ARMY
SBIR 08.1 PROPOSAL SUBMISSION INSTRUCTIONS

The U.S. Army Research, Development, and Engineering Command (RDECOM) is responsible for execution of the Army SBIR program. Information on the Army SBIR Program can be found at the following website: https://www.armysbir.com/.

Solicitation, topic, and general questions regarding the SBIR program should be addressed according to the DoD portion of this solicitation. For technical questions about the topic during the pre-Solicitation period, contact the Topic Authors listed for each topic in the Solicitation. To obtain answers to technical questions during the formal Solicitation period, visit http://www.dodsbir.net/sitis. For general inquiries or problems with the electronic submission, contact the DoD Help Desk at 1-866-724-7457 (8am to 5pm EST). Specific questions pertaining to the Army SBIR program should be submitted to:

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US Army Research, Development, and Engineering Command (RDECOM)
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The Army participates in one DoD SBIR Solicitation each year. Proposals not conforming to the terms of this Solicitation will not be considered. The Army reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality will be funded. Only Government personnel will evaluate proposals.

SUBMISSION OF ARMY SBIR PROPOSALS

The entire proposal (which includes Cover Sheets, Technical Proposal, Cost Proposal, and Company Commercialization Report) must be submitted electronically via the DoD SBIR/STTR Proposal Submission Site (http://www.dodsbir.net/submission). The Army prefers that small businesses complete the Cost Proposal form on the DoD Submission site, versus submitting within the body of the uploaded proposal. The Army WILL NOT accept any proposals which are not submitted via this site. Do not send a hardcopy of the proposal. Hand or electronic signature on the proposal is also NOT required. If the proposal is selected for award, the DoD Component program will contact you for signatures. If you experience problems uploading a proposal, call the DoD Help Desk 1-866-724-7457 (8am to 5pm EST). Selection and non-selection letters will be sent electronically via e-mail.

Army Phase I proposals have a 20-page limit (excluding the Cost Proposal and the Company Commercialization Report). Pages in excess of the 20-page limitation will not be considered in the evaluation of the proposal (including attachments, appendices, or references, but excluding the Cost Proposal and Company Commercialization Report).

Any proposal involving the use of Bio Hazard Materials must identify in the Technical Proposal whether the contractor has been certified by the Government to perform Bio Level - I, II or III work.

Companies should plan carefully for research involving animal or human subjects, or requiring access to government resources of any kind. Animal or human research must be based on formal protocols that are reviewed and approved both locally and through the Army's committee process. Resources such as equipment, reagents, samples, data, facilities, troops or recruits, and so forth, must all be arranged carefully. The few months available for a Phase I effort may preclude plans including these elements, unless coordinated before a contract is awarded.

If the offeror proposes to use a foreign national(s) [any person who is NOT a citizen or national of the United States, a lawful permanent resident, or a protected individual as defined by 8 U.S.C. 1324b(a)(3) – refer to Section 2.15 at the front of this solicitation for definitions of "lawful permanent resident" and "protected individual"] as key personnel, they must be clearly identified. **For foreign nationals, you must provide resumes, country of origin and an explanation of the individual's involvement.**

No Class 1 Ozone Depleting Chemicals/Ozone Depleting Substances will be allowed for use in this procurement without prior Government approval.

Phase I Proposals must describe the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL

The Army implemented the use of a Phase I Option that may be exercised to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to exercise the Phase I Option. The Phase I Option, which **must** be included as part of the Phase I proposal, covers activities over a period of up to four months and should describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 20-page limit for the Phase I proposal.

A firm-fixed-price or cost-plus-fixed-fee Phase I Cost Proposal ($120,000 maximum) must be submitted in detail online. Proposers that participate in this Solicitation must complete the Phase I Cost Proposal not to exceed the maximum dollar amount of $70,000 and a Phase I Option Cost Proposal (if applicable) not to exceed the maximum dollar amount of $50,000. Phase I and Phase I Option costs must be shown separately but may be presented side-by-side on a single Cost Proposal. The Cost Proposal DOES NOT count toward the 20-page Phase I proposal limitation.

Phase I Key Dates

08.1 Solicitation Pre-release	November 13 – December 9, 2007
08.1 Solicitation Opens	December 10, 2007 – January 9, 2008
Phase I Evaluations	January – February 2008
Phase I Selections	March 2008
Phase I Awards	May 2008*

**Subject to the Congressional Budget process*

PHASE II PROPOSAL SUBMISSION

***Note*! Phase II Proposal Submission is by Army Invitation only.** Small businesses are invited in writing by the Army to submit a Phase II proposal from Phase I projects based upon Phase I progress to date and the continued relevance of the project to future Army requirements. The Army exercises discretion on whether a Phase I award recipient is invited to propose for Phase II. Invitations are generally issued no earlier than five months after the Phase I contract award, with the Phase II proposals generally due one month later. In accordance with SBA policy, the Army reserves the right to negotiate mutually acceptable Phase II proposal submission dates with individual Phase I awardees, accomplish proposal reviews expeditiously, and proceed with Phase II awards.

Invited small businesses are required to develop and submit a technology transition and commercialization plan describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal. Army Phase II cost proposals must contain a budget for the entire 24 month Phase II period not to exceed the maximum dollar amount of $730,000. During contract negotiation, the contracting officer may require a cost proposal for a base year and an option year. These costs must be submitted using the Cost Proposal format (accessible electronically on the DoD submission site), and may be presented side-by-side on a single Cost Proposal Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the base year prior to extending funding for the option year.

Fast Track (see section 4.5 at the front of the Program Solicitation). Small businesses that participate in the Fast Track program do not require an invitation. Small businesses must submit (1) the Fast Track application within 150 days after the effective date of the SBIR phase I contract and (2) the Phase II proposal within 180 days after the effective date of its Phase I contract.

CONTRACTOR MANPOWER REPORTING APPLICATION (CMRA)

Accounting for Contract Services, otherwise known as Contractor Manpower Reporting Application (CMRA), is a Department of Defense Business Initiative Council (BIC) sponsored program to obtain better visibility of the contractor service workforce. This reporting requirement applies to all Army SBIR contracts.

Beginning in the DoD 2006.2 SBIR solicitation, offerors are instructed to include an estimate for the cost of complying with CMRA as part of the cost proposal for Phase I ($70,000 max), Phase I Option ($50,000 max), and Phase II ($730,000 max), under “CMRA Compliance” in Other Direct Costs. This is an estimated total cost (if any) that would be incurred to comply with the CMRA requirement. Only proposals that receive an award will be required to deliver CMRA reporting, i.e. if the proposal is selected and an award is made, the contract will include a deliverable for CMRA.

To date, there has been a wide range of estimated costs for CMRA. While most final negotiated costs have been minimal, there appears to be some higher cost estimates that can often be attributed to misunderstanding the requirement. The SBIR program desires for the Government to pay a fair and reasonable price. This technical analysis is intended to help determine this fair and reasonable price for CMRA as it applies to SBIR contracts.

- The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains the secure CMRA System. The CMRA website is located here: https://cmra.army.mil/.

- The CMRA requirement consists of the following items, which are located within the contract document, the contractor's existing cost accounting system (i.e. estimated direct labor hours, estimated direct labor dollars), or obtained from the contracting officer representative:

  (1) Contract number, including task and delivery order number;
  (2) Contractor name, address, phone number, e-mail address, identity of contractor employee entering data;
  (3) Estimated direct labor hours (including sub-contractors);
  (4) Estimated direct labor dollars paid this reporting period (including sub-contractors);
  (5) Predominant Federal Service Code (FSC) reflecting services provided by contractor (and separate predominant FSC for each sub-contractor if different);
  (6) Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (The Army Requiring Activity is responsible for providing the contractor with its UIC for the purposes of reporting this information);
  (7) Locations where contractor and sub-contractors perform the work (specified by zip code in the United States and nearest city, country, when in an overseas location, using standardized nomenclature provided on website);
- The reporting period will be the period of performance not to exceed 12 months ending September 30 of each government fiscal year and must be reported by 31 October of each calendar year.

- According to the required CMRA contract language, the contractor may use a direct XML data transfer to the Contractor Manpower Reporting System database server or fill in the fields on the Government website. The CMRA website also has a no-cost CMRA XML Converter Tool.

Given the small size of our SBIR contracts and companies, it is our opinion that the modification of contractor payroll systems for automatic XML data transfer is not in the best interest of the Government. CMRA is an annual reporting requirement that can be achieved through multiple means to include manual entry, MS Excel spreadsheet development, or use of the free Government XML converter tool. The annual reporting should take less than a few hours annually by an administrative level employee. Depending on labor rates, we would expect the total annual cost for SBIR companies to not exceed $500 annually, or to be included in overhead rates.

COMMERCIALIZATION PILOT PROGRAM (CPP)

In FY07, the Army initiated a CPP with a focused set of SBIR projects. The objective of the effort was to increase Army SBIR technology transition and commercialization success and accelerate the fielding of capabilities to Soldiers. The ultimate measure of success for the CPP is the Return on Investment (ROI), i.e. the further investment and sales of SBIR Technology as compared to the Army investment in the SBIR Technology. The CPP will: 1) assess and identify SBIR projects and companies with high transition potential that meet high priority requirements; 2) provide market research and business plan development; 3) match SBIR companies to customers and facilitate collaboration; 4) prepare detailed technology transition plans and agreements; 5) make recommendations and facilitate additional funding for select SBIR projects that meet the criteria identified above; and 6) track metrics and measure results for the SBIR projects within the CPP.

Based on its assessment of the SBIR project's potential for transition as described above, the Army will utilize a CPP investment fund of SBIR dollars targeted to enhance ongoing Phase II activities with expanded research, development, test and evaluation to accelerate transition and commercialization. The CPP investment fund must be expended according to all applicable SBIR policy on existing Phase II contracts. The size and timing of these enhancements will be dictated by the specific research requirements, availability of matching funds, proposed transition strategies, and individual contracting arrangements.

NON-PROPRIETARY SUMMARY REPORTS

All award winners must submit a Non-Proprietary Summary Report at the end of their Phase I project. The summary report is an unclassified, non-sensitive, and non-proprietary summation of Phase I results that is intended for public viewing on the Army SBIR / STTR Small Business Area. This summary report is in addition to the required Final Technical Report. The Non-Proprietary Summary Report should not exceed 700 words, and must include the technology description and anticipated applications / benefits for government and or private sector use. It should require minimal work from the contractor because most of this information is required in the final technical report. The summary report shall be submitted in accordance with the format and instructions posted within the Army SBIR Small Business Portal at http://www.armysbir.com/smallbusinessportal/Firm/Login.aspx. **This requirement for a final summary report will also apply to any subsequent Phase II contract.**

ARMY SUBMISSION OF FINAL TECHNICAL REPORTS

All final technical reports will be submitted to the awarding Army organization in accordance with Contract Data Requirements List (CDRL). Companies should not submit final reports directly to the Defense Technical Information Center (DTIC).

ARMY SBIR
PROGRAM COORDINATORS (PC) and Army SBIR 08.1 Topic Index

Participating Organizations	PC	Phone
Army Research Institute (ARI)	**Sharon Ardison**	**(703) 602-7995**
	Peter Legree	**(703) 602-7936**
A08-001		
A08-002		
A08-003		
Army Test & Evaluation Command (ATEC)	**Joanne Fendell**	**(410) 278-1471**
	Curtis Cohen	**(410) 278-1376**
A08-004		
A08-005		
A08-006		
Communication-Electronics RD&E Center (CERDEC)	**Suzanne Weeks**	**(732) 427-3275**
A08-007		
A08-008		
Edgewood Chemical Biological Center (ECBC)	**Ron Hinkle**	**(410) 436-2031**
A08-009		
PEO Enterprise Information Systems	**Ed Velez**	**(703) 806-0670**
	Rajat Ray	**(703) 806-4116**
A08-010		
PEO Intelligence, Electronic Warfare & Sensors	**John SantaPietro**	**(732) 578-6437**
	Rich Czernik	**(732) 578-6335**
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	Bharat Patel	**(732) 578-6458**
A08-011		
PEO Simulation, Training, & Instrumentation	**Robert Forbis**	**(407) 384-3884**
	Paul Smith	**(407) 384-3826**
A08-012		
Simulation and Training Technology Center (STTC)	**Thao Pham**	**(407) 384-5460**
A08-013		
A08-014		
A08-015		

DEPARTMENT OF THE ARMY
PROPOSAL CHECKLIST

This is a Checklist of Army Requirements for your proposal. Please review the checklist carefully to ensure that your proposal meets the Army SBIR requirements. You must also meet the general DoD requirements specified in the solicitation. **Failure to meet these requirements will result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

____ 1. The proposal addresses a Phase I effort (up to **$70,000** with up to a six-month duration) AND (if applicable) an optional effort (up to **$50,000** for an up to four-month period to provide interim Phase II funding).

____ 2. The proposal is limited to only **ONE** Army Solicitation topic.

____ 3. The technical content of the proposal, including the Option, includes the items identified in Section 3.5 of the Solicitation.

____ 4. The proposal, including the Phase I Option (if applicable), is 20 pages or less in length (excluding the Cost Proposal and Company Commercialization Report). Pages in excess of the 20-page limitation will not be considered in the evaluation of the proposal (including attachments, appendices, or references, but excluding the Cost Proposal and Company Commercialization Report).

____ 5. The Cost Proposal has been completed and submitted for both **the Phase I and Phase I Option** (if applicable) and the costs are shown separately. The Army prefers that small businesses complete the Cost Proposal form on the DoD Submission site, versus submitting within the body of the uploaded proposal. The total cost should match the amount on the cover pages.

____ 6. Requirement for Army Accounting for Contract Services, otherwise known as CMRA reporting is included in the Cost Proposal.

____ 7. If applicable, the Bio Hazard Material level has been identified in the technical proposal.

____ 8. If applicable, plan for research involving animal or human subjects, or requiring access to government resources of any kind.

____ 9. The Phase I Proposal describes the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

____ 10. If applicable, Foreign Nationals are identified in the proposal. An employee must have an H-1B Visa to work on a DoD contract.

Army SBIR 08.1 Topic Index

A08-001 Locus of Control as a Mediator of Risk Perception and Decision Making Among Army Aviators
A08-002 Leader Training for Building and Maintaining an Ethical Unit Climate
A08-003 Web-Based Diagnostic Tool for Optimizing Learning
A08-004 Sensor Artifact and Noise Reduction Algorithms for Cognitive and Physiological Status Monitoring
A08-005 Accurate Representation of Complex Terrain Effects in Network Simulations
A08-006 Crosswind Sensor Upgrade Initiative
A08-007 High-Power Integrated Radio Frequency (RF) Switches for Joint Tactical Radio Systems (JTRS)
A08-008 Megapixel Low Light Level Complementary Metal-Oxide Semiconductor (CMOS) Imager for Persistent Surveillance
A08-009 Non-contact Acoustic Ultrasonic Inspection System for Sealed Containers
A08-010 Cryogenically Ultra-Low Noise Amplifiers for Satellite Communication
A08-011 Innovative Low-Profile, Wideband Antennas for Radio Receivers on Mobile Air and Ground Platforms
A08-012 Embedded Training Enhancement Support Devices for Ground Soldier Systems
A08-013 High-Fidelity Runtime Database Engine
A08-014 Simulate the Physical Response of Building Rubble at Multiple Levels of Detail

Army SBIR 08.1 Topic Descriptions

A08-001 TITLE: Locus of Control as a Mediator of Risk Perception and Decision Making Among Army Aviators

TECHNOLOGY AREAS: Air Platform, Human Systems

OBJECTIVE: Develop and validate an on line tool for assessing sense of personal control, risk orientation, and the decisional processes of Army Aviators in potentially hazardous situations. The tool should incorporate a coherent rationale (e.g., attribution theory), derived from applications of social psychological theory, and have demonstrated utility in the collection, management, and analysis of risk-related data.

DESCRIPTION: Locus of Control (LOC) has been shown to predict a broad range of attitudes and behaviors, including personal sense of efficacy and the perception and management of risk. One is said to have internal locus of control when the person attributes outcomes to his or her own efforts; by contrast, an external locus of control is a belief that there is little use in trying, because "what will happen, will happen." Few researchers have examined the relationship between LOC, hazardous attitudes, pilot errors, and other variables germane to aviation safety. Most of this work, with one exception (Joseph & Ganesh, 2006) has employed small samples consisting of general aviation (non military) pilots. Comparisons across demographics (e.g., age, flight hours, type rating) have been cross-sectional, making the interpretation of trends in LOC and risk-related behaviors difficult. Also, researchers have pointed out psychometric problems with the Hazardous Attitudes (HAS) scales (Hunter, 2005). Analyses of aviation accidents have shown that problems with overconfidence, along with poor decision making and risk management, have been frequently cited as causal and contributing factors. Finally, research so far has not adequately explored a theoretical foundation to tie LOC and the related constructs concerning risk taking and decision making together, though disciplines such as social psychology are replete with theories having relevance to aviation safety (Stewart,2006). Most LOC research on aviation safety has sought to correlate LOC scales with scales purporting to measure hazardous attitudes. Only two have specifically addressed attribution theory (Wichman & Ball, 1983; Wilson & Fallshore, 2001). Future research should first investigate the cognitive components underlying sense of personal control and potentially hazardous behaviors among Army aviators. Researchers are encouraged to develop and validate new scales where deemed necessary. Examples of hypotheses, but not an exhaustive list, could include: effects of combat experience upon the sense of personal control and attitudes toward risk taking, effects of flight experience and age on LOC and hazardous attitudes, as well as the stability and change of cognitive attributional biases over time (e.g., optimistic and self-serving biases). This should be an innovative research effort relating LOC and attributional biases to attitudinal and behavioral variables, using a representative sample of Army aviators. The research should make use of appropriate statistical techniques, and should address a suitable theoretical model for integrating and understanding these constructs.

PHASE I: Develop and validate a prototype set of measures, addressing LOC and risk orientation. These measures will be validated against established measures of LOC and HAS. Develop a self-report criterion, similar to the Hunter (2005) Hazardous Events Scale (HES) which is relevant to military aviation. Other measures, relating to attributional biases, can also be used (Wichman & Ball, 1983). The validation sample will consist of Army Aviators of various ages and levels of experience, rated in various aircraft types, who will participate in an on line survey. The results of the survey will be analyzed and compared with the results of similar studies which employed samples of civil aviators. ARI has in place a Human Use Committee which reviews and approves research in accordance with Common Rule/DOD regulations as well as American Psychological Association ethical standards. All Army surveys must be approved by the ARI Survey Office. The Phase I deliverable will be a detailed, comprehensive contractor report of the validation research effort.

PHASE II: Building upon results of Phase I, develop, demonstrate, and validate an on line survey and data management tool for assessment and tracking of LOC and risk orientation. The contractor will demonstrate utility of the tool by collecting data on line from a second sample of Army Aviators. The tool should allow for the repeated assessment of respondents (e.g., quarterly), export of data to standard files (SPSS, excel), and have simple graphics and data tabulation capabilities. It should be compatible with Statistical Package for the Social Sciences (SPSS) for more extensive analyses. Utility of the tool in relationship to current accident and incident reporting systems (e.g., the Army Combat Readiness Center's Risk Management Information System) will be addressed. Phase II deliverables will be the on line tool,which the Army can use to track risk orientation of Aviators over the career cycle, a contractor report of the Phase II demonstration/ validation of the tool, a user manual, and other documentation supporting its use.

PHASE III: Currently, Army aviation safety on line data collection and reporting is limited to accident report databases; reporting is ex post facto. A proactive safety database management and analysis tool that includes reliable and valid measures of how pilots approach and deal with hazardous situations, would provide insight and understanding to the cognitive processes underlying risk taking, especially the taking of unreasonable risks. Quarterly reports on the status of risk perception could parallel the reporting of military aviation accidents and incidents; it is also possible that risk orientation data could be integrated into current DoD accident reporting systems, with the self-reports of pilots being correlated with the Human Factors Analysis and Classification System (HFACS) categories pertaining to attitudinal and personality predispositions to human error. This on line tool should have commercial potential in the area of aviation safety, as well as other areas of safety unrelated to aviation (e.g., automotive and industrial underwriters). The contractor should also be able to license the tool for use by commercial operators. Valid measures of risk orientation could likewise contribute to airline Crew Resource Management (CRM) programs, by asessing the risk orientations of crew members during line oriented flight training (LOFT) sessions. The "mix" of risk orientations on the flight deck may become an important adjunct to CRM training. For training program evaluation, pre and post-training assessments of LOC and risk perception could provide benchmarks. Early identification of potentially "high risk" attitudes among aircrews and poor decisions based upon these, could lead to the development of proactive training programs aimed at preventing accidents from occurring rather than attempting to explain them after they occur.

REFERENCES:
1. Hunter, D.R. (2002). Development of an aviation safety Locus of Control scale. Aviation, Space, & Environmental Medicine, 73, 1184-1188.

2. Hunter, D.R. (2005). Measurement of hazardous attitudes among pilots. International Journal of Aviation Psychology, 15, 23-24.

3. Hunter, D. R. (2006). Risk perception among general aviation pilots. International Journal of Aviation Psychology, 16, 135-144.

4. Joseph, C., & Ganesh, A. (2006). Aviation safety locus of control in Indian aviators. Indian Journal of Aerospace Medicine, 50, 14-21.

5. Stewart, John E. (2006). Locus of Control, attribution theory, and the "five deadly sins" of aviation. (Technical Report No. 1182). Arlington, VA. United States Army Research Institute for the Behavioral and Social Sciences.

6. Wichman, H., & Ball, J. (1983). Locus of control, self-serving biases, and attitudes toward safety in general aviation pilots. Aviation, Space, and Environmental Medicine, 54, 507-510.

7. Wilson, D.R.,& Fallshore, M. (2001). Optimistic and ability biases in pilots' decisions and perceptions of risk regarding VFR (visual flight rules) flight into IMC (instrument meteorological conditions). Proceedings of the 11th International Symposium on Aviation Psychology, Columbus, OH, March 5-8.

KEYWORDS: locus of control; sense of control; risk taking; hazardous attitudes; aviation psychology; self-attribution; attributional biases

A08-002 TITLE: Leader Training for Building and Maintaining an Ethical Unit Climate

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Develop a training program that will train leaders to build and maintain an ethical unit climate during stability, security, transition, and reconstruction (SSTR) and counterinsurgency (COIN) operations. The training program must be grounded in a theoretical framework that identifies the contextual, Soldier, unit, and leader factors that influence ethical climate.

DESCRIPTION: Army Soldiers frequently encounter situations that require speedy and sound ethical judgment, but often operate in complex and ambiguous situations in which they have incomplete information. Moreover, enemies rely on unconventional and unethical strategies for undermining U.S. goals, such as using noncombatants as human shields, randomly bombing civilians and Soldiers, and employing child soldiers. The moral asymmetry of the enemy places a heavy burden on the shoulders of U.S. Soldiers, but does not relieve Soldiers of their ethical obligations. In such an environment, it is imperative that an ethical climate has been established to guide Soldier judgment and action.

Both the Army leadership and counterinsurgency doctrines (Field Manuals 6-22 and 3-24, respectively) note the importance of ethical climate and identify the leader as essential in the creation of an ethical climate. In addition to impacting ethical behavior, ethical climate also is related to a number of organization-relevant outcomes, including reduced role ambiguity, less role conflict, job satisfaction, and organizational commitment (e.g., Babin, Boles, & Robin, 2000). While it is clear that creating an ethical climate is important to the full spectrum of military operations, it is less clear how to train leaders to establish and maintain an ethical climate in their units. Before effective training can be created, a theoretical framework identifying the contextual factors, individual Soldier differences, group processes, and leader knowledge, behaviors, and skills that impact ethical climate must be developed. The extensive psychology and management literature on organizational climate and culture and the growing body of work on ethical climate would likely inform the development of such a framework (e.g., Babin, Boles, Robin, 2000; Cullen, Victor, & Bronson, 1993; Grojean, Resick, Dickson, & Smith, 2004; Trevino, Weaver, & Reynolds, 2006). However, certain elements of the military operating environment, such as dealing with hostile forces and working in an environment of pervasive threat, pose unique challenges not encountered in the business world and also must be accommodated by the theoretical framework. The development of such a theoretical model would advance scientific and military understanding of the factors that contribute to ethical climate, and the application of this knowledge to training would represent pioneering work in individual-level training that impacts complex group-level phenomena.

PHASE I: Develop a theoretical model that identifies the variables (e.g., environmental factors, subordinate/Soldier variables, leader behaviors, and group-level processes) that impact ethical unit climate. Identify the relevant leader knowledge, skills, abilities, and behaviors for training leaders to create and maintain ethical climates and determine an appropriate and innovative training strategy for instructing leaders on how to create ethical climates. The training strategy should be informed by the best practices and empirical findings of the learning, training, and education literatures. Phase I will culminate in a report that adheres to scientific professional standards and documents the literature researched, the construction of the theoretical model of ethical climate, the description of a proposed training approach, and other results of Phase I work. Because of the current rate of deployments and the short timeframe of Phase I, offerors should not expect access to military personnel during Phase I work.

PHASE II: Offerors will develop an innovative leadership training program for building ethical climate based on the results of Phase I. Training should be geared toward company-grade officers and non-commissioned officers (NCOs). Additionally, this topic encourages state-of-the-science approaches to training. If the proposed training is web-based, it must be SCORM (Sharable Content Object Reference Model) and Section 508 compliant in accordance with Department of Defense guidelines. The validity of the training approach and content also should be established using accepted scientific practices. If possible, access to military organizations will be provided for Phase II activities. However, offerors are advised to develop alternate plans that do not rely on military organizations if access is not possible. Utilization of existing relationships with the military or similar organizations, with the expressed consent of the organization(s), is encouraged.

PHASE III: Within the military, the training community is likely to be interested in training content that targets the development of ethical climates. Ethical climate training proposed for this topic would likely be suited for the Basic Officer Leader Course, the Advanced Officer Course, the Captains Career Course, and various noncommissioned officer (NCO) courses. Given commonalities between the military and first responder organizations (e.g., police, firefighters), leader training for ethical climate would likely hold appeal for first-responder organizations, as well. The offeror also could capitalize on the private sector’s renewed interest in ethical climate. Large corporations with stockholders might be particularly interested in implementing ethical climate training, since ethical violations of executives have been associated with plummeting stock values, organizational crisis, and business failure.

REFERENCES:
1. Advanced Distributed Learning: SCORM. http://www.adlnet.gov/ and http://www.adlnet.gov/scorm/index.aspx. Accessed 6 June 2007.

2. Babin, B. J., Boles, J. S., & Robin, D. P. (2000). Representing the perceived ethical work climate among marketing employees. Journal of the Academy of Marketing Science, 28, 345-358.

3. Centre des Hautes Etudes Militaires. (2007, May-June). Ethics and operations: Training the combatant. Military Review, 109-112.

4. Cullen, J. B., Victor, B., & Bronson, J. W. (1993). The ethical climate questionnaire: An assessment of its development and validity. Psychological Reports, 73, 667-674.

5. Grojean, M. W., Resick, C. J., Dickson, M. W., & Smith, D. B. (2004). Leaders, values, and organizational climate: Examining leadership strategies for establishing an organizational climate regarding ethics. Journal of Business Ethics, 55, 223-241.

6. James, L. R., & Jones, A. P. (1974). Organizational climate: A review of theory and research. Psychological Bulletin, 81, 1096-1112.

7. Petraeus, D. H. (2006, January-February). Learning counterinsurgency: Observations from soldiering in Iraq. Military Review, 2-12.

8. Section 508 website. http://www.section508.gov/. Accessed 6 June 2007.

9. Trevino, L. K., Weaver, G. R., & Reynolds, S. J. (2006). Behavioral ethics in organizations: A review. Journal of Management, 32, 951-990.

10. U.S. Department of the Army. (2006). Army leadership: Competent, confident, and agile (FM 6-22). Washington, DC: Author.

11. U.S. Department of the Army. (2006). Counterinsurgency (FM 3-24). Washington, DC: Author.

KEYWORDS: Ethics, Ethical Climate, Leader Development, Training, Organizational Climate, Organizational Culture

A08-003 TITLE: Web-Based Diagnostic Tool for Optimizing Learning

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Develop a web-based diagnostic tool for understanding and optimizing learning.

DESCRIPTION: Organizations rely on workplace learning and continuous improvement to remain competitive (London & Moore, 1999). The process of transferring learning to practice in the work environment is essential to training effectiveness. Thayer and Teachout (1995) outlined seven variables that influence learning and directly affect transfer to the workplace: (1) reactions to previous training (Baldwin & Ford, 1988; Mathieu et al., 1992); (2) previous education (Mathieu et al., 1992); (3) self-efficacy (Ford et al., 1992); (4) ability (Ghiselli, 1966); (5) locus of control (Williams et al., 1991); (6) job involvement (Noe & Schmitt, 1986); and (7) career/job attitudes (Williams et al., 1991). In addition, how the training is framed (e.g., remedial vs. advanced; Quinones, 1995) and whether training is mandatory or voluntary will influence learning and transfer (Baldwin & Magjuka, 1997). All of these contribute to a pre-training environment that can promote or inhibit training effectiveness. It is important that designers of learning opportunities understand the contributing factors of training transfer in order to design and maintain training systems effectively.

Despite all that is known about the science of learning, training and other learning opportunities are not always successful. Diagnosis of where failures occur in the process provides a means for correcting or mitigating future failures. As technological advancements have made it possible for students to learn on their own (e.g. web-based learning) they have also made it possible for trainers to share and access resources on the web to assist in the learning process. But there is no comprehensive web-based system that provides trainers with resources for systematically understanding, diagnosing, and improving learning.

PHASE I: PHASE I will develop a conceptual model describing a web-based diagnostic tool for understanding the science of learning, uncovering weaknesses in learning and ultimately optimizing learning in individuals and teams. A literature review will identify relevant theoretical frames that may be adapted to a web-based system and identify existing tools that apply to learning failure diagnosis. Functional analysis will determine the options for the design and complexity of the user interface (e.g. menu driven, rule based or intelligent agent) and a tradeoff analysis will establish cost/benefit decision points. A matrix based decision aid will guide the prospective user through a classification process for the instructional program. This will identify the learning environment according to relevant factors (e.g. mandatory, remedial, team, prior knowledge) and pre-select design alternatives optimized for the situation. A performance diagnostic tool will track student performance and identify domains and training program points where failures occur and link these to suggested remedial actions. Deliverables will be: a) A set of candidate thoeretical frames applicable to a web-based tool, b) a list of existing tools for learning diagnosis, c) a list of parameters and alternative approaches to the user interfaces, d) a classification matrix for selecting the type of learning environment that is of interest to the user and e) the outline of components of a performance tracking tool.

PHASE II: PHASE II will develop and operate a prototype of the web-based system as described in Phase I. The prototype will be used in pilot testing to determine its potential for success as a diagnostic resource and revised as required. The resulting product will be used in a second iteration of pilot testing in which users will respond to probes eliciting content relevance, utility and reaction to the user interface.

PHASE III: PHASE III will produce and market the final web-based diagnostic tool design resulting from the Phase II effort. This tool will be applied to military team training settings in which individual performance is separable from team performance (e.g. aircrew procedural training) to provide the training manager the means to adjust the training presentation when failures occur. There is potential for later extension of the diagnostic tool to collective training settings in which individual performance is not separable from team performance. Commercially, this technology will be applicable to corporate training programs, especially where the training content is comparatively technical and where individual performance is separable from team performance. A similar extension to collective training may be possible in commercial applications. Universities, which increasingly involve themselves in online educational delivery, may use this technology to monitor and adjust training delivery to reduce the frequency of costly failures. The developer of this tool should be able to license the technology to a wide range of users.

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KEYWORDS: science of learning; performance diagnosis; web-based support

A08-004 TITLE: Sensor Artifact and Noise Reduction Algorithms for Cognitive and Physiological Status Monitoring

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: The development of a real-time suite of computational algorithms which increase the reliability of bio-sensor data for cognitive and physiological status monitoring (CPSM). These algorithms will be used in conjunction with physiological/cognitive sensors during developmental and operational test and evaluation (T&E). The sensor artifact and noise reduction algorithms will allow test controllers to reliably monitor physiological and cognitive status of the individual Soldier by reducing the contaminating effects of electromagnetic noise and motion artifacts under rigorous testing conditions.

DESCRIPTION: Projected requirements of US Army developmental and/or operational testing include routine ambulatory physiological/cognitive monitoring for the individual Soldier under active conditions, including dismounted Soldiers, vehicle- or aircraft-based C2 platforms, and stationary C2 platforms. Real-time physiological/cognitive state assessment requires a diverse array of sensor data, including electrocardiograms (ECG), electroencephalograms (EEG), electrooculograms (EOG), electromyograms (EMG), core body temperature, respiration, hydration, and blood oxygenation (SpO2). Under the anticipated test conditions the bio-monitoring sensors will be subject to random extreme levels of electromagnetic (EM) noise and motion artifacts which severely degrade signals and limit sensor accuracy. The ambient EM environment may include noise from systems under test (e.g., Soldier-borne radios) or test instrumentation (e.g., Soldier worn tracking devices).

In addition, much of the noise encountered during CPSM are unwanted signals from other sources in the body. There are significant differences between noise in biological preparations vs. electronic systems. Currently, there is no integrated and reliable solution to EMG contamination of EEG, coughing, swallowing, speaking, electrode motion relative to the body, vibration, impact, etc. All of these impact EEG, EMG, EOG and ECG measurements. Standard digital filtering and standard denoising (e.g., wavelet denoising) are not adequate for these conditions. Addressing these difficult noise/artifact issues will require new techniques to significantly reduce artifact and noise in EEG recordings under harsh conditions.

Projects under this topic should aim to provide a theory-based and practical engineering path toward the development of an effective artifact and noise reduction suite. The algorithm suite must be capable of reducing noise and artifacts in physiological/cognitive sensor data with a high degree of reliability. The algorithm suite must also be flexible enough to adapt to changes in the sensor suite, faulty sensors, or sensor drop-out while minimizing downtime and maximizing information flow. Although the algorithm suite will be designed for reliable physiological/cognitive monitoring under test conditions, future applications may include combat operations as a component of warfighting ensembles.

PHASE I: The Phase I project should define the overall structure and fundamental components of the artifact and noise reduction architecture, identify US Army test applications, and use computer simulations to define the artifact and noise reduction performance boundaries under realistic test conditions. This analysis should include a thorough consideration of sensors and noise artifact sources and a roadmap to development of effective cancellation or rejection algorithms for each identified source.

PHASE II: The Phase II project will develop a prototype integrated sensor artifact and noise reduction system suitable for integration with physiological/cognitive monitoring hardware and software. This prototype should achieve an aggressive criterion for sensor noise and artifact processing under realistic test conditions. This will require field trials of the system in conjunction with sensor systems under current development by the US Army. The Phase II trials will place statistical boundaries on the expected level of increased sensor system accuracy and reliability, as well as for tolerance of sensor dropout or failure. The result of the Phase II effort will be a detailed specification and performance assessment of effective algorithms for each sensor and the expected sources of artifact or noise for that sensor.

PHASE III: Beyond military testing, the sensor artifact and noise reduction system may have operational military and civilian applications, such as in monitoring of commercial vehicle, vessel or complex system operators. Medical technology for ambulatory patient monitoring will also require systems that automatically cancel or remove sensor noise artifacts. Physiological/cognitive monitoring enhanced with artifact and noise reduction technology may also be used to monitor and ensure the safety of emergency personnel or first responders working under hazardous conditions. Applications to the adventure sports industry, and the fitness equipment industry, are also feasible.

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KEYWORDS: Bio-sensors, noise cancellation, artifact rejection, ambulatory monitoring, wearable sensors, physiological status monitoring.

A08-005 TITLE: Accurate Representation of Complex Terrain Effects in Network Simulations

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PEO Missiles and Space

OBJECTIVE: This SBIR will develop a software tool for heterogeneous radios that will analyze cross-layer optimization based on environmental obstacles. The tool will provide the ability to operate as large wireless & sensor networks in mixed indoor-outdoor environments spread across urban, suburban, mountainous, rural terrains as well as tunnels, underground and underwater.

DESCRIPTION: The US Government is currently developing a scalable radio network emulation capability. The Government is also developing an urban modeling capability. What is lacking is the ability to analyze networked radios when an urban environment is injected into the radio network model. Such a tool can provide the ability to dynamically adapt to feedback on changes in channel quality triggered by the physical environment.

This SBIR will provide critical analysis into potential effectiveness of such adaptive radio technologies like Software Defined Radios (SDRs) and Cognitive Radios specifically to environmental challenges.

Large scale sensor networks and Mobile Ad-hoc NETworks (MANETs) are finding extensive applications in combat situations where rapid deployment and reliable connectivity is of utmost importance. Urban terrain presents a most challenging environment for these networks due to severe obstructions by buildings and rapid temporal and spatial signal fluctuations observed indoors as well as outdoors. Due to lack of infrastructure, mobility and node failures such networks could become severely fragmented. The performance of network fragments themselves may be unacceptable due to rapid signal fluctuations.

When soldiers use these networked radios, these problems are exacerbated during ad hoc network deployments in large areas characterized by heterogeneous features including urban, mountainous, sub-urban, rural terrains and indoor and outdoor connectivity. Performance evaluation of such networks via simulation is a promising approach due to prohibitive costs incurred in development of actual testbeds.

Software defined radios are a promising candidate for cross-layer implementations due to programming capability available at all the layers. The software-radio implementation will be able to evaluate the impact of terrain variability on all layers between the physical layer and the application layer as well as node failures and mobility at the device level. The development of a design tool is necessary to assess the robustness of layer-wise implementations against deleterious impact of heterogeneous terrain. Of interest is implementation of cross-layered techniques aimed at optimizing network performance to maintain user-defined quality-of-service constraints/goals. The cross-layered techniques may be based upon minimizing the difference between desired and observed performance through proactive/reactive network adaptation to time-variant conditions, while maintaining optimality of network-response with mobility and terrain variability. It is desirable that the software defined radios also work as simulation tools capable of performing network analysis, scaling to 3000 or more heterogeneous wireless radios that include existing and future communication technology. The tool should accept information to include but not limited to the following: terrain descriptions, network performance goals and constraints, protocols, numbers of nodes, locations of nodes, and RF environment and transmission parameters. The resulting output should provide measured performance in terms of deviation from the desired goals, the type and amount of device level interactions/failures and impact of heterogeneous terrain & environmental features on performance observed at the network, protocol, and application layers.

PHASE I: The goal of Phase I is to perform a feasibility study that models a group of networked radios in a simulated urban environment. Such a tool can provide the ability to dynamically adapt to feedback on changes in channel quality triggered by the physical environment.

PHASE II: The goal of Phase II is to build an advanced prototype that can demonstrate the impact of multiple cross-layer interactions on end-to-end quality of service metrics.

PHASE III: This new communication emulation technology has tremendous potential as a tool that any war fighter can use to war game tomorrow's mission. So the government commercial basis expands to all the services.

If this topic successfully completes Phase I and is funded for Phase II, ATEC has tagged this topic as an instrumentation development requirement in our POM. As such, if the technology matures into a successful prototype, ATEC will be positioned to secure additional units.

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KEYWORDS: wireless, network, radios, mobile, sensors, urban

A08-006 TITLE: <u>Crosswind Sensor Upgrade Initiative</u>

TECHNOLOGY AREAS: Sensors, Electronics

OBJECTIVE: To develop hardware to collect and analyze wind conditions in a turbulent environment from a single location.

DESCRIPTION: The Army currently uses anemometers, mounted on artillery vehicles, to measure crosswinds. From correction tables, the soldier can compensate for the crosswinds by making corrections to the trajectory. While these anemometers are good at measuring steady-state airflow, they are insufficient at measuring turbulent crosswinds.

Many of our ranges at Aberdeen Proving Ground are surrounded by trees. Trees impact the wind field much like rocks affect a flowing river. Smooth-flowing water moving past an obstacle such as a rock becomes turbulent as it moves around the rock. The same is true of the wind as it moves around trees on the testing ranges. Since cutting down all the trees is not an option, the challenge we have is how to quantify winds in such environments.

An accurate measurement of wind speed and direction is necessary to understand/correct for the impact wind has on a projectile. Particularly, turbulent crosswinds are of interest to ballisticians. We know one thing to be true - turbulent cross winds will alter the flight of the projectile as it passes there through. We don't know how turbulent cross winds alter the trajectory.

The military specifications (Picatinny Arsenal) for several rounds indicate that wind measurements have to be made at/near the gun, and then downrange at 200, 400, 700, 1000, 1400, 2000, and 2500 meters. Each of the wind measurements has an associated "wind cell" that represents a portion of the total flight distance of the round. The wind cell boundaries are the mid points between the sensors, except for the muzzle and target which are also cell boundaries. Ballistic corrections on the round are calculated by producing a correction factor for each wind cell which then is summed for the entire trajectory.

Currently our test ranges use wind anemometers to measure crosswinds. These sensors are set up on tripods and measure the wind at locations along a firing range. The sensors are often called "point sensors" because they are located at the MIL specific points along the firing range. Point sensors cannot give detailed wind information (over a range) in a turbulent wind field since the wind information is just a given speed and direction at a given point in time and space.

A scintillometer is another tool that measures crosswind along a range (up to 3000 meters) but relies on scintillation to deduce crosswind. In order to get strong values of scintillation, the instrument works most effectively (if at all) during sunny days. The instrument is also man-power intensive, requiring two people to set up and align it each day it is being used. Set up also requires line of sight between the transceiver and receiver, which may be difficult to obtain over long distances depending on elevation and tree-encroachment on the range.

The technology design must be capable of measuring and quantifying wind speed and direction in 200 meter increments in a rectangular air space measuring 3000 meters long and 200 meters wide. The unit must be a ruggedized, all-weather, portable device that requires limited manpower to operate.

The device will be validated at Aberdeen Test Centers Complex Range Firing Facility under various weather scenarios (e.g. sunny day and cloudy day) as well as under different wind regimes (high crosswind days, light and variable wind days, etc.). No modeling and simulation will be required to validate the device. Rather, validating will be performed by taking measurements over a period of time and firing the weapon. The target impact points will be calculated using data from this new technology as well as point sensors and scintillometers. The research will compare the calculated impact points with the actual impact points at the Complex Firing Range facility. The difference between the two will help build the turbulent ballistic correction data.

When this device is mounted to a weapon, the data produced will be compared to these known correction numbers. Any field soldier having a correction table and a mounted portable device will be able to compensate for turbulent wind conditions.
A technology that can accurately measure wind on complex terrains would 1) improve measurement of direct and indirect-fire performance, 2) used by the warfighter to reduce target misses, and 3) could be used commercially by airports to support aircraft landings.

PHASE I: To deliver a feasible study that outlines the plan to collect turbulent wind data flow in complex terrains, which ultimately could provide firing correction data. The study should address the hardware, such as the casing, sensors, electronics, power requirements, environmental considerations (mil std 810), and storage capability. Also, the study should address the methodology and skill set needed to implement the prototype as well as outline the transition from a Phase I concept to a Phase II prototype. And finally, the study should address the transition of this technology into commercial viability.

PHASE II: The goal of Phase II is to deliver a working prototype of the technology outlined in the Phase I study - a device that collects and analyzes turbulent wind flow. The technology design must be capable of measuring and quantifying wind speed and direction in 200 meter increments in a rectangular air space measuring 3000 meters long and 200 meters wide. The unit must be a ruggedized, all-weather, portable device that requires limited manpower to operate.

PHASE III: The ability to measure and characterize turbulent winds within a known area has commecial applicability within the government and also in private industry. The Army, Navy and Marines have weapon systems that could benefit from knowing the turbulent cross winds within a certain distance of their firing system.

In addition to government sales, this system could be used commercially by airports and heliopads to support aircraft landings.

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KEYWORDS: wind, direct fire, sensor, line of sight, turbulent

A08-007 TITLE: High-Power Integrated Radio Frequency (RF) Switches for Joint Tactical Radio Systems (JTRS)

TECHNOLOGY AREAS: Sensors, Electronics, Weapons

OBJECTIVE: Develop highly reliable, low-loss, low power consumption RF switches and switch matrices for JTRS systems.

DESCRIPTION: Emerging Joint Tactical Radio Systems (JTRS) include software controlled programmable reconfigurable radio-frequency (RF) hardware. High power RF-components constitute an essential part of this hardware and require compact highly reliable high-performance electronic building blocks. Due to their reconfigurable nature, the JTRS require a large number of RF switches configured as single pole – multiple throw (SPMT) or multiple poles – multiple throw (MPMT) units. In such multi-component switching blocks the use of traditional pin-diodes possess significant limitations on the overall system performance due to high bias current consumption in the forward biased state, relatively slow modulation speeds, vertical layout complicating the integration and low temperature stability.

RF switching using field-effect transistors features very low bias current consumption, fast switching speeds and planar structure allowing for easy integration. However RF switches based on GaAs technology suffer from low breakdown voltages and low maximum blocking RF powers. Emerging Group III Nitride based RF switches using Heterojunction Field Effect Transistors (HFET) and specifically insulated gate HFETs due to their much high power handling capability, temperature stability and potentially high reliability are ideal candidates for JTRS RF switches and monolithically integrated switch arrays.

PHASE I: Develop device models, switch simulations, and limited test sufficient to demonstrate insulated gate Group III-Nitride based high-power low-loss single pole - double throw (SPDT) RF switches applicable for JTRS with insertion loss less than 0.25 dB and capable of maximum RF powers up to 46 dBm.

PHASE II: Design and fabricate a minimum of ten (10) Single Pole – Double throw (SPDT) Group III- Nitride RF switches with insertion loss less then 0.2dB, across two decades of bandwidth (2 MHZ – 2000 MHZ), and demonstrate reliable operation at RF powers up to 46dBm. Characterize insertion loss, isolation, switch speed, maximum cold and hot switched RF power operation, and stability.

Develop and fabricate a minimum of ten (10) SP4T Group III-Nitride RF switches with insertion loss less then 0.4 dB, from 2 MHz – 2000 MHz, with reliable operation at RF powers up to 46dBm. Characterize insertion loss, isolation, switch speed, maximum cold and hot switched RF power operation, and stability

Develop, fabricate, and deliver a minimum of ten (10) brass board modules with Phase II switch devices, five (5) each for SPDT and SP4T, including switch driver circuitry, and supply a draft data sheet with characterized performance, specifications, for parts in die and packaged form, including drawings.

PHASE III: The Group III - Nitride RF Switch Integrated Circuits (ICs) has the potential for use across all JTRS Clusters and all branches of the United States Armed Forces, including satellite communications and future generations of military radios. These components have potential for use in all commercial RF markets where signal routing or multiplexing is required, including the wireless and cellular markets, automotive, and supporting applications such as automated test instrumentation.

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KEYWORDS: JTRS, RF switch, HFET, insulated gate, insertion loss, isolation

A08-008 TITLE: Megapixel Low Light Level Complementary Metal-Oxide Semiconductor (CMOS) Imager for Persistent Surveillance

TECHNOLOGY AREAS: Air Platform, Sensors, Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a large format Complementary Metal-Oxide Semiconductor (CMOS) sensor for low light visible–near infrared (NIR) imaging of large areas using a single focal plane/camera. A focal plane of this type can be used in persistent surveillance missions to provide continuous observation of wide areas.

DESCRIPTION: Persistent surveillance missions require the continuous observation of roadways, road junctions, and other areas of interest from platforms operating at low, medium, and high altitude. Because the area to be observed is not precisely known, the area of coverage for the sensor system is much greater than currently available target acquisition systems. Recent experiments have been conducted using up to 16 individual cameras with the video from each reconstructed to form a complete view of the area of interest. A single, monolithic CMOS sensor would provide significant advantages in terms of reduced complexity, size, weight, and power. Commercial applications include ground based border and seaport security for Homeland defense, perimeter security for nuclear power plants, and urban security camera system for cities and high value targets.

Recent advances in silicon based CMOS technology have shown the potential for operation during extremely low light conditions with both high frame rate and spectral response into the NIR. However, current commercial CMOS devices are too small. A research and development (R&D) effort is needed to develop a large area low light sensor and to scale current fabrication processes to produce a full wafer-size detector with acceptable cosmetic quality. Therefore, the Army is seeking an innovative monolithic CMOS design approach to solve this problem. The technical objectives for this project include: a) a large area, monolithic CMOS focal plane of at least 10K x 10K pixels with potential to expand to 20K x 20K pixels; b) pixel size of 5-10 microns; c) frame rate of 2 – 20 Hertz with sub-array readout capability of not less than 30 Hertz; d) low noise architecture for dawn to dusk operation; e) provision for color and black & white imagery; and f) capable of being manufactured using 200 mm wafer processes.

PHASE I: Perform an initial feasibility study and preliminary design of the CMOS focal plane array. This includes design trade studies and performance analysis, determination of overall device architecture, and pixel level design.

PHASE II: Design, fabricate, and demonstrate a prototype very large area CMOS sensor. A final design will be produced following review of the Phase I work. The detector will be fabricated and demonstrated to show it can meet performance goals for the persistent surveillance mission. The goal is to produce a working prototype of not less than 100 million pixels.

PHASE III: Optimize sensor characteristics including frame rate, read noise, quantum efficiency, and NIR operation to meet persistent surveillance requirements. Transition this R&D effort into a commercially viable product.

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KEYWORDS: persistant surveillance, CMOS sensor, Low light level sensor

A08-009 TITLE: Non-contact Acoustic Ultrasonic Inspection System for Sealed Containers

TECHNOLOGY AREAS: Materials/Processes, Electronics

ACQUISITION PROGRAM: PEO Ammunition

OBJECTIVE: To develop and field a noncontacting, long-standoff inspection system with the capability to identify the interior fills of a sealed container. The system should detect subtle changes in container vibration characteristics caused by differences in the physical properties of the fill material. A container would be inspected by acoustically inducing it to vibrate and sensing the vibrational response with a laser vibrometer. In principle a standoff distance of several meters is feasible. Previous work by the DOE proved this technology to be a reliable means of distinguishing between munition types with a variety of chemical and explosive fills. The intent is to extend this capability to allow explosive ordnance disposal (EOD) teams or security personnel at traffic control points to identify the contents of sealed cylinders as dangerous or hazardous without having to open the vessel or use a radioactive source like the Polarized Inelastic Neutron Scattering (PINS) device.

DESCRIPTION: The goal of this project is to develop a practical and reliable noncontacting inspection system for containers. This technology is required to meet the present threat as well as to address emerging threats. EOD teams would use this technology in theater and within CONUS to interrogate suspect containers such as gas cylinders, storage drums, and munitions to determine the threat and potential hazard of an improvised explosive device (IED) or materials discovered in caches, searches, and roadside stops. This information will allow the team to formulate a method of attack and mitigation to reduce the hazard and protect coalition and civilian lives.

Previous work performed by the U.S. Department of Energy, Office of Nonproliferation and National Security, between 1991 – 1993 developed methods to aid in identifying the chemical contents of munitions and chemical agent storage containers. A portable inspection system was developed and demonstrated during field trials at the Tooele Army Depot in FY-91 and again in FY-92. In FY-93 the effort concentrated on modeling the chemical fill of 155 mm artillery shells. However, the work was abandoned for military applications after the PINS device was selected. This technology was subsequently licensed by the DOE for commercial use. Laser vibrometry is currently used by various manufacturing industries to test the structural integrity of materials and components. However, significant research and development is needed to extend the principles developed by the DOE to determine the nature of contents in sealed vessels and containers beyond artillery shells. Additionally research is needed to extend the list of hazardous materials beyond traditional chemical warfare agents to include toxic industrial chemicals/materials.

The technology should be easily deployable, portable, and capable of at least several meters of stand-off. The technology should be capable of identifying toxic industrial chemicals, explosive mixtures, and chemical warfare agents as well as their physical form (gas, liquid, or solid). The return echoes from the injected ultrasonic pulses should be capable of extracting the necessary physical properties from the material and identify the specific components in a sealed container. It should also be capable of determining the fill level in storage containers; locating hidden cavities and packages; and identifying the physical state (gas, liquid, or solid) of the hazardous material. The system should be capable of interfacing with a PC computer for data downloads; software or firmware upgrades; and enhanced capabilities. The system should be capable of augmenting existing on-site material interrogation capabilities (X-Ray, neutron scattering, ?-ray spectroscopy).

The specific objectives of the program can be enumerated as follows:

1. Development of a prototype laser vibrometer for the specific purpose of identifying the physical state and potential hazard of the contents in a sealed vessel.
2. Demonstration of non-contact stand-off hazard prediction (> 10 meters) based on laser vibrometry.
3. Development of a database of the acoustic frequencies and resonance modes of materials used in IEDs.
4. Development of statistical classification algorithms to determine the relative hazard of a threat and to its most likely contents based on its acoustic spectrum.

PHASE I: Phase I research will be restricted to showing feasibility of using laser vibrometry to interrogate suspect containers such as gas cylinders, storage drums, and munitions to determine the threat and potential hazard of an improvised explosive device (IED). The effort should include sufficient modeling and experimental data to demonstrate the ability to identify the contents of sealed cylinders as dangerous or hazardous.

PHASE II: Phase II research will result in the delivery of a beta system or at a minimum a brass-board prototype capable of identifying toxic industrial chemicals, explosive mixtures, and chemical warfare agents; determining their physical form (gas, liquid, or solid); at a minimum distance of 10 meters. The system should have sufficient algorithm development to complete the data acquisition, preprocessing of the data, statistical analysis of collected spectra and classification analysis in real time and on board the instrument. Modeling in support of this phase should include:

a. Estimation of the effect of object contents (e.g., empty, gas, liquid, solid) on natural resonance frequencies.
b. Prediction of optimal experimental measurement locations on the object surface.
c. Estimation of the effect of geometrical variances on an IED's vibrational response.

PHASE III: Commercial applications of this technology include non-intrusive interrogation of sealed containers for law enforcement and international treaty verification in order to stop illicit drug smuggling; inspect food containers and hazardous waste containers; collect proper taxes and tariffs on shipments; and effectively maintain inventories.

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KEYWORDS: Acoustic Sensor, Laser, IED

A08-010 TITLE: <u>Cryogenically Ultra-Low Noise Amplifiers for Satellite Communication</u>

TECHNOLOGY AREAS: Electronics, Space Platforms

OBJECTIVE: To develop ultra-low noise microwave amplifiers in the 1-8 GHz band for use in signal processing associated with satellite reception.

DESCRIPTION: A Satellite Communications Earth Terminal receiver's total system noise temperature is a key parameter for achieving an acceptable G/T, figure of merit, for receiving satellite communications. Current satellite receivers use commercial semiconductor low noise amplifiers which operate near room temperature. Cryogenically cooled microwave amplifiers have demonstrated noise temperatures TN,AMP < 5K in this frequency range. The objective of the ultra-low noise amplifiers with wide bandwidths (500 MHz) and gains of 40 to 50 dB is to get an improvement of 3 to 4 dB of G/T.

NOTE: G/T is the industry's traditional definition of "figure of merit" of an earth station's receiving equipment and is stated as the ratio of the receiving antenna's gain G to the receiver's system noise temperature Ts. The unit of the figure of merit is dBi/K.

Proposed method for the microwave X band amplifiers must be a closed-cycle, seamless replacement to existing amplifier, which can interface a SATCOM antenna waveguide at the antenna feed output and a block down-converter operating at X-Band.

PHASE I: Technology feasibility study of proposed solution with consideration that the system must integrated to existing communication hardware and achieve the required objective of 3 to 4 dB improvements in G/T.

PHASE II: Develop a prototype of the proposed amplifier and demonstrate it operational capabilities.

PHASE III DUAL USE APPLICATIONS: Validation testing, full engineering documentation, and suitable Statement of Work for issuance of contract for production.

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Smith, A.; Sandell, R.; Burch, J.; Silver, A.;
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KEYWORDS: Cryogenically SHF Amplifiers, SATCOM

A08-011 TITLE: <u>Innovative Low-Profile, Wideband Antennas for Radio Receivers on Mobile Air and Ground Platforms</u>

TECHNOLOGY AREAS: Information Systems, Sensors

OBJECTIVE: Develop low-profile and conformal wideband antennas for SIGINT, EW and communications systems located on airborne and ground mobile platforms.

DESCRIPTION: Low-profile and conformal antenna designs are needed to replace the quarter wavelength high whip antenna for wide bandwidth mobile receiver systems. High profile designs are neither compatible nor desirable with airborne platforms or low-profile ground mobile platforms. Development is needed to find innovative concepts and optimized antenna designs compatible with Army airborne and ground mobile platforms. A low-profile antenna is a member of the class of antennas known as electrically small as defined by Wheeler (1). This class has some undesirable features such as low efficiency and reduced bandwidth. However, because of the wide range of electrically small and conformal antenna designs and parameter variations within specific antenna design classes, optimization of performance specifications applicable to wideband radio systems is feasible, albeit technically challenging. Best (2) and Yaghjian (3) discuss these technical issues and alternative approaches that can offer substantial differences and improvements in the performance characteristics of such low-profile and conformal antennas. By employing options such as embedded active devices and Meta-material loading, improved antenna performance may be possible. Electromagnetic modeling of the antenna on the airborne and ground platform may be necessary. Using electromagnetic analysis computer codes and messed models of the platforms, simulate performance can be calculated. This will provide design information to account for pattern and impedance distortion cause by the antenna’s interaction with the platform’s conducting and dielectric structures especially at the low end of the full 300MHz-to-3 GHz frequency band. The resulting antenna designs should be electrically small compared to the wavelength, light-weight for the airborne platform case and physically thin to allow conformal mounting. A single radiating element or the packaging of multiple radiators into one unit with multiple inputs to cover the full bandwidth is acceptable. Moderate efficiency consistent with electrical size is a goal. Spiral antennas are commonly employed for wide band systems but they have performance limitations. Better electrical and mechanical antenna designs are the goals of this project.

PHASE I: The objective of the Phase I is to develop concepts and analyze designs that are low-profile, wideband and show feasibility for air and ground platform operations. Design concepts and expected performance estimates should be delivered.

PHASE II: The objective of the Phase II will be to fabricate the most promising prototype antenna designs from Phase I and to test them on a simulated, or surrogate, platform to confirm efficient , high performance operation. Antenna prototypes with lab test data should be delivered.

PHASE III: Commercial applications for civilian communications and emergency responders should be considered. Application in SIGINT and EW systems should be the focus of the military applications with communications as a secondary, but important, systems area.

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2. S. R. Best, "On the performance properties of the Koch fractal and other bent wire monopoles," IEEE Trans. Antennas Propagat., vol. 51, pp. 1292-1300, June 2003

3. A. D. Yaghjian and S. R. Best, "Impedance, bandwidth and Q of antennas," IEEE Antennas Propagat . Int. Symp., June 2003, pp.501-504.

KEYWORDS: Antenna, conformal, low-profile, receiver, communications

A08-012 TITLE: <u>Embedded Training Enhancement Support Devices for Ground Soldier Systems</u>

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: Design an innovative device that could provide Soldiers improved Live, Virtual, and Constructive Embedded Training support. The device should operate within Ground Soldiers Systems low cost, weight and power limitations.

DESCRIPTION: The Army has mandated that in the future embedded training will provide the individual Soldier the capability to train anywhere at any time using his/her equipment combined with operational combat systems. A clear solution to this embedded training mandate has been elusive and remains a demanding technology challenge, especially for the individual Soldier. The ideal solution must provide live, virtual and constructive modes of training for the Soldier. An innovative device that could provide Soldiers improved Live, Virtual and Constructive Embedded Training support is desired to fill the current technology gap between today's lower fidelity devices and the future force systems that have proven to be expensive to field. Since the device will be used for live training under field conditions, it should be usable by the Soldiers when wearing gloves. This may require new and innovative input devices. The device should have, or be able to integrate with, an already existing tracking capability providing the Soldiers with positional information about themselves and their fellow teammates, enabling them to perform live training mission rehearsals. The device should use the latest mobile technologies and be able to provide advanced graphics, high processor speeds and large storage capacity. The design goals of the device include: battery life over 24 hours, weight less than four pounds and cost under $1,500. The device should provide advanced graphics capabilities including 3D and 2D views for virtual training simulations. It should be able to communicate with other similar devices and systems over a wireless network. The capability to use the device for unmanned systems operations or any other dual use capability would be a plus. The device should be interoperable between mounted/dismounted Soldier capabilities. The research should focus on support of small unit training at platoon level and below, down to a single Soldier. The Army has spent considerable funding and time developing Land Warrior, a futuristic Soldier system and related technology programs such as Future Force Warrior and, in the near future, Ground Soldier Systems. However, none of these Soldier systems has the desired capability for embedded training. Innovative research is required to find a solution for this technology gap. A possible solution may be found in adapting the latest generation of small, low cost, low weight and low power device(s) to Soldier embedded training needs and is the focus of this topic.

PHASE I: Evaluate Ground Soldier Systems and related embedded training requirements, live training environment technologies, and current mobile technologies to determine suitable technology platforms for Soldier-level embedded training within the constraints of Ground Soldier Systems. Conduct a trade study on feasible technologies and their specifications to provide embedded training solutions to Soldiers.

PHASE II: Design and develop the training device to provide live, virtual and constructive embedded training and perform field demonstrations.

PHASE III: The products of this research could be used in a broad range of military and civilian applications. The small device could be incorporated into the Soldier systems of tomorrow. The Program Executive Office (PEO) Soldier has expressed interest in using this technology in the Ground Soldier Systems program. The device would provide embedded training to all future Soldiers and allow them to train anywhere, anytime, using their operational equipment. The Live Training program has also expressed interest in this topic as they are currently looking for an embedded training solution for Soldiers that may provide the next generation operator control unit. This research will also directly transition to current DOD Science and Technology programs involving embedded training, specifically the Scalable Embedded Training and Mission Rehearsal (SET-MR) Army Technology Objective (ATO). The SET-MR ATO is already working with PEO Soldier and the Future Force Warrior program to address embedded training technology shortfalls and is a natural transition path and possible source for matching funds. There is also possible joint applicability by providing the technology to the US Marine Corps for embedded training. This would improve the capability for Army and Marines to train together and therefore fight more efficiently and effectively. There are many civilian applications for this device also. Hunters could use the devices to communicate to each other their locations, meeting places and strategies while being quiet. Hikers could also use the device to plan their hikes and rendezvous points with their fellow hikers. Parents and children could use the device to track each other at outside events and communicate with their children where to go if in trouble or hurt and where to meet at the end of the day. The device could also provide Home Land Defense with virtual planning and operational tools applicable to firemen, police officers and other first responders, both for training and operational use. In conclusion, the military and commercial possibilities for this research are limitless.

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3. Operational Requirements Document (ORD)
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4. Future Force Warrior and the Ground Soldier System
https://peosoldier.army.mil/portfolio/swar/ffw/FFWandGSS.pdf

5. PEO Soldier
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KEYWORDS: Embedded Training, Future Force Warrior, Ground Soldier Systems, Mounted/Dismounted Soldier, Live, Virtual and Constructive Training

A08-013 TITLE: High-Fidelity Runtime Database Engine

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Exploit emerging technologies to define a high-fidelity terrain engine for simulation that optimizes real-world accuracy and algorithm performance on limited resources. Investigate, design, prototype, and demonstrate an efficient runtime environment representation and services engine (feature query, terrain reasoning, line of sight, etc.) for high-resolution source data (e.g., 1m LIDAR, IFSAR). The effort must satisfy storage, accuracy, and performance constraints for semi-automated forces (SAF), embedded training simulation and Live (simulation of combat realism for live players) environment while providing correlation to the real world. This research will not only address training simulation, but it will also address the operational need for troops in the field to correlate with simulated environments by capturing and incorporating surrounding physical terrain updates to the runtime environment simulated representation to improve accuracy and interoperability of live and simulated domains.

DESCRIPTION: Provide a research capability that results in the development of high-fidelity terrain engine that provides a runtime environment and services at orders of magnitude greater resolution and accuracy than current constructive (transverse/reasoning in simulation with semi-automated forces), live (laser-tag war games and engagement simulations) and virtual (three dimensional graphics representation at medium fidelity) Modeling and Simulation applications. Over the past 10 years, visual technology has improved by leaps and bounds, resulting in much greater visual appeal for virtual training simulations. Conversely, the geometric database representation used for terrain reasoning, such as semi-automated forces (SAF) and Live Environment, have remained relatively stagnant or yet to be addressed . For example, aside from the addition of building interior geometric representation, the OneSAF (Army constructive simulation) terrain format remains largely the same as that designed on WARSIM (Army Brigade Simulation) in the mid-nineties. Data collection has improved and much higher resolution data (i.e. ground truth) is becoming more readily available. This effort will design and develop software modules and capabilities that produce a high fidelity runtime environment geometric representation and functions as a services engine (feature query, line of sight, route planning, etc.) using high-resolution source data. The high-fidelity terrain engine must develop efficient mechanisms for geometrically representing and manipulating high-resolution data. The ultimate result of the research is to move away from the traditional method of producing environmental services for M&S and evolve into a new problem space by requiring a high fidelity engine that can represent terrain density far beyond anything handled within the previous "high end" cases of simulation. The main function of the engine is to provide and develop services such as Line of Sight (LOS), terrain reasoning, queries; simulated weapons flyout calculations by modeling the surrounding physical terrain. It is anticipated that this approach will also be sufficient to support advanced live simulation functionality simulating combat realism for live players.

PHASE I: Investigate likely innovative technologies pertaining to geometric representations and algorithms to determine the appropriate approach for efficiently representing and operating on the environment. Investigate issues with spatial reference frames, quantify earth curvature effects, and address the ability to support different coordinate systems for generating high fidelity correlated environment. Consider and document approaches for comparing this approach to pre-existing systems to identify and categorize changes. Provide architectural concepts describing how these changes could be propagated, integrated, and operated on. Summarize design and results in a final report, to include recommended future enhancements for a more productized implementation. For example, development of concept modules that can be integrated into other systems such as OOS and at the same time can function as a stand alone complete system, from source to product, for producing highly accurate high resolution environments.

PHASE II: Apply findings from Phase I concepts to create technology to support Live-Virtual-Constructive training, including embedded training, to develop a High-Fidelity Runtime Database Engine providing a wide range of representations and services for the real world on a simulated terrain environment. Conceptualize approaches for lightweight, very user friendly mechanisms (e.g. OneTESS Player Unit) to define sizing, performance, and fidelity requirements for the high-fidelity terrain engine. Demonstrate direct applicability to OneTESS, OOS, and FCS through technology system like SE Core. Develop a prototype showing the dynamic aspects of creating, deleting, and modifying the terrain surface and features causing a change to other applications (visuals, CGF) and maintaining correlation to the real world. In addition, collect metrics and compare them with current systems to ensure performance is on par with typical results.

PHASE III: Broaden scope to transition to other domains needing high-fidelity environments such as robotics, gaming, emergency response, and homeland security. Augment the high-resolution terrain engine format and services to accommodate additional features and attribution to support targeted domains. Consider extended capabilities to include dense urban settings, weather, sensors, and other poorly represented environmental aspects that are important for simulation.

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KEYWORDS: High-Fidelity Geometric Representation, M&S Services (feature query, line of sight, route planning, etc), High Fidelity Engine, Complex Domain, Modeling and Simulation, LIDAR, IFSAR, Modeling and Simulation

A08-014 TITLE: Simulate the Physical Response of Building Rubble at Multiple Levels of Detail

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Design and develop a capability to model the physical characteristics of building rubble, including flyout from munition detonation and collision with static and dynamic simulation entities. The resulting models of Rubble fragments should impact mobility of vehicles and personnel, provide input to damage models, and affect line of sight and other functions within visual and semi-automated forces applications. The capability must work within widely used computer generated forces simulations such as the OneSAF Objective System as well as government and commercial simulation applications and image generators.

DESCRIPTION: Accurate representation of rubble is important in simulations for several reasons. Rubble causes damage during flyout, and it affects mobility of vehicles and personnel, line of sight on the urban battlefield, and reconstruction efforts. Simulations that require representation of rubble have varying requirements for the fidelity of the rubble that range from a homogenous rubble pile to individual rubble pieces. This effort should use physics-based rubble flyout models to predict where rubble fragments will land, determine where collisions occur with objects in the environment, and create an accurate quantity of rubble from an incident. Rubble should be modeled at multiple resolutions to accommodate environments with varying resolutions. Rubble fragments should be located according to calculations produced by the rubble flyout model and collision effects. Generated rubble may feed into mobility models, entity damage models, and other models to produce a more accurate simulation.

PHASE I: Develop a software concept design for a tool that models rubble flyout using a physics model from building damage. The software concept should lead to a capability that can be used to detect collisions of rubble with simulation entities and modification of the terrain surface in modeling and simulation applications.

PHASE II: Develop a prototype software tool that implements a rubble pile generator. The capability should model the flyout and collision with entities based on the munition type and building characteristics. Conduct research into simulation capabilities to determine how they will interact with the rubble pile. Capabilities investigated should include the impact of rubble on mobility models, line of sight, and route planning algorithms.

PHASE III: Enhance the prototype rubble pile generator to make it suitable for transition to modeling and simulation applications. Develop a fieldable capability for simulating rubble flyout and subsequent effects caused by a munition event or natural disaster. Military applications may include integration with virtual and construction simulations used for training and mission rehearsal. Commercial applications may include integration with emergency response or homeland defense training simulations.

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KEYWORDS: Physics based representation, rubble, second and third order effects, look-up tables, simulation, damage effects