architecture and be able to communicate information to the supply infrastructure and maintenance planning activities. This will reduce maintenance costs by eliminating time directed maintenance and improving maintenance planning. Manning will be reduced due to reduced workload. The logistics footprint will be less due to reduced sparing and transportation requirements. Improved operational flexibility will be achieved because prognostics will allow operators to make tactical, mission specific decisions with full knowledge of the remaining useful life of his equipment. The open system architecture identified above is directly applicable for aircraft, surface ships, submarines, and commercial applications such as aircraft, ships, chemical plants, and offshore oil production platforms where analyzing the condition of equipment is vital.

DESCRIPTION: Weapon systems currently under development have a required level of machinery prognostics that can not currently be met. A number of machinery

types within an open architecture for machinery prognostics, and the validation of the prognostics system. Comprehensive failure data sets must be developed to enable benchmarking and comparison of systems and algorithms. Destructive testing will be required. The effort must result in a system that is viable in the commercial marketplace.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $4,500K

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TITLE: UNDERSEA FIBER-OPTIC MICRO-CABLE

OBJECTIVE: Develop and test a capability to protect fiber-optic undersea micro-cable on the seafloor by burial. Future undersea surveillance fiber-optic micro-cables and acoustic arrays will be deployed from a towed deployment vehicle (TDV) operating near the ocean floor. Survivability is the number one risk to light weight undersea surveillance systems. The telecommunications industry could use this burial system for installation of small festooned, or island to island type systems that simply require a small cable with multiple fiber optic elements. A burial sled with the cable on the sled could allow the use of much smaller cable than presently used, and would be installable faster than traditional larger cable methods. These uses would make the installed system much cheaper from a boat rental, time to install, and material cost, cable at less cost point of view.

DESCRIPTION: The ability to harden the system by burial will increase the survivability of these critical systems by an order of magnitude. The ability of these small, 0.2” to 0.05” fiber optic micro-cables, to survive in some environments is questionable. The ability to bury these cables will enhance survivability and lengthen the life of these lightweight cable systems. In addition, the ability to bury the acoustic sensing portion of the system will produce a very straight array which will enhance the ability of the system to beam form, and detect targets. Depth of cable burial is dependent on the local environmental threats usually fishing trawls. Required deliverables: 1. Develop system level performance requirements. 2. Select concept for development. 3.

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TITLE: VERY LARGE TWO-COLOR 'WAFER FUSED' IR ARRAY TECHNOLOGY

OBJECTIVE: Develop higher spatial resolution, more uniform, more rugged, two color detector arrays operating in the 3-5 micron wavelength band. Resolution, reliability and cost, of IR imagers for threat awareness, target recognition, and Drug Enforcement Agency application is currently defined as major DOD-wide strategic thrusts. The commercial application rests in medical tomography, search and rescue (shipwreck, earthquakes etc.) thermal analysis of wear, home insulation monitoring, crop and environment monitoring, electrical circuit heat dissipation, etc.

DESCRIPTION: Part I - IR systems have to be operated at ~77K (liquid nitrogen). The IR elements are electrically connected to Silicon control and read out circuit chips through soft indium metal 'bump bonds'. The different expansion rates and extents of the Si and the HgCdTe IR elements cause severe stress as units are cycled from RT to 77K, leading to rapid degradation and failure, of the metal bump contacts. This effect is an extensive one, in that it is most pronounced at the edges of arrays, and obviously gets worse in large area arrays. Bigger arrays are needed to allow more elements (pixels), to get better spatial image resolution. Current goals are 1000 x1000 arrays, however Navy has determined that satisfactory performance can only be achieved with 2000 x 500 element two color arrays. This is outside current Bump-bonding technology. This topic addresses possible new approaches that will allow virtually unlimited array sizes. The goal is to demonstrate 2000 x 500 two color arrays, that do NOT employ 'bump-bonding'. The technology proposed utilizes 'wafer-bonding' or 'fusion'. In this process IR detector films are fused directly to Si substrates. Individual pixels, which are ~20 microns on a side, are then 'liberated' by established etching techniques. The small size of individual elements then overcomes the accumulative strain associated with thermal expansion coefficient mismatch.

Part II - The second thrust is for technology to prepare films with films composition, and D* uniformity better than 3% over >3" diameter substrates, which are compatible with

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Aircraft Sustainment

TITLE: ADVANCED METALLIZATION PROCESSES FOR HIGH DENSITY INTERCONNECT

OBJECTIVE: Develop advanced patterned metallization technologies for reliable low cost electronic device interconnect on high thermal conductivity (HTC) substrates including ALN, AlSiC and CVD Diamond (CVDD), High Performance DOD Electronics such as naval avionics generate high power, resulting in low system lifetime and high repair and replacement costs as well as platform downtime. There is a need for affordable high density interconnect schemes suitable for HITC substrates. The result of such processes would be high performance devices with improved reliability and affordability. Such processes would also be of value to the private sector in high performance application such as computer workstations and commercial avionics.

DESCRIPTION: The development of high density interconnect processes for HTC substrates will benefit both the military and commercial sectors by providing high performance electronic systems with increased reliability and affordability. Two key technologies are emphasized: selective additive metallization technologies capable of high resolution metal definition and high thermal conductivity substrates including AlN, AlSiC and CVDD. Successful proposals in this topic area will develop interconnect processes that substantially increase system life and reduce fabrication and repair costs in naval electronic systems.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1200K

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OBJECTIVE: Provide lightweight composite cable connectors for power and communication capable of effective physical protection from corrosion, mechanical damage, waterproof, temperature, EMI/EMP, easy to connect or couple, affordable, with low maintenance to enhance the lifetime and survivability of both existing equipment and new/commercial off the shelf equipment. This will substantially reduce life cycle costs and extend service life of equipments. The connectors will be of composite material and their construction will be in compliance with both OSHA and EPA regulations. The major naval benefit is reduced down time by virtue of the above enhancements and thus improved mission effectiveness, minimized maintenance and improved operational readiness. Such cable connectors have strong civilian market application for transportation, process, and marine industries.

DESCRIPTION: A significant percentage of "downtime" in Naval equipments is caused by failure of electrical equipments. A significant portion of these failures are attributed to faulty cable connectors. Cable connectors are employed both in the transmission of power and the exchange of information such as data or vocal transmission. Signal transmissions often are high data rate and require signal shielding protection. Cable connector assemblies will contain both wire and fiber optic channels and EMI and EMP protection grounding must be provided in all elements of the cable connector assemblies. These cable connectors will be equally applicable for use in commercial applications such as: commercial signal transmission systems; connectors for marine industries such as merchant marine and oil platforms; connectors for commercial process industries subject to harsh environmental conditions; connectors for transportation devices, cars, aircraft, trains, anywhere where there is a harsh corrosive environment and maintenance downtime a costly penalty. Key technologies are lightweight high strength composites, corrosion resistance, and simple maintenance and installation capability.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1,250K

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OBJECTIVE: Develop the next generation of production design tools to predict sound transmission through, and scattering and radiation by, structures immersed in a fluid. In particular, develop computer simulation capabilities which can predict the behavior of structures too complex or too large to be modeled accurately and cost-effectively by currently available models.

DESCRIPTION: Design of both military and commercial systems is increasingly relying upon simulation to produce cheaper more nearly optimal final designs, eliminate or reduce the need for prototyping and experimental testing, and decrease the frequency of design errors. However, this approach requires highly accurate, fast, and robust simulation of the systems under design. In many cases, crucial deficiencies in predictive capabilities limit the accuracy of predictions, or make modeling too expensive and time-consuming to be viable. In particular, in the area of acoustic design of military platforms and systems, deficiencies in the ability to model large or complex systems or to predict accurately the behavior at mid-frequencies limits numerical prediction. This often results in greater that necessary cost and poorer than possible performance of systems and platforms. It frequently necessitates an expensive iterative design/build/re-design process. Perhaps most importantly, lack of confidence in prediction limits revolutionary design and forces an evolutionary design approach. The same considerations apply in the design of commercial aircraft and automobiles.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $2,400K

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TITLE: REDUCED COST MANUFACTURING FOR INTEGRALLY BLADED ROTORS (IBRS OR BLISKS)

OBJECTIVE: Develop lower cost processes to manufacture high performance integrally bladed rotors for compression system components.

described, the use of IBRs presents new challenges for manufacturing. IBRs are expensive to manufacture and involve complex forgings and finish machining (conventional and electrochemical) procedures. Conventional methods of manufacturing IBRs consist of machining a forged billet. With conventional milling, material is slowly cut away into chips. This process is very time consuming and generates much waste. Other methods of IBR manufacture such as electrochemical machining (ECM) have proven to be very expensive. In order for the full performance benefit of IBRs to be realized, manufacturing costs need to be reduced in order to make this technology affordable.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $3.6M

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TITLE: HIGH IMPACT, SUPPLY-BASE DUAL-USE TECHNOLOGY AND SPECIAL PROCESSES IDENTIFICATION, DEVELOPMENT AND IMPLEMENTATION

OBJECTIVE: To develop and implement high impact, technologies that will have a high impact for achieving lean (more efficient (waste free) lower cost) production for small and mid-size supplier tier companies that supply special processes or technology products for military/commercial application. Target companies will be those with a business base in the areas of Aircraft Sustainment, Information Systems and Technology and Advanced High Speed Vessels and Structural Systems for Large, Sea Based Structures. An estimated 65-75% of the cost of both military weapon systems and commercial product systems resides in the supply chain. Special focus on enhancing the performance and technical capabilities of these companies can greatly enhance the affordability of defense products and price competitiveness of commercial products.

DESCRIPTION: The lack of affordable and tailored special processes and technology products, which are applicable to small and mid-size weapon systems suppliers, is a constraint for many of these companies. The situation impacts those firms with a business

Low cost, low volume manufacturing Rapid repair and remanufacturing	Technologies to facilitate the exchange, management, manipulation and protection of information	Technologies for high speed, health monitoring and increased reliability of composite structures Cost effective and transferable manufacturing thrusts for advanced composite materials, metallics, ceramics and chemicals

All proposed efforts will involve a partnership between an Original Equipment Manufacturer (OEM) and three to six of "volunteer" suppliers from its supplier base. The supplier volunteers should undertake a lean production facilitation approach to project selection, development and implementation through a process sponsored by the Navy Manufacturing Technology Program called *Pathways for Continuous Improvement.* A Navy ManTech-sponsored *Pathways* facilitator will assist each company in the group in identifying one or more specific technology development areas. Each participating supplier will then scope these areas with the assistance of the *Pathways* facilitator, and the most promising, high impact, technology development projects will be executed and implemented. Impact will be measured, according to a pre-determined set of expected performance metrics including a high return on investment (e.g., greater than 3:1), transferability of processes and technologies to the supplier base, and commercial application, and cost reduction, as well as other improvements that can be "rolled up" to OEM or prime contractor level. Project metrics will be geared to making military benefit and commercial application a reality so that the *Pathways* process that can be employed with other firms in the defense supplier base in the future.

It is envisioned that two OEM Teams will be selected.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1200K

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requirements include increased mission capabilities, smarter/leaner maintenance and logistics, and reduction/elimination of Navy pollution. Advanced materials and processes will play an important role in achieving these goals for Navy and are directly applicable to commercial markets as well.

DESCRIPTION: As the number of high performance materials systems available to designers have grown, so to have the number of materials systems used in manufacture. While the proliferation of advanced materials results in improved performance, it often has also increased non-recurring and recurring acquisition and operational costs. The Navy is interested in reducing these costs without limiting the performance options available to designers and in reducing maintenance costs without reducing platform readiness or systems reliability. Efforts in the areas of manufacturing and maintaining advanced composite materials, metallics, ceramics, and protective coatings and chemicals that are more cost effective than state-of-the-art approaches will enable the Navy and commercial industries to field vehicles without sacrificing capabilities.
Proposals sought in these areas include but are not limited to:

- Certification of resin transfer molded textile composites
- Repair of high temperature imide-based composite structure
- Multiple source materials suppliers
- Reliable Structural adhesives fabrication processes; bond integrity assessment NDI
- Propulsion materials and processes
- High temperature lubrication
- Affordable casting technologies
- Low cost materials and processes for engine front frames
- Ceramic matrix composites for Sensors and systems for CBM/in-situ health monitoring
- Low VOC and environmentally compliant paint systems (and removal), corrosion preventive compounds, operational chemicals, and surface pretreatments
- New machinery parts treatment to prevent wear, increased longevity, increased performance, and reduced maintenance.
- Nano-structured materials and application methods
- Composite material for load-bearing structure
- Thermal Barrier Coatings for application to both advanced nickel based superalloys and to future refractory metal alloys such as Molybdenum and Niobium.

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Distributed Mission Training

TITLE: DESKTOP HYDRODYNAMIC SHIPHANDLING MODELS

OBJECTIVE: Develop a family of hydrodynamics models to "drive" the dynamics of various classes of ships, integrated into a powerful multi-media desktop virtual reality display system including sea state, currents, weather, terrain, bottom and channel models, and automated navigation systems, to give the ship driver on the bridge the look and feel of the actual handling characteristics of that class ship in a variety of conditions.

DESCRIPTION: In both military and commercial shipping, the commanding officer is responsible for the proper operation of the ship. However, junior officers or harbor pilots

aid, providing crew training prior to entering infrequently visited harbors or channels. Applications include naval warships and large commercial ships such as freighters and passenger ships.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $200K

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TITLE: TEACHING FACTORIES FOR DEVELOPMENT AND DEMONSTRATION OF ADVANCED PRODUCTION EQUIPMENT AND PROCESSES

OBJECTIVE: To provide a mechanism for U.S. industry to tailor and evaluate advanced manufacturing technologies in a "hands-on" environment. The approach should allow for cooperative endeavors among both defense and commercial industrial entities, providing a neutral environment. A primary goal of the effort should be to demonstrate the use of commercial practices to produce military acceptable products, specifically evaluating cost efficiencies realized through single process utilization.

DESCRIPTION: In order to maximize the benefits of government sponsored development in programs such as Manufacturing Technology, it is necessary to disseminate the results across the widest possible spectrum of U.S. industry. Although publications and end-of-project demonstrations certainly play a role in this technology transfer effort, a more effective mechanism would include the capability for interested parties to actually operate the equipment, or walk through the process in a production environment. Beyond the capacity to allow prospective users to "try before buy", it is envisioned that the activity would allow for private-public cooperative ventures pre-competitive consortia activity the development of industry standards, and other joint activities in a non-threatening environment. By providing an "off-line" evaluation capability, the teaching factory concept will encourage investment in advanced technology which might otherwise have been avoided as presenting too great a technical

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $9000K

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TITLE: AUTOMATION TO REDUCE CARRIER MANNING

OBJECTIVE: Develop automation technologies to substantially reduce manning on aircraft carriers. Manning reduction is a goal of multiple Navy programs (i.e. CVX, DD21). Automation can also reduce personnel exposure to hazardous operations such as firefighting. The automation technologies to be developed will need to perform in the ship environment over a wide range of environmental conditions, manning levels, and operational situations. The automation technologies described above also have applications in the commercial sector such as warehouse automation, firefighting and police emergencies, and depot-type maintenance.

DESCRIPTION: The development and availability of manning reducing automation will benefit both the military and commercial sectors by greatly reducing life-cycle costs associated with personnel expenditures, such as salaries, training, and turnover. Three key areas will be emphasized: (1) technologies to increase collaboration between humans and machines in order to reduce logistics footprint and increase manning efficiency of operations, (2) Technologies to enable automation to work at various performance levels and compensate for potential damage and mechanism failures, (3) Technologies to increase the effectiveness of human-in-the loop. Successful proposals in this topic area will develop automation technologies that will contribute to make manning reductions attainable.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1,200K

GOVT TPOC: C. F. Snyder, Ship Systems Department, CDNSWC Code 21

TITLE: SENSORY ENHANCEMENTS TO VIRTUAL AND LIVE TRAINING SYSTEMS

OBJECTIVE: Develop aural, olfactory, and tactile sensation enhancements for existing and future training systems. Enhancements such as smell, sound and tactile effects (wind, shock, and touch) can be very beneficial to military and civilian training scenarios in both the virtual and live environments. Past research has provided environmentally safe smoke for fire-fighter trainers and some research is underway to add various chemical smells to these same trainers in the commercial market. Research has also been conducted to introduce smells into medical/surgical trainers for both commercial and military use. Sound and recoil (tactile) effects are being used in military small arms trainers. Other tactile effects, like the sensing of air movement, blast sensations, and the feel of objects in the virtual world are being explored at various research facilities.

DESCRIPTION: The development and availability of sensory enhancements to training systems will result in higher training effectiveness, more realistic training, and better training transfer. There are numerous disjointed efforts investigating individual sensory enhancements for training within the Government, industry and academia. These research efforts need to be transformed into useable products for military training applications.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $200K

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Fuel Efficiency and Advanced Propulsion Technology

TITLE: MEDIUM POWER ELECTRONIC BUILDING BLOCK

DESCRIPTION: The development of affordable power electronic systems between 10 and 250KW) is crucial to the Navy's electrically reconfigurable ships of the 21st century. The Power Electronic Building Block (PEBB) program is establishing the S&T basis of a new infrastructure for the power electronics for the Navy after Next through the development of solid state switching technologies, novel and unique control simulations, modeling and methodologies, advanced packaging and thermal management methods and advanced system level simulation. A successful proposal for this program will demonstrate the commercial viability of some, or all, of the following key elements from the PEBB program and demonstrate a major impact on the cost, performance or sustainability of Navy power systems.
(1) Novel device and/or mixed-hybrid circuits (IGBT, MCT, SiC, etc)
(2) Application of superior materials
(3) Modular- Hierarchical PEBB component through system level packaging concepts
(4) Innovative thermal management techniques
(5) Efficient control algorithms/architectures/ topologies

Additional background information on the objectives, accomplishments, participants and technologies of the PEBB program can be found on http://pebb.onr.navy.mil.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $2000K

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TITLE: VERY HIGH POWER ELECTRONIC BUILDING BLOCK (HPEBB) DEMONSTRATION

OBJECTIVE: Develop a very high power (250KW to 10MW) applications and demonstrations that incorporate key aspects of the Navy's Power Electronic Building Block (PEBB) program. The application/ demonstration will address Navy requirements and also have commercial application. The Navy applications include, but are not limited

Block (PEBB) program is developing an S&T basis and infrastructure for the power electronics for the new century through the development of switching technologies, new control methodologies, advanced packaging methods and advanced system simulation capabilities. A successful proposal for this program will demonstrate the commercial viability of key elements from the PEBB program and demonstrate a major impact on the cost, performance or sustainability of high power Navy systems.
(1) Novel device applications (, i.e. IGBT, MCT, SiC GTOs)
(2) Modular/ Hierarchical PEBB packaging concepts
(3) Advanced Topologies
(4) Innovative thermal management techniques
(5) Superior control algorithms/architecture(s)

Additional background information on the objectives, accomplishments, participants and technologies of the PEBB program can be found on http://pebb.onr.navy.mil.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $2000K

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TITLE: ADVANCED PROPULSION TECHNOLOGY—HYDROGEN DENSE FUELS

OBJECTIVE: To develop, characterize, and demonstrate stable, hydrogen dense fuels, such as stabilized aluminum hydride (alane), for military and commercial propellant and other commercial applications, such as polymerization catalysts and selective reducing agents.

DESCRIPTION: The use of alane in new propellants is projected to yield greater than 10% gain of specific impulse (I_{sp}) over the state of the art solid propellants. This would translate into a 30% increase in range for a single stage tactical missile, a 4,400 lb (10%) payload increase for the Titan Solid Rocket Motor (SRM), or a 1,100 lb (20%) payload

our energetics development community. The goals of this project will be to: (i) develop a synthetic process to produce stabilized metal hydrides such as aluminum hydride (alane), suitable for scale-up in a pilot plant; (ii) physically and chemically characterize the stabilized material and establish the mechanism and reliability of the selected stabilization technique, and (iii) demonstrate the safe use of these new metal hydrides. The propellant goal of the effort will be to demonstrate feasibility of a propellant formulated with a stabilized alane fuel at the 1-10 lb. batch scale. The commercial goal is to demonstrate the use of a stabilized alane as a chemical reagent or catalyst. Alane could replace a number of highly reactive metal hydrides, which require special and costly handling precautions, including shielding from air and water, and thus limit their application.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1600K

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TITLE: HIGH DENSITY, HIGH EFFICIENCY, ADVANCED PROGRAMMBLE POINT-OF-USE POWER SUPPLY

OBJECTIVE: To determine the material, active device and passive component parameters governing the design and fabrication of high performance (>90-95% efficiency at all loads at 1.5 V_{dc} and 3.3 V_{dc}) and compact ($\geq$ 100 watts per cubic inch in 100-watt module) dc-to-dc power supply and demonstrate the feasibility of transitioning these advances in materials, devices (silicon; wide bandgap semiconductors), circuit concepts and passive components (transformers; inductors; capacitances) into reliable, low cost, manufacturable prototypes incorporating integrated magnetics, capacitances and multi-D interconnects. In addition to raising the power supply reliability from a typical 25,000 hours MTBF to over 250,000 hours MTBF (including immunity to, and operation in, harsh EMI environments such as noise from high voltage/current switching), the dual-use commercialization (and potential high volume production) will reduce the cost by one order of magnitude, from $10/watt to less than $1/watt.

DESCRIPTION: The development and availability of low cost, reliable, manufacturable power supplies technologies is critical where small size, light weight and high efficiency are required, particularly in systems which use a distributed power approach. It is recognized, that with the lower supply voltage (9.0 to 1.5 volts and even lower) required for next generation electronics, a centralized power system architecture will no longer be viable. Power distribution weight and the losses through connector PINs bringing power to processors and other modules will become unacceptable. The airborne phased-array radar is a case in point: for example, 60 pounds (from a total of 140) of the radar's power subsystem weight is made up of high current distribution bus bars. For example, when applied to an F/A-18 radar upgrade to an active electronically steered array, the candidate dual-use power supply technology would eliminate most of the bus bar weight; thus, halving the system weight. Likewise, for ships using similar active array technology mounted high on a mast, halving the weight would be significant. Applying the technology to digital systems would have even greater weight benefits because the radar power subsystem is dominated by an input EMI filter, not needed in the digital electronics. In addition, for aircraft the impact of this weight reduction is multiplied because it takes about three-pounds of aircraft weight and six-pounds of fuel for every pound of avionics. For the F/A-18 upgrade the weight savings would exceed 400 pounds per aircraft.

Similarly, in satellite applications where small size, light weight and high efficiency are paramount concerns, the technology to generate, condition and store 500 watts of average power with solar panels requires over a 300-pound weight. The proposed dual-use power supply technology will provide 20% to 40% more power from a power system permitting a corresponding reduction in power system weight, valued at $15K to $60K per pound of launch weight; a 40% reduction equates to over $7M in launch cost savings for a 500-watt system. With today's larger satellites employing multi-kilowatt power systems, the savings will be very dramatic.

The payoff is pervasive, from reducing acquisition costs with proven, demonstrated power supply designs for military aircraft and commercial applications (ranging from the electric car to industrial induction heating), to developing a revolutionary capability with large commercial markets, namely the automobile/transportation industries including commercial aircraft and utilities.

The development of a 100-watt per cubic inch, 90-95% efficient, power supply suitable for dual-use in military environments, requires innovative advances in the areas of power semiconductors, integrated magnetics, components, capacitive elements, integrated

higher efficiency, advanced packaging, and low profile matrix (integrated) magnetic components are projected to be in excess of three orders of magnitude.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $800K

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TITLE: ADVANCED POWER GENERATION AND CONTROL OF NAVAL SHIPBOARD ELECTRIC POWER SYSTEMS

OBJECTIVE: The technology is for advanced power generation and control of naval shipboard electric power plants, including the ability to automatically reconfigure the generation and distribution system topology to meet load power quality requirements. The Navy desires the ability to automatically control the electric plant to respond to battle conditions and damage control stresses without loss of continuity to vital combat, weapon, auxiliary, and propulsion system loads.

DESCRIPTION: The development of an integrated electric power system which incorporates novel power dense electric power sources, a flexible, survivable electrical distribution architecture and an intelligent control system with anticipatory control that offers fast response to ship load charges in normal and casualty conditions. Integrating the power sources, distribution system and control system provides the flexibility to more easily accommodate existing loads and future such as electronic catapults, linear motor for elevators, advanced aircraft and electric arresting systems. The expected benefits are reduced operating and support costs through reduced manning from automated controls, and improved warfighting capability through continuous operation of combat and weapon systems. The commercial viability derives from similar control for power generation and distribution in light of the electric power industry deregulation, which is driving the power industry to a more control-based operation to improve cost and power quality delivery to large commercial customers.

TITLE: MULTI-FUNCTION POWER CONTROLLER TECHNOLOGIES FOR AIRCRAFT ELECTRICAL POWER SYSTEM APPLICATIONS

OBJECTIVE: Develop technologies that will reduce the cost and complexity of aircraft electrical power systems, utilizing advanced concepts, such as Power Electronic Building Blocks (PEBB). Current aircraft power systems are complex and much of the equipment is application specific. Development of technologies for a single package, multi-function controller that replaces numerous equipment and simplifies the design of electric power systems will lead to significant cost and weight reductions. Areas of application include power conversion (inverter/converter controllers, avionics, transformer-rectifier), circuit protection (circuit breaker, current limiter, automatic bus transfer) and controllers (motors, actuators, generator control unit). These areas provide critical needs on naval aircraft and are a large portion of the cost and weight of the weapon system. Avionics and radar systems play a large role in many fighter/attack missions, and electronics warfare and surveillance missions rely heavily on significant electronics components. Current state of the art uses a wide variety of components that drive up cost and does not provide for commonality. Development of technologies in this area will benefit both the military and commercial sectors by providing common, low cost, intelligent power modules.

DESCRIPTION: The development of aircraft power technologies that are simple in design and have a wide range of application will result in lower acquisition and maintenance costs as well as reduced life cycle costs. Weight reduction will enhance mission range and payload capabilities and provide for a smaller aircraft. Successful proposals in this topic area will develop technologies that provide for a common, low cost solution to many aircraft power system requirements. The current Navy PEBB program addresses ship based electrical system requirements. Technologies developed under that program may be considered when addressing the more stringent aircraft requirements. Requirements that need to be addressed include increased power density, electrical isolation, thermal environment and thermal management, high efficiency, electromagnetic field insensitivity, reliability and shock and vibration tolerance. Technologies should be consistent with the More Electric Aircraft initiative.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $900K

GOVT TPOC: Wayne Boblitt, NAVAIR 4.4.4

TITLE: ELECTRO-MAGNETO-RHEOLOGIC APPLICATIONS TO CIRCUIT BREAKERS

OBJECTIVE: Apply electro-rheologic or magneto-rheologic techniques to improve performance of electric circuit breakers and switches, especially to eliminate contact chatter, transient opening, and premature tripping in heavy vibration and shock environments. Shock-induced tripping of circuit breakers onboard ship is a significant "common-mode" failure that can disable a large number of components of weapon systems and other vital functions. Contact chatter incurs the rebooting of combat system computers, trips radar transmitters off line, and produces large transients that can damage equipment.

DESCRIPTION: Electro-rheologic and magneto-rheologic technologies allow electric control of the viscosity of a fluid, permitting rapid adjustment of the mechanical properties of a dynamic system. These materials are being considered for use in a number of shipboard systems, to improve the ship's performance in high shock and high vibration environments. Circuit breakers and switches have proven particularly susceptible to shock-induced tripping and to contact chatter under acceleration loads, which can disable key shipboard components. The contradictory requirements of a circuit breaker to hold tightly closed, when not under overload conditions, and yet trip quickly under overload, suggest the use of electro-rheologic materials to allow the needed change in response. (Here and below, we include both electric-field and magnetic-field controlled materials under the title "electro-rheologic.") These improved circuit breakers will be applicable to any power distribution system that must function under high shock and vibration loads. Particular applications include rail transportation, improved earthquake resistance for power plants, industrial facilities, apartment and office buildings, and electric vehicles. More generally, electro-rheologic adjustment to Electro-mechanical systems will bring improvements in actuators such as solenoids, in use in industrial processes, robots, and machinery.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1,250K

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OBJECTIVE: Provide reliable, interoperable, voice/data wide band next generation tactical communications. It has been long recognized that information transfer/tactical communications have been a major obstacle in conducting Command and Control. The approach utilized for execution of this task is centered around the leverage of other Services/DOD developments and leverage of commercial communications technology. The developments to be leveraged such as the Navy Slice radio or the Army's FDR will be modified/adapted to meet USMC requirements utilizing COTS (Commercial Off the Shelf) technology incorporating new waveforms as necessary, LPI (Low Probability Intercept), interoperability, digital transfer capabilities, wideband, antenna, co-site interference, etc. Those adaptations will be analyzed, prototyped tested, evaluated and demonstrated to be followed by transition into the USMC acquisition system. An additional component of this task will be involved in taking the technical lead in tactical beyond line of sight comms and provide solutions and recommendations to the Marine Corps in pursuit of technological and acquisition investment strategies. All commercial radio systems currently available have the limitations discussed below. The further development of radio technology will have a broad base effect on the communications industry.

DESCRIPTION: Reliable, wideband tactical communications is a major deficiency at all echelons of the Marine Corps. Systems presently being utilized such as SINCGARS (Single Channel Ground and Airborne Radios), lack range, usable bandwidth for data transfer, reliability and interoperability with other radios and tactical systems. Due to the enormous cost of radio development, the Marine Corps must partner with other services and industry.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $8000K

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TITLE: ADVANCED PROGRAMMABLE INTERACTIVE CONTROLLERS

diagnostics/measurements, 4) and interfacing with electronic information systems. This technology has additional applications and integration potential to modeling and simulation, automated testing and maintenance, virtual training, and real time condition based data monitoring.

DESCRIPTION: Traditional control units are expensive to produce and support, have limited and isolated build in test capabilities, and require excessive training, repair, maintenance and supply support programs. NSWCCD (Code 962) is currently looking at a software based unit, replacing multiple units, for Submarine Towed Buoys. Initially the entire system was modeled and circuitry simulated. Interactive training and data acquisition applications and capabilities are being incorporated. A controller, based on this technology, could not only control the antenna and handler equipment, but would be able to suggest optimum operating scenarios to the user based both on external operating conditions and internal inputs, self identify any problems, and store various data. Options include touch screen help menus and remote or portable access. The operator could call up appropriate instructions such as applicable portions of Ship Systems Manuals (SSMs). This technology could be adapted for use with any type of machinery or equipment with a requirement for a control/feedback system. The result would be an open architecture, modular, and user proactive human and hardware interface that integrates controls, information technology, and condition based maintenance.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $2,000K

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TITLE: HUMAN-CENTERED ENGINEERING ENVIRONMENT

OBJECTIVE: This effort will establish a human centric design environment that is integrated with a systems engineering design environment. This environment will support new defense and commercial system acquisition by integrating the necessary human performance attributes and analytical tools. This systems engineering

new system designs. It will facilitate design trade studies to be conducted to support manning analysis, assessment of workload, and assessment of the affects of automation on the human element of the system.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $ 500K

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TITLE: PILOT TAXIING AID

OBJECTIVE: Develop a system that gives pilots visual cues in order to taxi aircraft and autonomously directs them around the carrier flight deck. The Navy benefit in terms of savings from manpower reduction is estimated at $1.6 million per year and $80 million over the life of the ship. A commercial application can be easily envisioned for commercial airports.

DESCRIPTION: For Naval aviation to continue to be a viable part of the nation's military arsenal, the cost of operating aircraft carriers clearly needs to be reduced. The most significant driver of that cost is personnel, and the most significant manning driver is in the ship's Air Department. Air operations on the carrier is still a very manpower intensive process, conducted in the hazardous environment of the flight deck. A reduction in numbers of flight deck personnel would contribute to an overall improvement in safety, as well as a reduction in cost.

One of the most manpower intensive tasks on the flight deck is the task of directing aircraft. After recovery, the pilot will typically taxi to an initial spot. Once the aircraft is serviced, the pilot will taxi into a queue behind the jet blast deflector. When his/her turn comes up, the pilot will then taxi into the catapult shuttle for launch. (There may be other aircraft moves within this process that are facilitated by tow tractors.) Every time the pilot taxies the aircraft on the flight deck, he/she is aided by a "director," or "yellow shirt," who knows the spot the aircraft needs to go and guides the pilot through use of hand signals, constantly keeping aware of moving obstacles in the

would be developed include autonomous path planning and navigation algorithms to control aircraft movement, multiple active proximity sensors to determine exact and accurate location of the aircraft, and optics for visual display. Current path planning techniques will be challenged by the large volume of tracking targets (up to 50 aircraft) acting in a dynamic and constrained environment where other fixed and moving obstacles exist and parking spots are tight.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $3000K

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TITLE: RISK-BASED SYSTEMS ENGINEERING

OBJECTIVE: Risk-based design processes for shipboard hull, mechanical and electrical (HM&E) distributive systems need to be developed. These processes must also be capable of accounting for the interface requirements between these systems and the ship's structure. Process discipline and rule sets for establishing system performance requirements must keep pace with advances in system architecture, technology and complexity. These same engineering processes need to continue driving towards more realistic system simulations capable of analyzing system performance under actual operating conditions. With the service life projections of future naval vessels approaching 60+ years the need to factor the effects of time into our system engineering capabilities is self-evident. There is also a need to assess potential changes in system performance when exposed over an extended period of time to differing environmental and mechanical influences. In addition, the capability to model and simulate the effect of all inter- and intra-system linkages and interfaces is essential in assessing overall system performance. The design processes mentioned above are directly applicable to commercial ships and offshore structures.

DESCRIPTION: The development and availability of risk-based system engineering

develop design processes, tools and risk-based rule sets that will substantially improve design capabilities to effect overall lifecycle system performance and cost.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $1,200K

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TITLE: HULL, MECHANICAL AND ELECTRICAL (HM&E) OPEN SYSTEMS ARCHITECTURE

OBJECTIVE: In order to maintain an adequate level of control over 'mission critical' HM&E systems and lifecycle costs the Navy must explore the utility of an open system architecture approach towards future ship system engineering. This task will define and standardize the operational interfaces to be maintained throughout the vessel's service life without defining specific hardware and software solutions. These interfaces will allow the Navy to effectively manage both the software and hardware requirements of component-to-subsystem, subsystem-to-system, system-to-system, system-to-ship, ship-to-ship and ship-to-shore operational relationships. Control of system interfaces, in lieu of traditional 'Level III' design details, will significantly diminish the level of Navy oversight required to keep this design information current and accurate. Standardized interfaces will allow the industrial base to innovate within the spatial and performance bounds established by the interface standards. The need for customized system design solutions will be significantly reduced thereby allowing commercial off the shelf (COTS) hardware and software to play a much larger role in the fleet of the future. The engineering and design processes mentioned above are directly applicable to commercial ships and offshore structures.

DESCRIPTION: The development and availability of HM&E open systems architecture processes will benefit the military and commercial sectors by reducing infrastructure and support costs for developing, maintaining and storing detail design data and increasing the supplier base for HM&E system components. Three key process

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Advanced High Speed Vessels and Structural Systems For Large Sea-Based Structures

TITLE: FAST SHIPS

OBJECTIVE: To conceptualize, analyze, and demonstrate (at less than full scale), the feasibility of high speed ships for both commercial and military transport. The broad goals at full scale are: speeds in excess of 70 knots, ranges in excess of 6,000 miles, payload (cargo) in excess of 5,000 tons, shallow draft for small port entry, offloading under adverse weather conditions, and reasonable power requirements.

DESCRIPTION: Military logistics as well as some commercial sector requirements could be met by the development of fast ships; such vessels would considerably reduce transit time from current practice, and possibly create new markets, since they offer new capabilities. There are currently several technical approaches to creating fast ships, some of which have been demonstrated and are in use, especially in the small ferry market. Such demonstrators have limited payload and range when compared to a modern military logistics ship. The dominant physics limiting range/speed is the skin friction drag of the hull, and fast ships with conventional hull shapes have excessive power requirements, that make the broad goals described in the objective not feasible. Thus, novel approaches are required to meet these goals. The analysis and the demonstration should be done using state-of-the-art technologies, in order to assess the concept feasibility as accurately and as completely as possible. Although this program is about technology demonstration, technology development, such as improved computational fluid dynamics, is welcome under the condition that is necessary for the goals to be met.

Environmental Monitoring

TITLE: ACTIVE OPERATOR GUIDANCE

OBJECTIVE: To demonstrate a computer-based display system to assist in planning shipboard operations in heavy weather near real-time and forecasted up to 72 hours, and to use the system to validate and refine deck motion and attitude criteria for various shipboard tasks. The specific military application is in planning aircraft carrier flight operations in heavy weather and in refining deck motion criteria for fixed-wing aircraft operations. The projected payoff will be in increasing operational capability by reducing the risks of inadvertently selecting inappropriate course and speed changes and in improving criteria for use in ship design and operation. Active Operator Guidance (AOG) may be adapted to provide guidance and refined design criteria for any weather-sensitive shipboard operation, military or commercial.

DESCRIPTION: The AOG display uses directional wave spectra to determine the ship motion levels and to show, in ship speed and heading format, where motion limits on particular operations will be exceeded. Prototypes have been demonstrated to support aircraft operations on aircraft carriers and other air capable ships, with manual input of wind and wave conditions. In the system being developed, access to measured and forecast wind and wave conditions will be automated to more accurately represent the effects on aircraft operations. Successful proposals in this area will develop a variety of applications to weather-sensitive shipboard operations.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: $800K

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