ADDENDUM TO NAVY SBIR FY2001.2 TOPICS

NAVY
PROPOSAL SUBMISSION
INTRODUCTION

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research (ONR). The Navy SBIR Program Manager is Mr. Vincent D. Schaper, (703) 696-8528. The Deputy SBIR Program Manager is Mr. John Williams, (703) 696-0342. If you have any questions of a specific nature, you may contact one of the above persons. For general inquiries or problems with the electronic submission, contact the DoD Help Desk at 1-866-216-4095 (8AM to 8PM EST). For technical questions about the topic, contact the Topic Authors listed on the website on or before 1 July 2001.

The Navy's SBIR program is a mission-oriented program that integrates the needs and requirements of the Navy's Fleet through R&D topics that have dual-use potential. Information on the Navy SBIR Program can be found on the Navy SBIR website at **http://www.onr.navy.mil/sbir**. Additional information pertaining to the Department of the Navy's mission can be obtained by viewing the website at **http://www.navy.mil**.

PHASE I PROPOSAL SUBMISSION:

When you prepare your proposal, keep in mind that Phase I should address the feasibility of a solution to the topic. The Navy only accepts Phase I proposals with a base effort not exceeding $70,000 and with the option not exceeding $30,000. The technical period of performance for the Phase I should be 6 months and for the Phase I option should be 3 months. The Phase I option should address the transition into the Phase II effort and should be the initiation of the next phase of the SBIR project (i.e. initial part of Phase II). Phase I proposals, including the option, have a 25-page limit (see section 3.3). The Navy will evaluate and select Phase I proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. For technical questions about the topic, contact the Topic Authors listed on the website on or before **1 July 2001**. 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. The Navy typically provides a firm fixed price contract or awards a small purchase agreement as a Phase I award.

It is mandatory that a DoD Proposal Cover Sheet and the Company Commercialization Report are submitted electronically through the DoD SBIR website at **http://www.dodsbir.net/submission**. If you have any questions or problems with the electronic submission contact the DoD SBIR Helpdesk at 1-866-216-4095 (8AM to 8PM EST).

NEW! OPTIONAL ELECTRONIC SUBMISSION OF TECHNICAL PROPOSALS

For this solicitation, companies will have **two** options for submission of proposals to the Navy:

Option 1 -All Electronic Proposal Submission:
Complete electronic submission which will include the submission of the Cover Sheets, Cost Proposal, Company Commercialization Report, and the **entire** technical proposal including all forms via the DoD Submission site. The DoD proposal submission site **http://www.dodsbir.net/submission** will lead you through the process for submitting your technical proposal and all of the sections electronically. If you choose to submit your technical proposal electronically, it must be submitted online on or before the **3:00 pm EST, 15 August 2001 deadline,** but a hardcopy will not be required at this time. *Acceptable Formats for Online Submission:* All technical proposal files will be converted to Portable Document Format (PDF) for evaluation purposes; therefore, submissions may be received in PDF format but other acceptable formats (PC/Windows) are MS Word, WordPerfect, Text, Rich Text Format (RTF), and Adobe Acrobat. The Technical Proposal should include all graphics and attachments and should conform to the limitations on margins and number of pages specified in the front section of this DoD Solicitation. Most proposals will be printed out on black and white printers so make sure all graphics are distinguishable in black and white. It is strongly encouraged that you perform a virus check on each submission to avoid complications or delays in downloading your Technical Proposal.

Option 2 -Paper Submission of Proposal and Electronic Submission of Cover Sheets and Company Commercialization Report:
Hardcopy submission of Technical Proposal **and** electronic submission of Cover Sheets and Company Commercialization Report through the DoD proposal submission site, http://www.dodsbir.net/submission. You must print out the forms directly from this web site, sign the forms, and submit them with your hardcopy proposal. The format of your hardcopy proposal should be: Proposal Cover Sheet Pages (signed), Technical Proposal and Option (25-page limit), Cost Proposal (signed), and Company Commercialization Report (signed). **For Option 2 you must mail**

one original and four copies of your Phase I proposal to the address below. Proposals must be received by 15 August 2001.

U.S Mail packages send to:
Office of Naval Research
ONR 364 SBIR
Ballston Tower #2, Room 106
800 North Quincy Street
Arlington, VA 22217-5660

Overnight Mail Services or Courier packages send to:
Office of Naval Research
ONR 364 SBIR
Ballston Tower #2, Room 106
801 North Randolph Street
Arlington, VA 22203
PHASE I ELECTRONIC FINAL REPORT:

All Phase I award winners must electronically submit a Phase I summary report through the Navy SBIR website at the end of their Phase I. The Phase I Summary Report is a non-proprietary summary of Phase I results and should include potential applications and benefits and not exceed 700 words. It should require minimal work from the contractor because most of this information is required in the final report. The summary of the final report will be submitted through the Navy SBIR/STTR Website at: **http://www.onr.navy.mil/sbir**, click on "Submission", then click on "Submit a Phase I or II Summary Report".

ADDITIONAL NOTES:

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

2. The Navy will allow firms to include with their proposals, success stories that have been submitted through the Navy SBIR website at **http://www.onr.navy.mil/sbir**. A Navy success story is any follow-on funds that the firm has received from a past Phase II Navy SBIR or STTR award. The success story should then be printed and included as appendices to the proposal. These pages will not be counted towards the 25-page limit. The success story information will be used as part of the evaluation of the third criteria, Commercial Potential (listed in Section 4.2 of this solicitation) which includes the Company's Commercialization Report (formerly Appendix E) and the strategy described to commercialize the technology discussed in the proposal. The Navy is very interested in companies that transition SBIR efforts directly into Navy and DoD programs and/or weapon systems. If a firm has never received a Navy SBIR Phase II it will not count against them. Phase III efforts should also be reported to the Navy SBIR program office noted above.

NAVY FAST TRACK DATES AND REQUIREMENTS:

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

PHASE II PROPOSAL SUBMISSION:

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 that Activity's proper point of contact, listed in Table 1, during or at the end of a 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 to the Navy, obtain a copy of the Phase II instructions from the Navy SBIR website or request the instructions from the Navy Activity POC listed in Table 1. 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). The Navy typically provides a cost plus fixed fee contract or an Other Transition Agreement (OTA) as a Phase II award. The type of award is at the discretion of the contracting officer.

Upon receiving an invitation, submission of a Phase II proposal should consist of three elements: 1) a $600,000 base effort, which is the demonstration phase of the SBIR project; 2) a separate 2 to 5 page Transition/Marketing plan (formerly called a "commercialization plan") describing how, to whom and at what stage you will market/transition your technology to the government, government prime contractor, and/or private sector; and 3) at least one Phase II Option ($150,000) which would be a fully costed and well defined section describing a test and evaluation plan or further R&D if the Transition/Marketing plan is evaluated as being successful. Phase II efforts are typically two (2) years and Phase II options are typically an additional six (6) months. Some Navy Activities have different schedules and award amounts; you are required to get specific guidance from them before submitting your Phase II proposal. Phase II proposals together with the Phase II Option are limited to 40 pages (unless otherwise directed by the TPOC or contract officer). The Transition/Marketing plan must be a separate document that is submitted through the Navy SBIR website under "Submission" and included with the proposal hard copy. All Phase II proposals must have a Proposal Cover Sheet and Company Commercialization Report submitted through the DoD SBIR website at **http://www.dodsbir.net/submission** and Transition/Marketing plan submitted through the Navy SBIR website at **http://www.onr.navy.mil/sbir.**

All Phase II award winners must attend a two day Commercialization Assistance/Business Plan Development Course from the Navy. This is typically taken at the beginning of the 2nd year of the Phase II. If you receive a Phase II award, you will be contacted with more information regarding this program.

As with the Phase I award, Phase II award winners must electronically submit a Phase II summary report through the Navy SBIR website at the end of their Phase II. The Phase II Summary Report is a non-proprietary summary of Phase II results and should include potential applications and benefits and not exceed 700 words. It should require minimal work from the contractor because most of this information is required in the final report. The summary of the final report will be submitted through the Navy SBIR/STTR Website at: **http://www.onr.navy.mil/sbir**, click on "Submission", then click on "Submit a Phase I or II Summary Report".

The Navy has adopted a New Phase II Enhancement Plan to encourage transition of Navy SBIR funded technology to the Fleet. Since the Law (PL102-564) permits Phase III awards during Phase II work, the Navy will provide a 1 to 4 match of Phase II to Phase III funds that the company obtains from an acquisition program. Up to $250,000 in additional SBIR funds can be provided as long as the Phase III is awarded and funded during the Phase II. If you have questions, please contact the Navy Activity POC.

Effective in Fiscal Year 2000, a Navy activity will not issue a Navy SBIR Phase II award to a company when the elapsed time between the completion of the Phase I award and the actual Phase II award date is eight (8) months or greater; unless the process and the award has been formally reviewed and approved by the Navy SBIR Program Office. Also, any SBIR Phase I contract that has been extended by a no cost extension beyond one (1) year will be ineligible for a Navy SBIR Phase II award using SBIR funds.

Topic Numbers	Point of Contact	Activity	Phone
N01-184 to N01-185	Mr. Bill Degentesh	NAVSEA	202-781-3740
N01-186	Mr. Douglas Harry	ONR	703-696-4286
N01-187 to N01-192	Ms. Carol Van Wyk	NAVAIR	301-342-0215

Do not contact the Program Managers for technical questions. For technical questions, please contact the topic authors during the pre-solicitation period from 1 May 2001 until 1 July 2001. These topic authors are listed on the Navy website under "Solicitation" or the DoD website. After 1 July, you must use the SITIS system listed in section 1.5c at the front of the solicitation or go to the DoD website for more information.

PHASE I PROPOSAL SUBMISSION CHECKLIST:

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

____1. The DoD Proposal Cover Sheet and the DoD Company Commercialization Report have been submitted electronically through the DoD submission site.

____2. The Phase I proposed cost for the base effort does not exceed $70,000. The Phase I Option proposed cost does not exceed $30,000. The costs for the base and option are clearly separate, and identified on the Proposal Cover Sheet, in the cost proposal, and in the work plan section of the proposal.

____3. Submission: Option 1) Cover Sheets, Company Commercialization Report, and Technical Proposal have been submitted online on or before 15 August 2001.
Option 2) Cover Sheets and Company Commercialization Report (submitted online) and an original and 4 copies of the entire PH I proposal must be received on or before 15 August 2001 at the address above. The Navy will not accept late or incomplete proposals.

NAVY 01.2 ADDENDUM SBIR TITLE INDEX

Naval Sea Systems Command (NAVSEA)

N01-184 Simulation of Radiation Scattering and Coupling Properties of Large Phased Arrays
N01-185 Intelligent Flight Deck Camera Control with Video Mosaic

Office of Naval Research (ONR)

N01-186 Environmental Data Fusion for Mine Warfare

Naval Air Systems Command (NAVAIR)

N01-187 Optimal Diversity Reception for Ship Relative Global Positioning System (SRGPS)
N01-188 Smart Flat Panel Multifunction Color Display (MFCD) with Positive Pilot Feedback
N01-189 Open Architecture Software Using Middleware Isolation Layers
N01-190 Multi-Level Security in Real-Time Shared Memory Avionic Systems
N01-191 Autonomous Vehicle Management System
N01-192 Personal Computer (PC) Graphics Support for Texel Level Sensor Simulation

Naval Sea Systems Command (NAVSEA)

N01-184 TITLE: Simulation of Radiation Scattering and Coupling Properties of Large Phased Arrays

TECHNOLOGY AREAS: Information Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: ACAT I: DD-21

OBJECTIVE: Develop computer simulation program for modeling large phased arrays containing thousands of elements that are typically found in shipboard antenna applications. The models should be able to simulate the truncation effects of these large arrays and accurately predict the modifications introduced in their radiation, scattering, and EMI coupling characteristics of these arrays.

DESCRIPTION: Large phased arrays are found in many radar and communication systems. They are typically analyzed by using perturbation schemes, which assume that the field distribution in the aperture of the array is the same as that in a windowed doubly periodic infinite array. This approximation is introduced because the number of unknowns associated with the typical shipboard phased array problem becomes unmanageably large and the problem cannot be handled by using existing EM solvers.

However, the use of such a "windowing" approximation can introduce significant errors in the characterization of the array -- in terms of its radiation, scattering and EMI coupling characteristics. For instance, the estimate of the level of the far-field sidelobes of an array can have significant errors under the above approximation. Likewise the RCS of a large phased array cannot be accurately predicted by using a perturbational approach applied to the infinite array problem. Furthermore, in estimating the EMI levels, the scattering from the array must be accurately modeled together with the coupling to the internal electronics. The estimates of the scattering and internal coupling levels may also be unreliable when a crude approximation based on a simple truncation of an infinite array is used.

The objective of this effort would be to develop accurate, efficient, yet reliable methods for simulating large but finite phased arrays. As mentioned above the existing methods are limited in their ability to handle realistically large phased arrays and, hence, new innovative techniques are needed to model the problem.

The technique proposed should be applicable to phased arrays of interest to the DON-DD21 program, containing thousands of elements. Also, the technique should be general enough to handle different types of phased array elements that may be used in shipboard antenna arrays. Finally, the method should be applicable to arbitrary geometries of the template that may be used to truncate the array.

PHASE I: Develop accurate numerical technique for analyzing large phased arrays with q view to predicting their radiation, scattering and coupling characteristics. Validate the technique by comparing the results with those derived by using currently available EM modeling tools for moderate sized arrays. Demonstrate how these results can be extrapolated for much larger size arrays that cannot be handled via present simulation techniques.

PHASE II: Develop software module based on the technique developed in Phase I, complete with graphical user interface, to handle large phased arrays with elements typically found in shipboard antenna applications. Validate the results for pattern modification, change in TCS and internal coupling effects of the truncation by comparing with the measured data.

PHASE III: Successful design capability should transition to the Navy's Integrated Topside Design Program.

COMMERCIAL POTENTIAL: The commercial world will benefit directly from this software module in solving large array problems, e.g., companies in the communication business.

KEYWORDS: radiation; scattering; EMI coupling; phased arrays

N01-185 TITLE: Intelligent Flight Deck Camera Control with Video Mosaic

TECHNOLOGY AREAS: Information Systems, Ground/Sea Vehicles, Materials/Processes

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: ACAT ID

OBJECTIVE: Develop a system that provides full and constant video surveillance of the flight deck of an aircraft carrier using minimal man-in-the-loop operation. This would require the following technology advances: (1)

Intelligent and automatic control of a pan/tilt/zoom camera for detailed coverage of both routine/repeated tasks and non-routine/emergency incidents, and (2) Machine vision algorithms that piece together video feeds from multiple cameras with different viewing angles and fields into one seamless mosaic.

DESCRIPTION: In order to constantly monitor flight operations, aircraft carriers employ a system of cameras and displays called the Integrated Launch and Recovery Television System. The ILARTS system allows the ready rooms, flight deck control, and the combat information center to view recoveries, launches, aircraft movements on the deck, and other activities, enabling a rapid response in case of emergencies as well as a tape archive that can be used to investigate a mishap. A key component of ILARTS is the manned island camera, which is located about 40 feet above the flight deck. The island camera is a pan, tilt, and zoom (10:1 zoom lens) that picks up the aircraft as it grabs one of the arresting wires, zooms in for a close up to pick up the aircraft's side number and follows the arresting wire back to its sheaves to determine which of the wires was engaged. If the aircraft bolters, the cameraman follows the aircraft as it departs the ship. The island camera also tracks each of the aircraft as it launches from the time it is in the catapult out to a half mile.

The island camera resides in an enclosure on the inboard forward corner at the 07 level which has been built as an air conditioned weather tight compartment surrounded by a polycarbonate window. This island appendage is location-critical because of the required angles of visibility from this camera. There would be significant benefit to the ship in eliminating this island camera space: a cost avoidance for construction in excess of $200K, reduced island radar cross section, potential workload reduction of 1-3 MY/Y through reduction of camera operators (annual savings of $75K to $225K per ship), weight reduction of more than 8 long tons, VCG reduction of 0.03 feet, and starboard list reduction of 0.03 degrees. To accomplish this, the Navy needs autonomous, intelligent control of the pan/tilt/zoom camera for routine tasks, plus a way of remotely controlling the camera from the ILARTS control room one level underneath the flight deck for non-routine tasks.

Routine tasks requiring automatic camera control would be: (1) Recovery: Track the recovering aircraft once it crosses the ramp, zoom in on the side number, zoom out, track to it's initial spot; and (2) Launch: Cover each aircraft launch out to a half-mile. Data to support automatic control are the following. For recovery, the SPN-46 Precision Approach Radar and the Virtual Imaging System for Approach and Landing (VISUAL) electro-optic tracker provides distance to ramp and closing speed information. VISUAL is currently in development. For launch, the catapult control system indicates when a catapult launch has commenced. Data for both recovery and launch will also be available through the Aviation Data Management and Control System (ADMACS), an Air Department-wide LAN on the carrier. ADMACS is currently in development.

Non-routine tasks requiring manual intervention include emergencies or activities such as a flight deck explosion, blown tire, man overboard rescue operation, or cargo transfer via helicopter ("vertical replenishment" or VERTREP). This remote control requires (1) obtaining the situational awareness needed to recognize that an activity is taking place that requires detailed video coverage by the pan/tilt/zoom camera, (2) initial acquiring of the aircraft/helicopter/person/object by the camera and then (3) pan/tilt/zoom control of the camera to achieve a detailed view of the aircraft/object and the control needed to continue the view of the object if the aircraft/object is moving. These must occur during very high-tempo operations where multiple activities are occurring simultaneously on the flight deck and in the air space around the ship and includes both day and night operations.

Because there is no spot high enough to mount one camera for a "God's eye view" of the flight deck, multiple fixed cameras will be used to provide the video feeds necessary to give the ILARTS operator some level of situational awareness needed for remote operation of the pan/tilt/zoom camera. However, utilizing one display, rather than multiple displays, is necessary to minimize equipment costs, minimize operator scan and fatigue, and feasibly fit into a constrained space. Therefore, the Navy needs one seamless view of the flight deck and surrounding area. Algorithms would need to be developed that transform each camera's viewing angle into one common viewing angle and match the "seams" between fields of view. (Note: the "seams" may include both horizontal (pan) seams and vertical (tilt) seams.)

Areas for camera coverage: (1) Flight deck, (2) Half mile forward of the bow and waist catapults, (3) Quarter mile around the flight deck for VERTREP or search and rescue (SAR) operations. Analysis of number of cameras and lens capabilities to completely cover the scene is germane to this topic. However, selection of the type of camera to operate in all light and weather conditions is not necessary for this topic. Proposals to this topic should be focused on the algorithms necessary the intelligent camera control and mosaic of multiple video feeds. Means of tracking aircraft other than visual (such as laser or active emissions from aircraft) could be considered for augmenting the camera suite if necessary.

PHASE I: Develop a concept and demonstrate the feasibility of that concept towards achieving the stated objective. This should involve developing algorithms and testing those algorithms in a lab environment. For the intelligent camera control, a lab demonstration could show a pan/tilt/zoom camera tracking moving objects on video or following a prescribed script that simulates flight operations. The concept should also identify interfaces to carrier systems, input data for triggering control sequences, output data from pan/tilt/zoom unit providing camera position for feedback, and any additional hardware required. For the video mosaic, the lab demonstration should manipulate multiple video streams from different viewing angles and display the video onto one monitor with one viewing angle. The concept should also identify the number of fixed cameras and mounting locations to achieve complete coverage as described above. In addition, identify interfaces and hardware required for remote operation of the pan/tilt/zoom camera. The Phase I final report should include an analysis of alternative concepts as well as an assessment of cost.

PHASE II: Develop a prototype system and demonstrate it aboard a carrier during flight operations at sea. The demonstration should show the system automatically controlling a pan/tilt/zoom camera for the routine tasks stated above, continuously keeping the aircraft in the field of view during recovery or launch operations. It should display complete flight deck coverage (as described above) on one monitor in the ILARTS Control Room. It should demonstrate remote manned camera control from the ILARTS Control Room and from Primary Flight Control (PriFly). An operator controlling the camera remotely should be able to find and zoom-in on an object on the flight deck in any arbitrary location in 4 seconds or less. The Phase II final report should include an execution plan for Phase III, including cost and schedule.

PHASE III: Produce and field systems for the 12 aircraft carrier fleet, plus systems for lab and training. Assist in providing the logistics necessary to operate and maintain the systems.

COMMERCIAL POTENTIAL: This technology would satisfy any application,which requires monitoring multiple cameras with multiple viewing angles. There would be numerous opportunities in the commercial sector, including entertainment, sports, traffic management and security/surveillance.

KEYWORDS: Machine vision, Video mosaic, Intelligent control, Human factors

Office of Naval Research (ONR)

N01-186 TITLE: Environmental Data Fusion for Mine Warfare

TECHNOLOGY AREAS: Information Systems, Human Systems

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

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

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

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

PHASE III: Team with the manufacturer of one of the Navy's underwater MCM reconnaissance systems or environmental tactical decision aids, such as MEDAL, to integrate the concept into future generations. Team with manufacturers of commercial environmental fusion systems, such as satellite remote sensing displays, to integrate the concept into these products.

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

REFERENCES:

1. Samet, Hanan, 'Applications of Spatial Data Structures, Computer Graphics, Image Processing, and GIS", Addison-Wesley, 1990;
2. Fayyad, Piatetsky-Shapiro, Smyth, and Uthurusamy, eds. "Advances in knowledge discovery and data mining", AAAI Press, 1996

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

Naval Air Systems Command (NAVAIR)

N01-187 TITLE: Optimal Diversity Reception for Ship Relative Global Positioning System (SRGPS)

TECHNOLOGY AREAS: Information Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: ACAT I: NAVAIR 1.0

OBJECTIVE: Develop a SRGPS system with improved blockage, multi-path, and interference performance

DESCRIPTION: A cornerstone of the Navy SRGPS is the continuous transmission of shipside phase and pseudo-range measurements to the approaching aircraft. Continuity and quality of these satellite measurements critically drive the overall SRGPS navigation continuity and integrity. Faulty measurements, even if detected prior to transmission, impact system performance. Therefore, improvements are needed in shipside signal processing that are resistant to signal blockages, specular multi-path and interference, and to errors induced by radio frequency (RF) path elements such as nullers. As in civilian differential GPS (DGPS) landing systems, multiple antennas and receivers can provide redundancy for detecting multi-path, blockages, and phase anomaly events. However, in the shipboard environment, detection events will be more frequent. Correction of anomalies may be possible with techniques that optimally process the signals from multiple antennas. GPS-related technical papers have discussed processing techniques for civil, shore-based applications, which might be adaptable for shipboard applications. Also, it might be possible to combine such a technique with inertial aiding (for motion compensation) and with the newly defined military code (M-code) modulation for further improvements in multi-path rejection and tracking.

PHASE I: Analyze the architecture and performance of a multi-antenna optimal diversity reception system, including ship antenna configuration options, and interface with a ship inertial navigation system (SINS) or other aiding systems. The proof-of-concept will cover the impact of multi-path, blockage, attenuation, and nuller disturbances, for the current military precise (P/Y) code and the future M-code environments. Baseline comparisons will include conventional diversity systems.

PHASE II: Build and test a prototype P/Y code system to verify critical performance characteristics. The multi-antenna prototype system will be evaluated in RF-level simulations, and in field measurements.

PHASE III: Construct and install units aboard high-priority Navy vessels.

COMMERCIAL POTENTIAL: This technology applies directly to all safety-of-life DGPS systems, including Federal Aviation Administration (FAA) precision landing. Additionally, the developed multi-antenna signal processor will find application in code division multiple access (CDMA) wireless and phone station infrastructure for improved signal tracking and system capacity.

REFERENCES:

1. Final Draft, Operational Requirements Document I (ORD), Joint Precision Approach and Landing System (JPALS), ACAT Level ID, USAF 002-94-I, 4 Mar 98 (unclassified)
2. Joint Precision Approach and Landing System (JPALS), Single Acquisition Management Plan (SAMP), Version V12, 15 Sep 98 (unclassified)
3. Performance of Ship Relative GPS (SRGPS) Reference Station Diversity Reception Alternatives, Sennott, J.W., Senffner, D., and Najmulski, K. Proceedings of ION-GPS-2000, September 2000.
4. Design and Performance of Code Tracking for the GPS M-Code Signal, Betz, J.W., Proceedings of ION-GPS-2000, September 2000

KEYWORDS: Global Positioning System (GPS); Avionics; Receiver; Processing; Multi-path; Blockage

N01-188 TITLE: Smart Flat Panel Multifunction Color Display (MFCD) with Positive Pilot Feedback

TECHNOLOGY AREAS: Information Systems, Human Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: ACAT: IC (PEO-A)

OBJECTIVE: Develop a multifunction flat panel display employing active matrix liquid crystal display (AMLCD) and MFCD technology. The flat panel display will use touch screen technology to activate sub-screens or internal systems. Each screen will provide both visual and biomechanical feedback. The biomechanical feedback may be done through attaching a device to the pilot or operator's glove using infrared technology. The MFCD may be utilized as both sensor and digital map displays.

DESCRIPTION: Cathode ray tube (CRT) MFCDs are an obsolescent reality. CRT orders and economical production rates are declining. Support of CRT MFCD beyond FY 02/03 will be increasingly risky due to parts availability. Long-term CRT availability is also questionable, and future cost is expected to increase. Over the last two years, suppliers have announced "last time buys" for many CRT components.

Conversion to smart AMLCD MFCDs will improve system performance and reliability, and reduce future procurement and life-cycle cost. The application of this technology to aviation display systems has the potential of $100,000,000 cost saving over the next 10 years. The reduction of mechanical components will result in greater reliability and reduced failures. The video display can be used as a smart system, which can be designed for pilot head-down use capable of displaying mission data, navigation, and other multifunction color display information in high performance aircraft.

PHASE I: Propose a design concept and identify technology developments required. Review current available AMLCD MFCD touch screen technologies against Navy requirements for aviation display systems. Identify technology deficiencies. Assess human factors associated with pilot workload and biomechanical feedback systems, which impart tactile sensory perception when the screen is touched. Determine performance parameters, feasibility and practicality of an AMLCD MFCD touch screen that provides both visual feedback and a biomechanical feedback that can be felt by the hand when the screen is touched

PHASE II: Develop the touch screen technology and biomechanical feedback system identified in Phase I. Integrate the touch screen flat panel display and biomechanical feedback system into a prototype display system. Demonstrate the performance characteristics and interface compatibility of the of the prototype display system with existing Navy data/software architecture. Finalize the design of the flat panel display, controller circuitry, system software, and biomechanical feedback device to fit within the current CRT cockpit envelope.

PHASE III: Conduct full-scale demonstration. Finalize production processes.

COMMERCIAL POTENTIAL: Commercial applications include the commercial aircraft industry, private aircraft and boats, PC gaming, automotive displays, and personal computers.

REFERENCES:

1. A Comparison of Numerical Data Entry with Touch Sensitive and Conventional Numerical Keypads, Report Number AFAMRL-TR-85-007.
2. "The Touch Panel System; Design and Development," Report Number RADC-TR-84-258. 3. "Six Sensor System," Roy O'Connor and David J. Bak, Design News, March 22, 1999.
3. "Advanced Displays and Interactive Displays Report Compendium II," Report AD Number: ADA380138.
4. Avionics Handbook, International Coverage of New and Emerging Technology; CRC Press, 2000 N.W. Corporate Blvd., Boca Raton, FL 33431-9868

KEYWORDS: Smart Flat Panel Multifunction Color Display; Positive Pilot Feedback; Active Matrix Liquid Crystal Display (AMLCD); Multifunction Color Display (MFCD); Touch Screen Technology; Visual and Mechanical Feedback.

N01-189 TITLE: Open Architecture Software Using Middleware Isolation Layers

TECHNOLOGY AREAS: Information Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: ACAT I:PEO-A; PEO-T

OBJECTIVE: Develop open architecture "middleware" software that allows reuse of application software modules from one real-time system to the next and facilitates "plug and play" of software from different sources into a real-time (particularly avionic) system.

DESCRIPTION: While plug and play application software has been very successful in the commercial personal computer (PC) arena (consider all the applications that can be "plugged" into Windows), few military real-time applications have achieved plug and play portability to, or reuse by other military real-time systems. Most real-time systems are built new from the ground up for each new program, even though many of the algorithms implemented are very similar to those in existing systems. This "reinvention of the wheel" for each new military system is costly and time-consuming resulting in very expensive systems, very long development times, and very expensive upgrades. Total ownership costs (TOC) have suffered. For example, programs such as the F-22 aircraft will have expended multi-billions of dollars on software over their life cycle. Without this new plug and play technology for software, the Joint Strike Fighter (JSF) will experience similar software cost growth. 40 percent savings on software TOC is reasonable if a technology for software reuse can be developed.

Modern military avionic real-time systems (e.g., JSF) are inherently different from most PC based commercial systems in that they must be deterministic; have low weight, volume, and power (and hence efficiency); and they must support multi-level security. Commercial middleware, such as common object request broker architecture (CORBA), has not been generally applicable to modern avionics because it has not been deterministic, it has not been efficient (the central processing unit (CPU) overhead for the middleware has sometimes exceeded 50 percent), and it has not provided multi-level security. Some efforts have been made toward developing real-time middleware. The Object Management Group has a limited development effort devoted to real-time middleware. The adaptive communication environment (ACE) object request broker (ORB) (TAO) was flown in the AV-8B at China Lake, CA. Results to date have shown that additional R&D are needed in the areas listed above. This effort seeks to perform the additional R&D needed—based on additional CORBA R&D or on entirely new concepts. The middleware should provide an interface "shell," defining the interfaces among application modules, and to the operating system, such that modules are easily reused in other systems having the same requirements. It should be able to handle worst case differences among modules (developed in different languages, presents a disparate interface, only available across a large area network (LAN), requires dynamic binding at run time, etc.), but scalable to add only minimal overhead when differences among modules are slight. CPU cycles should not be wasted resolving differences that do not exist. In fact it is anticipated that worst case difference will be seldom encountered. Consideration should be given to real-time systems with multi-processors, systems using both message passing and shared memory, systems with multiple virtual memory spaces, and systems with multi-level security. Consideration should also be given to the need to upgrade hardware periodically to new technologies that may include changing the CPU instruction set architectures or operating systems.

PHASE I: Define avionic real-time system performance requirements. Analyze, and document potential approaches to meet these requirements. Select an approach and document the effort for Phase II. Clearly show the rationale for the chosen approach over other approaches. Analyze the approach for determinism, computer resource utilization, and multi-level security. Address the feasibility and practicality of the proposed solution for a modern military avionic system.

PHASE II: Implement the approach chosen in Phase I. Design the system and develop the software. Demonstrate a prototype on a multi-processor system with multiple virtual memory spaces per processor using both shared memory and message passing. Evaluate the system in the areas of enhanced software modularity, portability, and reuse as well as for determinism, efficiency, and support for multi-level security.

PHASE III: Finalize the software. Perform a full-scale demonstration of the product.

COMMERCIAL POTENTIAL: This technology should be applicable to commercial real-time systems such as those used in telephony, medical imaging, and power plant and chemical plant control.

REFERENCES:

1. http://www.omg.org/
2. http://www.omg.org/techprocess/meetings/schedule/RT_Notification_RFP.html
3. http://www.omg.org/homepages/realtime/
4. http://cgi.omg.org/archives/realtime/msg00080.html
5. http://www.jast.mil/html/misnsys.htm; Avionics Architecture Definition Main Document

KEYWORDS: Real-Time Computing; Avionics; Software Portability; Open Architecture; Common Object Request Broker Architecture (CORBA); Middleware; Military Computing

N01-190 TITLE: Multi-Level Security in Real-Time Shared Memory Avionic Systems

TECHNOLOGY AREAS: Information Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: ACAT I:PEO-A; PEO-T

OBJECTIVE: Develop the hardware and software for the management and control of multi-level security in real-time, shared memory, multi-processor avionic systems.

DESCRIPTION: Next generation real-time avionic processors will be characterized by supporting multi-millions of lines of software classified at multiple security levels (unclassified, secret, top secret, etc), having multiple processors, and having a requirement for very high throughput. To avoid a "system high" environment where all multi-million lines of software must be treated as if they are classified at the highest level present (often top secret), dramatically increasing software costs, multi-level secure systems are desirable. In multi-level secure systems only the small amount of software that is actually classified needs to be specially managed. Current multi-level secure multi-processor avionic computers have used "message passing" communications among processors.

A faster and much lower latency (See Note 1) method of multi-processor communications is via "shared memory." The use of shared memory communications can result in reduced cost because, being faster, fewer processors are needed to do a given task. Several, shared memory interconnect systems (such as IEEE 1596 Scalable Coherent Interface) have demonstrated the improved speed benefits of shared memory. However, they do not meet the military's requirement for multi-level secure (unclassified though top secret) shared memory systems. The development of interconnect hardware, supporting interconnect software, and operating system are required.

Note 1: Used here, latency refers to the time required for the target application software to receive the needed data over the interconnect system. Message passing systems, even those with very high bit per second measurements, often invoke large delays before and after passing the data. Shared memory systems do not generally experience those delays.

PHASE I: Compare current shared memory interconnect system capabilities to the military requirement for multi-level secure multi-processor systems. Identify technology developments in interconnect hardware, supporting interconnect software, and operating system. Assess the feasibility and practicality of developing these technologies. Analyze the likelihood of security compromises with a shared memory interconnect system.

PHASE II: Develop the interconnect hardware, interconnect software, and operating system technologies identified in Phase I. Fabricate a prototype and demonstrate a secure shared memory interconnect system. Finalize system design.

PHASE III: Conduct full-scale field demonstration. Finalize production processes and software.

COMMERCIAL POTENTIAL: This project will develop high performance secure computer technology that will be applicable to all forms of military computing. However, the same technology should additionally be applicable to other industries needing security such as banking and Internet financial transactions.

REFERENCES:
1. http://www.computer.org/cspress/CATALOG/ST01049.htm
2. http://www.scizzl.com/
3. http://www.rapidio.org/

KEY WORDS: Secure Computing; Shared Memory; Real-Time; Multi-Processors; Avionics, Military Computing

N01-191 TITLE: Autonomous Vehicle Management System

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: Develop a system that allows for autonomous in-flight replanning of the air vehicle based on system status, sensor input, and preset mission objectives. The autonomous operation state models should provide the ground control station operator with improved vehicle health assessment, state prediction trend, vehicle operation options, and multi vehicle management. Technologies developed will support Vertical Takeoff Unmanned Air Vehicle (VTUAV) tactics for intelligence, surveillance, and reconnaissance (ISR).

DESCRIPTION: The development of decision aiding processes for the VTUAV is critical to mission effectiveness of the system. Electro-optical/infrared (EO/IR), radio frequency (RF) information, navigation system, and vehicle health information will challenge the ability of the operator at the ground control station to correlate multiple sets of data from one or multiple VTUAVs while making time critical decisions.

The VTUAV system incorporates significant unmanned air vehicle (UAV) technical advances in virtually all of its major subsystems. To fully exploit the potential of this advanced ISR mission system, there is a need for effective decision aids to support tactical employment. Technologies that support real-time operation are of interest.

Autonomous operation models will enable the weapon system to achieve enhanced survivability. The autonomous operation models are needed to monitor vehicle health, subsystem state changes, and recommended courses of action to maximize ISR mission execution and indicate vehicle survivability.

Cognitive readiness of the ground control station operator with ISR information and tactical decision support solutions provided will incorporate the effects of significant battlefield conditions. The approach should also provide for learning experience; during the course of a mission the system should be capable of self-update based on the current conditions and mission results. Current conditions will be based on communication timing, route planning, weather, responses to threat, and recommended targets.

The implementation should be capable of rapid execution to support the real-time interaction of the ground control station operator. Autonomous operation decision aids in the ground control station and/or VTUAV will allow multiply vehicle operation by a single ground control station operator.

PHASE I: Provide a feasibility study to identify innovative approaches regarding the autonomy needed for surveillance, reconnaissance, and targeting missions for one to multiple UAVs. It should examine mission regeneration capabilities and applicable system technologies that would allow for real-time system reconfiguration and adaptive mission replanning based on self-system status, external sensor input, and external commands. The study should examine existing algorithms and algorithm development techniques enabling the vehicle to choose its mission and to adjust for unanticipated threats and changing conditions. This SBIR should identify the level of technology necessary for this autonomous operation (e.g., processor requirements, sensor type/quantity/resolution requirement) and compare the requirement to that available from commercial-off-the-shelf (COTS) components.

PHASE II: For the technology identified in Phase I, concept development will involve the generation of algorithms and testing on a software testbed. Hardware-in-the-loop (HWIL) will allow for demonstration and testing of autonomous capabilities identified in Phase I.

PHASE III: Demonstrate the ability to successfully integrate the tested algorithms from Phase II into the VTUAV or tactical control system (TCS).

COMMERCIAL POTENTIAL: In the growing market for UAVs and unmanned combat air vehicles (UCAVs), immediate customers for these products/technologies include both military and commercial markets. Autonomous health monitoring has application in commercial industry and on military aircraft and weapon systems. Fishing fleets, drug enforcement, and fire fighting are some commercial applications.

KEYWORDS: Autonomous Operation; Unmanned Air Vehicles (UAVs); Unmanned Combat Air Vehicles (UCAVs); Intelligent Control; Automated Vehicle Management Systems; Multi-Vehicle Management

N01-192 TITLE: Personal Computer (PC) Graphics Support for Texel Level Sensor Simulation

TECHNOLOGY AREAS: Information Systems, Human Systems

DOD ACQUISITION PROGRAM SUPPORTING THIS TOPIC: ACAT I: NAVAIR 1.0

OBJECTIVE: Develop a PC video card that incorporates dynamic texture indexing and three independent spline fogging.

DESCRIPTION: As the military relies more on advance sensors to deploy its weapons and execute missions, the importance of simulating these sensors for training at all levels has increased. Currently, only the most expensive simulation specific image generators can perform the high fidelity simulation of these sensors at the 60-Hz refresh rate and these systems cost from $300,000 to $1 million per graphic channel. The goal is to incorporate several of the most important high-end graphic capabilities into a desktop PC video card that would cost less than $25,000 per graphic channel. The capabilities to be incorporated on the video card are three independent spline fog architecture and a high-bandwidth index texture color look-up capacity.

The problem with current fog simulations is that, no matter how the effects of visibility on surfaces/lights in the scene (propagation) are calculated, it is equally applied to all surfaces/lights as a function of range no matter the color, material, or spectral emission. Thus, a red, green, or blue surface at equal distance would fog (disappear) at the same range. In reality, because of different wavelengths of the light being reflected, the loss of energy to the environment (absorption and scattering) would be different for each surface. This difference would cause a different detection range for each surface (an example is the use of camouflage). The required PC video card conversion is hardware supporting multiple (3 or more) separate fog splines that can be rendered into a single scene at a 60 Hz refresh rate for proper in-band sensor propagation simulation.

An additional problem with low-cost simulation hardware is the lack of bandwidth to texture memory for real-time change of the texture color lookup tables separate from the paging of the texture data into texture memory. This limitation limits the use of the current generation high-fidelity sensor simulation technologies that calculate the in-band intensity of each texture pixel (texel) in real-time. It also wastes limited bandwidth resources to allow for updating of the scenes. More specifically, the current generation of sensor simulation software stores material indexes in textures instead of colors (called wavelength independent material texture maps) to allow for infrared, night vision, and out-the-window simulations to be calculated from a single stored database. The material indexes in the index map are then calculated with the effects of the diurnal cycle, weather, and other effects (possibly local illumination from lamp posts) taken into account. The results are stored in the texture color lookup tables that are applied to the textures in real time by indexing. Over time for a static eye-point, the environment changes and the texture color tables are updated to reflect these changes. The results are then applied to the current textures in real time to allow for the effects of thermal crossover.

PHASE I: Identify approaches for the implementation of real-time three spline fog, real-time texture color table updating, and indexing to meet the current generation simulation requirements at 60 Hz refresh rate. Document the practicality and feasibility of the approaches. Select an approach for development in Phase II. Assess any limitations in the design and technologies needing development. Characterize the approach’s impact on overall system performance.

PHASE II: Develop the software and hardware identified in the Phase I approach. Assemble a prototype video card. Demonstrate the performance and functional capabilities including a real time simulation using a desktop PC. Finalize the video card hardware and software design for further development in Phase III.

PHASE III: Complete video card development. Conduct full-scale demonstration in a specified training system application. (The training system application will be identified during Phase II.)

COMMERCIAL POTENTIAL: Real-time, high-performance simulation of sensor-based imagery including night vision goggle scenes and thermal imagery. The ability to create high-quality, low-cost training simulation for police training. New generation of game scene rendering capabilities will be possible.

KEYWORDS: Simulation; Imaging; Sensors; Computer Hardware, PC Graphics, Real-time