

DEFENSE THREAT REDUCTION AGENCY
15.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

The mission of the Defense Threat Reduction Agency (DTRA) is to safeguard the United States and its allies from chemical, biological, radiological, nuclear, and high-yield explosive (CBRNE) weapons of mass destruction (WMD) by providing capabilities to reduce, eliminate and counter the threat and mitigate its effects. The activities described herein are drawn from DTRA's basic & applied research, nuclear technologies, counter WMD technologies, and information sciences and applications portfolios. Communications for this program should be directed to:

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The DTRA SBIR Program complements the agency's principal technology programs to detect, locate, and track WMD; interdict or neutralize adversary WMD capabilities; protect against and restore capabilities following WMD use; attribute parties responsible for WMD attacks; and provide situational awareness and decision support to key leaders. SBIR topics reflect the current strategic priorities where small businesses are believed to have capabilities to address challenging technical issues. DTRA supports efforts to advance manufacturing technology through SBIR, where the challenges of such technology are inherent to technical issues of interest to the agency.

PROPOSAL PREPARATION AND SUBMISSION

The SBIR Program Solicitation (found at <https://sbir.defensebusiness.org>) provides the proposal preparation instructions. For DTRA Phase I, consideration is limited to those proposals which do not exceed \$150,000 and seven months of performance. Proposals may define and address a subset of the overall topic scope. Proposals applicable to more than one DTRA topic must be submitted under each topic. Please note that the solicitation has been extensively rewritten and should be read carefully prior to proposal submission.

PHASE I PROPOSAL REVIEW AND EVALUATION

During the proposal review process, employees from ByteCubed LLC and TASC, Inc. will provide administrative support for proposal handling and will have access to proposal information on an administrative basis only. Organizational conflict of interest provisions apply to these entities and their contracts include specifications for non-disclosure of proprietary information. All proposers to DTRA topics consent to the disclosure of their information to ByteCubed, LEIDOS, SUNTIVA and TASC employees under these conditions.

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The Technical Point of Contact (TPOC) leads the evaluation process of all proposals submitted in their topics. DTRA will make a determination as to whether the proposal is relevant to the topic solicited. Only relevant topics will be evaluated against further criteria. DTRA will evaluate Phase I proposals using the criteria specified in section 6.0 of the DoD SBIR Program Solicitation during the review and evaluation process. The criteria will be in descending order of importance with technical merit being the most important, followed by qualifications, and followed by the commercialization potential. With other factors being equal, cost of the proposal may be included in the evaluation. DTRA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. However, a DTRA SBIR goal is to provide awards in each Phase I topic solicited.

CONTINUATION TO PHASE II

Small business concerns awarded a Phase I contract will be permitted to submit a Phase II proposal for evaluation and potential award selection. The Phase II proposals must be submitted NLT 30 days AFTER the end of the 7-month Phase I effort.

All SBIR Phase II awards made on topics from solicitations prior to FY 13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

Phase II review and evaluation will be similar to the Phase I process. The TPOC leads the evaluation process of all proposals submitted in their topic areas. The Phase II proposal evaluations will use the criteria specified in section 8.0 of the DoD SBIR Program Solicitation for the review and evaluation process. The criteria will be in descending order of importance with technical merit being the most important, followed by contractor's qualifications, and followed by the commercialization potential. With other factors being equal, cost of the proposal may be included in the evaluation. DTRA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

DECISION AND NOTIFICATION

DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

Following the EA decision, DTRA SBIR will release notification e-mails for each accepted or rejected offer. E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official. Offerors may request a debriefing of the evaluation of their not selected proposal and should submit this request via email to dtra.belvoir.J9.mbx.sbir@mail.mil and include "SBIR 15.2 Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without

additional negotiations by the contracting officer or opportunity for revision for proposals that are reasonable and complete.

DTRA manages SBIR as an ongoing program and does not classify individual Phase I awards as new program starts for the purpose of Continuing Resolution Authority.

OTHER CONSIDERATIONS

DTRA does not utilize a Phase II Enhancement process. While funds have not specifically been set aside for bridge funding between Phase I and Phase II, the potential offeror is advised to read carefully the conditions set out in this solicitation.

E-mail correspondence is considered to be written correspondence for this purpose and is encouraged.

DTRA SBIR 15.2 Topic Index

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DTRA SBIR 15.2 Topic Descriptions

DTRA152-001 TITLE: Radiation Hardened Optoelectronics for Optical Interconnects

TECHNOLOGY AREAS: Materials/Processes, Electronics

OBJECTIVE: Enable low power high bandwidth radiation hard chip to chip or intra-chip communication for satellites and unmanned vehicles by utilizing optical rather than electrical interconnects.

DESCRIPTION: With the dominance of parallel processing, the rise integrated “system on chip” (SOC) architecture, and the continuing need to handle more data more quickly, traditional electronic interconnects are reaching their practical limits. Optical data transfer has already replaced electronic data transfer in long distance applications (km) and shorter distance high bandwidth applications (m-cm) due the combination of high bandwidth and low loss. Optical interconnects can also be very robust in extreme temperature and radiation environments making them well suited for satellite and unmanned vehicle applications. Optical data transfer over shorter (cm-mm) distances faces several significant technical and integration challenges. Some of these challenges are directly related to scaling: diffraction limitations, coupling efficiencies and cross talk, and fabricating efficient scaled emitters and detectors. Other challenges are related to material and wavelength challenges. Silicon, the semiconductor of choice for the electronic industry, has an indirect optical band gap making it an inefficient emitter or lasing material. Silicon, while a common detector material for visible wavelength, cannot be used as a detector for the common telecommunication wavelengths (1550 nm and 1330 nm). All silicon/silicon oxide optical interconnects would be ideal for integrating with conventional CMOS fabrication, however it is likely that techniques utilizing alternate semiconductors will be required at least in the near term. Current solutions include epitaxial germanium and wafer bonded III-V semiconductors for detectors and emitters. Hardening the optoelectronic components of optical interconnects to radiation effects (total ionizing dose, displacement damage, single events, color center formation, and optical loss) is necessary before they are incorporated in satellites or unmanned vehicles (unmanned aerial vehicles or robots) that are expected to operate in high radiation environments. Electronics and optoelectronics in these systems are typically expected to be able retain functionality during gamma, neutron, and high energy ion exposures with lifetime total ionizing doses between 100kRad and 1MRad (silicon). Optical interconnects may also offer significant advantages in hardening systems against electromagnetic pulses and electromagnetic weapons by eliminating the antenna effects caused by cabling or long electrical interconnects.

PHASE I: Demonstration and preliminary radiation effects testing (to a WMD relevant dose) of at least one scaled or near scaled active optical interconnect component (e.g. emitter, modulator, detector). Development of a plan for scaled (or near scaled) complete optical interconnect prototype.

PHASE II: Development, fabrication, and preliminary radiation effects testing (to a WMD relevant dose) of a scaled or near scaled optical interconnect prototype with at least two active components and a coupled waveguide. Development of an approach for mitigating any observed radiation effects.

PHASE III: Dual use applications: Suitably scaled and energy efficient optical interconnects could be utilized in commercial server, data centers, and high performance computers. Radiation resistant high reliability optical interconnects also have potential applications in commercial aviation, automobiles, and medical devices.

REFERENCES:

1. D. Miller, "Optical interconnects to electronic chips," Applied Optics 49, F59-F70 (2010)

2. P. Dong; Y.K. Chen; G.H.Duan; D.T. Neilson, "Silicon photonic devices and integrated circuits" Nanophotonics, Volume 3, Issue 4-5, Pages 215–228 (2014)

KEYWORDS: Optoelectronics, Interconnects, Rad-Hard, Electronics, Radiation Hardened, Satellite

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DTRA152-002 TITLE: Materials Development for Enhanced X-ray Detection of Dynamic Material Events Under Fast Loading Rates

TECHNOLOGY AREAS: Materials/Processes, Sensors

OBJECTIVE: The objective of this effort is to develop x-ray detector materials that provide high frame rate collection for measuring dynamic material events across a range of temporal and spatial scales.

DESCRIPTION: The Defense Threat Reduction Agency's Basic Research Program, Thrust Area 4 – Science to Defeat WMD (weapons of mass destruction), has been supporting research of hard and deeply buried targets including penetration of concretes and geological materials. With new experimental facilities that now couple high intensity and high flux x-ray capabilities with impact drivers (e.g. lasers, gas guns, etc.), an exciting opportunity exists for directly probing material deformation mechanisms under extreme loading conditions. Limitations in detection capabilities still present a significant hurdle to providing a complete mapping of the temporal evolution of complex materials under dynamic loading. New materials or methods that enhance x-ray diffraction and/or x-ray imaging measurements are desired, including both direct and indirect detection methods. Indirect detection uses phosphors or scintillators to convert x-rays to visible photons; whereas, direct detection schemes directly convert an x-ray photon to an electrical signal for readout. Certain detection schemes are currently more attractive to different experimental conditions and regimes of interest.

PHASE I: Any new or improved materials must provide good sensitivity for photon energies greater than 20 keV. Proposed materials for enhanced indirect detection must possess fast decay times below 25 ns, spatial resolution < 5 μm and demonstrate photon collection efficiency >90%. In addition to being sensitive beyond 20 keV, materials for improved direct detection must be capable of achieving temporal resolution better than 150 ns (much faster temporal resolution capabilities would be desired). Submitters are expected to produce materials that satisfy conditions for direct or indirect detection, not both. Experimental results must demonstrate that the materials of interest can reach or exceed these specifications.

PHASE II: Based upon the Phase I performance results of these materials, DTRA will decide based upon costs/risks if Phase II work is to be initiated. Phase II work will focus on incorporating the improved material or technology into a detector capable of high frame rates (>10 MHz) and many frame data collection/storage (20-500 frames). Any detector will be submitted for further testing under high rate experimental conditions. Development of a commercialization strategy should also be achieved in Phase II.

PHASE III: In addition to providing enhanced detection capabilities for directly probing complex materials under high rate deformation, new developments in time domain x-ray detection technology could be beneficial for investigating complex biological processes.

REFERENCES:

1. Defense Threat Reduction Agency Broad Agency Announcement HDTRA1-11-16-BRCWMD-BAA, PerE Topic 9, “Crustal-Earth Materials and Manufactured Materials under Dynamic Extremes”.
2. Sol M. Gruner, “X-ray imaging detectors”, Physics Today, 65, 29 (2012).
<http://dx.doi.org/10.1063/PT.3.1819>
3. P.K. Lambert, et al. “Time-resolved x-ray diffraction techniques for bulk polycrystalline materials under dynamic loading”, Rev. of Sci. Instrum., 85, 093901 (2014). <http://dx.doi.org/10.1063/1.4893881>

KEYWORDS: X-ray Detection, X-ray Diffraction, X-ray Imaging

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DTRA152-003 TITLE: High Performance Computing (HPC) Application Performance
Prediction & Profiling Tools

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The objective of this project is to develop approaches for a HPC oriented performance prediction and profiling package that can be utilized by both users and computer center user support personnel. For users, the tools would provide a series of non-intrusive profiling capabilities that generate graphs and analyses reports that can be reviewed to quickly reveal performance bottlenecks. By using profiling tools, the user can assess performance issues on existing architectures and identify candidate applications or code blocks most suitable for porting to use of heterogeneous HPC architectures, code regions that can be tuned for energy efficiency, and areas needing refactoring for future HPC architectures. Performance Prediction enable “will what if” analyses to predict the impact of changes in system balance or architecture on existing code or to give design targets for new code.

DESCRIPTION: DTRA uses High Fidelity computer codes to investigate weapon effects phenomenology and techniques for countering WMD. End to end High Fidelity simulations in support of the DTRA Agent Defeat Warfighter Capability will require calculations including multiple phenomena that occur in vastly different time scales (μ s to hours). The resulting code run times will be prohibitively long without optimization for next generation computer architectures.

PHASE I: Develop an approach for design or modification of existing code profiling tools that are capable of handling High Fidelity codes as described above. Identify key concepts and methods that, when implemented, will provide non-intrusive tools that are effectively operable on complex High Fidelity applications codes. State of the art, innovative application code profiling tools as envisioned here, will need to enable performance and energy use prediction on a cross platform basis, i.e., Run on one architecture to predict performance on a future or different architecture. The tools must operate on optimized executables, not source code, and produce readily understandable results.

PHASE II: Develop a production ready suite of profiling tools based on the Phase I approach. Demonstrate the use of the tools on DTRA in-house and DOD HPCMP systems on a broad range of High Fidelity application codes to include both rectangular grid and unstructured, three-dimensional adaptive mesh, coupled Computational Fluid Dynamics (CFD) / Computational Structural Mechanics (CSM) codes, explicit finite element codes used for short strong shocks, and chemistry codes used in conjunction with CFD codes

PHASE III: The code profiling tools developed for use on very demanding application codes will be well suited, once refined, for use on more general HPC workloads. Improvements in this phase are expected to involve ease of use enhancements and hardening of the profiling tools for use on a wide range of application software used in Government research and industry.

REFERENCES:

1. "PEBIL: Efficient Static Binary Instrumentation for Linux" Michael A. Laurenzano, Mustafa M. Tikir, Laura Carrington, Allan Snively Performance Modeling and Characterization Laboratory San Diego Supercomputer Center <http://www.sdsc.edu/PMaC/publications/pubs/laurenzanopebil2010.pdf>
2. "PSnAP: Accurate Synthetic Address Streams Through Memory Profiles" Catherine Mills Olschanowsky 1, Mustafa M. Tikir 2, Laura Carrington 2, and Allan Snively 1, 2; 1 Department of Computer Science and Engineering University of California at San Diego ; 2 San Diego Supercomputer Center <http://www.sdsc.edu/PMaC/publications/olschanowsky2009psnap.html>

KEYWORDS: Code performance predicting, code profiling, software tools, next generation computer architectures, Exascale, heterogeneous architectures, GPGPU, many-core CPU

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DTRA152-004 TITLE: Instrumentation for Characterization of Fireballs, Hot Gases, & Aerosols from Defeat of Targets Containing Biological and Chemical Agents

TECHNOLOGY AREAS: Sensors

OBJECTIVE: The objective of this project is to develop advanced diagnostics or instrumentation to qualitatively and quantitatively characterize the fireball, hot gases and aerosols that are released from defeat of storage or production facilities containing biological- and chemical- agents. Since defeat involves the use of explosives or high temperature incendiaries, the instrumentation developed must be stand-off or ruggedized to survive the high temperature, high pressure and corrosive/reactive atmosphere created by weapon engagement with a chemical/biological target, and demonstrate repeatable performance under such field conditions. Smaller, agile instruments with ability to collect data simultaneously from multiple points, is of interest. In addition, instruments should collect time-resolved data in a highly dynamic environment where chemical reactions and physical changes such as fluid flow and particle-size redistribution may be occurring at microsecond to millisecond time scales.

DESCRIPTION: Testing of methods to defeat chemical and biological agents often requires scaled experiments involving rapid combustion of bio- and chemical- agent simulants. This effort will focus on the development of next-generation instrumentation for effective characterization of physical and chemical processes occurring during rapid combustion in the expanding fireball, to provide quantitative and qualitative data on chemical reactions and physical changes such as particle distribution and fluid

flow that result in formation of the final plume. The instrumentation developed must be stand-off or ruggedized to survive the high temperature, high pressure and corrosive/reactive atmosphere created by weapon engagement with a chemical/biological target, and demonstrate repeatable performance under such field conditions. Smaller, agile instruments that can be easily transported from one site to another, requiring minimal utilities (power, water, etc.) and infrastructure at field site, is optimum. In addition, instruments should collect data in a highly dynamic environment where chemical reactions of chemical agents and physical changes such as fluid flow and particle-size redistribution may be occurring at microsecond to millisecond time scales. Specifically we are interested in measuring the following:

- Temperature as a function of space and time,
- Chemical specie and concentration as a function of space and time and
- Droplet/particle velocity and size distribution as a function of space and time. Spatially resolved measurements, where a single instrument could collect data from multiple positions within or just outside the fireball, are desired. The measurements from these instruments and data obtained from testing will provide the basis for modeling and simulation of the first few seconds of the expanding fireball. Temperature measurements of laboratory scale clean (no agent/simulant/by products or other debris) fireballs have progressed using pyrometry and emission spectroscopy. Species have been measured with mass spectroscopy and other optical techniques and particle size distribution by particle image velocimetry. However these techniques have not scaled up to larger scale up to field scale because of at least two reasons. First the fireball is dirty containing not only detonation products but agent/simulant and byproducts and other debris and second the environment is extremely harsh making instrument survival difficult.

PHASE I: Provide proof of concept for next-generation instrumentation for quantitative and qualitative characterization of the physical and chemical process in fireballs. Demonstrate feasibility that new technologies will survive and collect useful data in the harsh environment of explosive fireballs. A proof of concept demonstration shall consist of measuring at least one of the following; temperature as a function of space and time, chemical specie and concentration as a function of space and time and droplet/particle velocity and size distribution as a function of space and time in an explosively generated fireball consisting of explosive detonation products and Triethyl phosphate (TEP), a commonly used simulant. It is anticipated that this would be a laboratory scale test. Technologies of interest include but are not limited to

PHASE II: Expand the technology to other relevant agents/simulants. Scale-up, ruggedize and deliver prototypes of instrumentation to demonstrate in relevant testing. Plan and conduct small-scale testing within project scope, and participate in government-provided mid- to large-scale explosives testing. Demonstrate cost-effective data analysis and fast turn-around for repeated testing.

PHASE III: Support testing at DTRA Test Division (J9CXT); DTRA Weapons Division (J9CXW) the Army Corps of Engineers, Engineer Research and Development Center (ERDC); Air Force Research Lab (AFRL); Naval Surface Warfare Centers (NSWC); Naval Air Warfare Centers (NAWC); Energetic Materials Research and Testing Center (EMRTC) affiliated with New Mexico Tech; and other laboratories around the country. This technology might also have utility in rocket motor performance instrumentation, or other extremely high rate combustion processes.

REFERENCES:

1. Lewis, W. K., and C. G. Rumchik. "Measurement of Apparent Temperature in Post-detonation Fireballs Using Atomic Emission Spectroscopy." *Journal of Applied Physics* 105(5)0674-0676. Web. 1 Mar. 2009.
2. Frost / McGill University Montreal, Quebec, Canada H3A2K6, David L., Samuel Goroshin / McGill University Montreal, Quebec, Canada H3A2K6, Malcolm Cairns / McGill University Montreal, Quebec, Canada H3A2K6, Robert Ripley / Martec Limited, 1888 Brunswick St., Halifax, Nova Scotia, B3J3J8

Canada, and Fan Zhang / Defence R&D Canada - Suffield, PO Box 4000, Stn Main, Medicine Hat, Alberta, T1A8K6 Canada. "Temperature Measurements in a Multiphase Fireball" The 22nd International Colloquium on the Dynamics of Explosions and Reactive Systems (2009).

3. Densmore / US Army Research Laboratory, Aberdeen Proving Ground, Maryland, 21005 USA, John M., Matthew M. Bliss, Kevin L. McNesby, and Bonnie E. Homan. "High Speed Digital Color Imaging Pyrometry." Applied Optics-OT 50.17 (2011): 2659-2665.

4. "Multi-component, Multi-point Interferometric Rayleigh/Mie Doppler Velocimeter." 1.53 NP-2008-04-77-LaRC. LARC-DL-technologygateway@mail.nasa.gov. <technologygateway.nasa.gov>.

KEYWORDS: advanced diagnostics, advanced instrumentation, agent defeat, characterization

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DTRA152-005 TITLE: Joint Learning of Text-based Categories

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: The DTRA Special Programs Office (J9CXQ) is seeking research in the areas of information detection and extraction in unsupervised learning environments.

DESCRIPTION: J9CXQ has the challenge of identifying and extracting evidential information from a complex and ambiguous text. An automated extraction system is being developed that will detect and characterize categories of entities, relations, events, and topics. The extracted information will be stored in a knowledge base that will enable automatically finding patterns and searching for critical information. These detection and extraction algorithms depend on well-formed definitions of the elements (entities, relations, events). They are further disambiguated using context such as the topics found in the documents. These definitions typically expressed as a probability distribution. Since these elements are not known beforehand the algorithms must not only characterize them, but also discover them in the first place. The task of creating these characterizations are too large to do manually, and even when known beforehand, the task of annotating is prohibitive, hence it is necessary to automate the process both to discover the categories and then represent them probabilistically. Traditionally this is done using an unsupervised learning algorithm such as Latent Dirichlet Allocation (LDA). Currently, despite the fact that each of the elements is highly interrelated (i.e. topic, entity, relations and events), each of these are learned independently. What is needed is to learn all of these elements in an interrelated manner. This is

because a better characterization of one will improve characterizations of the other. For example, topics are identified in an unsupervised way using entity classes are found by clustering in vector spaces in an unsupervised way, or named entity recognition (e.g. using conditional random fields) in a supervised way. Not only will a joint learning approach improve accuracy, but it will also enable tighter, more specific classes which should make the overall analysis of text much more powerful. J9CXQ is seeking research in the area of knowledge representation and reasoning systems that can support the following combination of requirements:

- (1) The method should infer classes of entities, relationships, and contextual topics in a joint manner to account for interdependencies.
- (2) The method should not require extensive annotation, and should be unsupervised or require a minimal amount of human input.
- (3) None of the classes are predefined, but they are discovered through learning.
- (4) Readily adapts or transfers to new domains,
- (5) The ability for an analyst to set the topic or distribution of entities or relations and see the effect on the remaining variables.
- (6) Ideally, the method will include context information and should not be solely based on a bag-of-words language model.
- (7) Flexible output that facilitates data analysis and visualization.
- (8) Given the novelty of the method, it should be well documented both within the source code and auxiliary supportive documentation.

PHASE I: From basic research develop and demonstrate proof-of-concept. Research and develop methodologies that should infer classes of entities, relationships, and contextual topics in a joint manner to account for interdependencies. At the conclusion of Phase I, produce a conceptual architecture design identifying necessary hardware and software to create a system and identify technology gaps that must be resolved prior to building a system. Develop a proof-of-concept demonstration to support the architecture design.

PHASE II: Build a prototype system that will support testing and evaluation. Develop, demonstrate, and validate a prototype system based on the preliminary design from Phase I. All appropriate engineering testing will be performed, and a critical design review will be performed to finalize the design. The Phase II deliverable will include a working prototype of the software, specification for its development, and demonstration of the eight specified requirements.

PHASE III: Integrate into the J9CXQ CWMD Analyst Reasoning Environment to provide a new inference capability over extracted events, entities and relationships. Optimize the prototype system and demonstrate it at the full scale level. This technology will have broad application in military, government, and commercial settings. Within the military and government, there is an increasing emphasis on technologies that aid decision-makers while managing big data. Developing tools that can rapidly integrate information and provide a process for analyzing data to compliment a user's decision making process will be a powerful addition to strategic, operational, and tactical decision making.

REFERENCES:

1. Blei, David; Ng, Andrew; Jordan, Michael, Latent Dirichlet Allocation (2003) The Journal of Machine Learning Research.
2. Rink, Bryan, Harabagiu, Sandra (2011) A Generative Model for Unsupervised Discovery of Relations and Argument Classes from Clinical Texts Proceedings of the 2011 Conference on Empirical Methods in Natural Language Processing.

KEYWORDS: Text analysis, NLP, Clustering, Language modeling

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DTRA152-006 TITLE: Island-mode Enhancement Strategies and Methodologies for Defense Critical Infrastructure

TECHNOLOGY AREAS: Nuclear Technology

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 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop and test innovative strategies and methodologies to enhance island-mode technologies and innovative tactics for defense critical infrastructure (DCI) in the event of commercial power grid loss/disruption due to an electromagnetic pulse (EMP) or high power microwaves (HPM).

DESCRIPTION: The defense critical infrastructure (DCI) is the composite of DoD and non-DoD assets essential to project, support, and sustain military forces and operations worldwide. The DCI includes, but is not limited to, elements such as military bases, ballistic missile defense installations, radar sites, etc. An electromagnetic (EM) attack (nuclear electromagnetic pulse [EMP] or non-nuclear EMP [e.g., high-power microwave, HPM]) has the potential to degrade or shut down portions of the electric power grid important to the DoD. While a power grid may employ intentional islanding techniques to protect sections of the grid and prevent a cascading collapse of the power grid, the broad reach of potential EM attacks with the potential of simultaneous levels of disruption might prevent traditional islanding protection methods from being sufficient for continued operations of the DCI. Restoring the commercial grid from the still functioning regions may not be possible or could take weeks or months. Significant elements of the DCI require uninterrupted power for prolonged periods to perform time-critical missions (e.g., sites hardened to MIL-STD-188-125-1). To ensure these continued operations, DCI sites must be able to function as a microgrid that can operate in both grid-connected and intentional island-mode (grid-isolated). Such a microgrid is defined as a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the power grid. The purpose of this topic is, through systematic study of a typical DCI site, to develop enhanced methodologies and technologies for providing intentional island-mode capability at DCI sites in the event of grid loss. Methodologies should account for the need of immediate and continuous operations at sites and the seamless transition to and from commercial power (grid-connected and grid isolated states). The emphasis of this project should be on determining how to best prepare an existing DoD site for intentional island-mode operation and identifying major risks and hurdles. This work will require refinement of existing technologies and development of new technologies and is directed specifically toward applying the new knowledge to meet the survivability of DoD sites to EM attacks affecting large geographical areas. The goal of this project is to develop a set of methodologies and strategies that can be applied, along with existing methods, to enhance the resilience of DCI assets such as military bases. Such methods should aid in the development of islanding at DoD sites to ensure survivability to geographically large EM threats. These methods may also be applied to the commercial sector and other areas of the government: hospitals, civilian infrastructure, businesses, etc.

PHASE I: The successful Phase I project should develop innovative strategies and methodologies for DCI island-mode operations in the event of power grid disruption or failure due to an EM threat. Sufficient detail should be developed to show technical competency and/or proof of concept. Phase I

deliverables should also include a draft test plan detailing a testing approach to demonstrate these strategies as well as establishing performance goals. Additionally, a draft roadmap should be developed indicating Phase II and Phase III plans, timelines, and addressing key decision points and milestones.

PHASE II: Phase II will focus on intentional island-mode methodologies and strategies at a specific DCI site (TBD). Limited initial testing may occur at a proto-type site, via modeling, or prior to full scale testing at a DCI site. Identify and address key island-mode hurdles, limitations, and obstacles and provide recommendations on addressing these areas. Methodologies and strategies should be improved and expanded based on testing, assessments, and available data. Clear documentation on strategies/methodologies and improvements is a priority. Identification of dual use commercial applications is an important aspect of this phase.

PHASE III: The Phase III project would focus execution of the Phase II test plan and on expanding these methodologies and strategies to include systems/infrastructure outside the DCI. This could include other DoD/government agency sites, hospitals, civilian infrastructure, or other commercial sites. Methodologies developed for the site specific work in Phase II could be expanded for a different site or generalized to create overarching guidelines.

REFERENCES:

1. DoDI DoD 3020.40, "Policy and Responsibilities for Critical Infrastructure," July 1, 2010. "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack," Critical National Infrastructures, 2008. http://www.empcommission.org/docs/A2473-EMP_Commission-7MB.pdf
2. "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack," Volume 1: Executive Report 2004. http://www.empcommission.org/docs/empc_exec_rpt.pdf

KEYWORDS: Electromagnetic Pulse, EMP, High Power Microwave, HPM, power grid, defense critical infrastructure, DCI, islanding, microgrid

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DTRA152-007 TITLE: Multi-mode Handheld Radioisotope Identification Instrument

TECHNOLOGY AREAS: Sensors, Electronics, Nuclear Technology

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 5.4.c.(8) of the solicitation.

OBJECTIVE: Design and develop compact handheld instrumentation that identifies and categorizes isotopic sources based on gamma-ray, thermal and fast neutron radiation signatures.

DESCRIPTION: DTRA is seeking development of handheld radioisotope identification instrumentation with extended capabilities for identifying and categorizing isotopic sources. Passive measurements of gamma-ray signatures can be adversely compromised by shielding around the source. Neutrons are an additional signature that may either substantiate a finding or, more importantly, elucidate an anomaly that may arise from purposeful shielding. Currently offered instruments tend to optionally include neutron detectors of limited sensitivity that can be added to otherwise, gamma-ray centered designs. Of particular interest is to significantly increase thermal neutron sensitivity to a minimum of 15 cps/nv. Furthermore, instrumentation may also find a role in verification and inspections, and determining the presence of particular Pu isotopes (or their enrichment) through fast neutron spectroscopy would be beneficial. Note here that such a goal specifically requires sensitivity to energetic neutrons (to several MeV). It is preferable that the instrument is capable of accomplishing all detection functions without need for optional sensors that may increase the unit size, weight, or power consumption. The preferred form-factor is that of a compact instrument than can be personally worn or carried in a holster, allowing for hands-free operation. Examples of operation and form would be the identiFinder® R400 and HDS-101GN. The instrument should meet or exceed the requirements of the relevant ANSI N42.34[1] standard for handheld instruments for the detection and identification of radionuclides, and include the capability to distinguish neutrons by energy (thermal versus fast). Solutions must employ low-power electronics and need to be battery operated with useful lifetime targets of 8+ hours between recharge or replacement. There is a high desire for solutions that are physically robust and insensitive to adverse environmental conditions. The systems should be capable of identifying radioisotopic sources in mixed radiation (gamma plus neutron) environments. Instruments may be entirely self-contained or may utilize a short range wireless connection (e.g. Bluetooth) to commonly available tablet, laptop or smartphone devices for user interaction. Overall practicality of the operating conditions and ergonomics should be a factor in selecting packaging designs. For gamma-rays, it is desirable to utilize detectors that can achieve an energy resolution of < 5% FWHM at 662 keV. Additionally, the sensitivity should be greater than 1000 cps/μSv/hr for Cs-137. Commercial radioisotope identification software can be used. Ultimately, it is preferable that the instrument be capable of running GADRAS software[2] for radioisotope identification. Minimally, it should provide file formats compatible with the ANSI N42.42 standard[3].

PHASE I: Identify key operational components and develop the initial design of the handheld radioisotope identification instrument. Extensive modelling studies must be performed to demonstrate detector sensitivity, and capability for gamma, fast and thermal neutron detection and radioisotope identification. Demonstrate pathways to meeting performance goals in Phase II.

PHASE II: Develop a prototype instrument that accomplishes the goals of gamma-ray, thermal and fast neutron measurements. The instrument shall not be dependent on post-acquisition analysis of data. Incorporate GADRAS or other radioisotope identification software. Demonstrate radioisotopic identification consistent with N42.34, identifying areas where the prototype diverges from the standard. Demonstrate the application of neutron detection to identification of radioisotopes with specific examples of SNM.

PHASE III: DUAL USE APPLICATIONS: Develop a commercial instrument, with suitable partners as needed, for military applications of interest to DTRA as well as domestic applications to support first responders and regulatory inspections, border and port security, power plant maintenance and environmental clean-up.

REFERENCES:

1. ANSI N42.34, American National Standard Performance Criteria for Hand-Held Instruments for the Detection and Identification of Radionuclides.
2. SAND2009-6550, Benchmarks for GADRAS Performance Validation, Sandia National Laboratory.

3. ANSI N42.42, American National Standard Performance Criteria for Data Format Standard for Radiation Detectors used for Homeland Security

KEYWORDS: Handheld radiation detectors; Radioisotope identification; Low-Power Electronics.

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DTRA152-008 TITLE: Standoff Detection of Highly Enriched Uranium

TECHNOLOGY AREAS: Nuclear Technology

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 5.4.c.(8) of the solicitation.

OBJECTIVE: Identify a technical approach that will allow standoff detection from within a compact vehicle. The entire detection system should be less than 43 liters (1.5 cubic feet) in volume and less than 45 kg (100 pounds) in total weight. The system will be capable of detecting a 25 kg mass of HEU (a projected area orthogonal to the sensor of less than 155 square centimeters) positioned behind a wall with a thickness of one concrete measurement unit at a distance of 20 meters while moving at of 60 KPH. Resolution should be 85%, and integration time needs to be selectable. System also needs to meet a greater than 90% probability of detection at a 90% confidence level.

DESCRIPTION: Within the Federal and State governments there are several select agencies whose mission is to detect the presence of highly enriched uranium without revealing the search activity or the means of detection. The most challenging task is detection from an undisclosed survey vehicle moving at no more than typical urban speeds. The commercial applications for this product would be fall out for DOD requirement in various size weight and power configurations. The end users would be nuclear power plant operators and first responder organizations with hazardous material response missions. The market would be for standoff detection of reactor materials that are loose as a result of a reactor mishap. General requirements include: a. The detector cannot be visible to the surrounding public; b. The detector must fit within a compact vehicle and not larger than 43 liters in volume and 45 kg in total weight and may be powered by the vehicle electrical system c. Detector data must include the time date and location of the detection with such data communicated to the search personnel operating the SUV d. Detector must be capable of operating continuously for not less than 12 hours.

PHASE I: 1) Model alternative detector approaches to identify the detector media, algorithms, supporting software and hardware meet the requirement. 2) Design and model bread board level systems that can be tested against surrogate material at the distances and speeds required. 3) Select the alternative approach capable of meeting the speed and distance detection of the target uranium sources.

PHASE II: 1) Build a bread board level design and test against surrogate material at the distances and speeds required. 2) Refine the bread board system to a prototype design. 3) Construct and prototype capable of meeting the speed and distance detection of the target uranium sources and test to show it meets performance requirements.

PHASE III: A compact, mobile detection system would be of utility to Federal and State agencies responsible for detecting HEU. This dual use technology applies to both military and civilian detection requirements.

REFERENCES:

1. Radiation Detection Measurement, Third Edition, Glenn Knoll, New Jersey, 200
2. Fissile Materials Working Group, edited by Alan J. Kuperman. Abingdon: Routledge, 2013.

KEYWORDS: Standoff detection, thermal neutron absorption, compact, detection, vehicle mounted

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