ARMY
SBIR 09.1 PROPOSAL SUBMISSION INSTRUCTIONS
DoD Small Business Innovation (SBIR) Program

The US Army Research, Development, and Engineering Command (RDECOM) is responsible for the execution of the Army SBIR Program. Information on the Army SBIR Program can be found at the following Web site: 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 (8:00 am to 5:00 pm ET). Specific questions pertaining to the Army SBIR Program should be submitted to:

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The Army participates in three DoD SBIR Solicitations 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 at 1-866-724-7457 (8:00 am to 5:00 pm ET). 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

09.1 Solicitation Pre-release	November 12 – December 7, 2008
09.1 Solicitation Opens	December 8 – January 14, 2009
Phase I Evaluations	February – March 2009
Phase I Selections	March 2009
Phase I Awards	May 2009*

**Subject to the Congressional Budget process*

PHASE II PROPOSAL SUBMISSION

Note! Phase II Proposal Submission is by Army Invitation only.

For Phase II, no separate solicitation will be issued and no unsolicited proposals will be accepted. Only those firms that were awarded Phase I contracts, and have successfully completed their Phase I efforts, will be invited to submit a Phase II proposal. Invitations to submit Phase II proposals will be released at or before the end of the Phase I period of performance. The decision to invite a Phase II proposal will be made based upon the success of the Phase I contract to meet the technical goals of the topic, as well as the overall merit based upon the criteria in section 4.3. DoD is not obligated to make any awards under Phase I, II, or III. DoD is not responsible for any money expended by the proposer before award of any contract. For specifics regarding the evaluation and award of Phase I or II contracts, please read the front section of this solicitation very carefully. Every Phase II proposal will be reviewed for overall merit based upon the criteria in section 4.3 of this solicitation, repeated below:

a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.

b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.

c. The potential for commercial (defense and private sector) application and the benefits expected to accrue from this commercialization. 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 Web site 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 subcontractors);
  (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, and country when in an overseas location, using standardized nomenclature provided on Web site);

- 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 Web site. The CMRA Web site 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 $500.00 annually, or to be included in overhead rates.

DISCRETIONARY TECHNICAL ASSISTANCE

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), the Army will provide technical assistance services to small businesses engaged in SBIR projects through a network of scientists and engineers engaged in a wide range of technologies. The objective of this effort is to increase Army SBIR technology transition and commercialization success, thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth.

The Army has stationed Technical Assistance Advocates (TAAs) in five regions across the Army to provide technical assistance to small businesses that have Phase I and Phase II projects with the participating organizations within their regions.

For more information go to http://www.armysbir.com/sbir/taa_desc.htm.

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 09.1 Topic Index

Participating Organizations		PC	Phone
Aviation and Missile RD&E Center (Missile)		**Otho Thomas**	**(256) 842-9227**
A09-001	High Efficiency, Low Current, Switching Power Supply		
A09-002	Anti-tamper for JTAG boundary scan ports		
A09-003	High-Speed Surface Measurement Device		
A09-004	Solid State Infrared Flare		
A09-005	Polarimetric Sensor for Air-to-Surface Missile Systems		
A09-006	Missile Interceptor Base Flow Simulation		
A09-007	Equation of State for High Pressure Air		
A09-008	Metallic Grid Application for Green Ceramic Domes		
Edgewood Chemical Biological Center (ECBC)		**Ron Hinkle**	**(410) 436-2031**
A09-009	Low-Cost Method for Metal Nano-Coating of Anisotropic Carbon Fibers		
A09-010	Tactical Biofuel Production System for Forward Fixed Sites		
PEO Enterprise Information Systems		**Ed Velez** **Rajat Ray**	**(703) 806-0670** **(703) 806-4116**
A09-011	Bimodal Biometric Collection Device to Identify and Verify Subjects		
Program Executive Office Missiles and Space (PEO MS)		**George Burruss** **Rod Summers**	**(256) 313-3523** **(256) 313-1049**
A09-012	Tactical Ballistic Missile (TBM) Composite Tracking and Discrimination Capability for Army System of Systems (ASoS) Integrated Air and Missile Defense (IAMD)		

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, the 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 091 Topic Index

Army SBIR 091 Topic Descriptions

A09-001 TITLE: High Efficiency, Low Current, Switching Power Supply

TECHNOLOGY AREAS: Ground/Sea Vehicles, Electronics

ACQUISITION PROGRAM: PEO Missiles and Space

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: Contractor shall develop a low current, ultra high efficiency switching power supply for low power applications. The goal is to create a 1.0 to 10 mA switching power supply with greater than 99.8% energy efficiency. The switch mode power supply shall incorporate battery monitoring features.

DESCRIPTION: We are interested in an ultra high efficiency dc-dc converter power supply for low power battery applications. The DC to DC converter is required to take an input voltage from 1.5 to 15 volts. The output voltage shall be digitally programmable over the range of 2 to 6 volts DC. The DC to DC converter shall provide a power efficiency of greater than 99.8% over the output current range of 1 to 10 mA and greater than 99% efficiency for current range of 0.1 to 1 mA. The switching power supply shall incorporate battery monitory features to estimate the health of the battery, and remaining battery capacity.

The Phase III production level integrated circuit is required is required to meet
(1) peak-to-peak output ripple voltage shall be less than 4 millivolts. The root-mean-squared output ripple voltage shall be less than 0.4 millivolts.
(2) surface mount device shall be no larger than length, width, height of 0.78 by 0.43 by 0.21 inches with a minimum of external passive components (zero external passives are preferred).

PHASE I: Contractor shall research and determine the feasibility of developing a switching power supply to meet the following requirements:
(1) greater than 99.8% efficiency for an output current of 1 to 10 mA.
(2) greater than 99.0% efficiency for an output current of 0.1 mA to 1 mA.
(3) battery monitoring features (health of the battery, and estimate the remaining battery capacity)
(4) input voltage range of 1.5 to 15 volts.
(5) a digitally settable output voltage over the range of 2 to 6 volts DC.
(6) standby and shutdown modes to minimize non-operating power drain
- maximum current for standby mode < 10 microamps
- maximum current for shutdown mode < 0.1 microamps
(7) peak-to-peak output ripple voltage < 4 millivolts
(8) root-mean-squared output ripple voltage < 0.4 millivolts
(9) integrated circuit size no larger than (length, width, height) 0.78 by 0.43 by 0.21 inches.
(10) electromagnetic compatibility/radiated electromagnetic emissions of MIL-STD-461E.
(11) Temperature range:
- operating temperature range of – 50 Celsius to +85 Celsius.
- nonoperating temperature range of – 55 Celsius to +125 Celsius.
- Operation over the full military temperature range will be considered a plus.

The contractor shall provide a report describing the feasibility of achieving requirements (1) through (11).

PHASE II: Contractor shall develop proposed switch mode power supply from Phase I into a working prototype. Contractor shall miniaturize prototype switching power supply into a surface mount style package, smaller than (length, width, height) 0.78 by 0.43 by 0.21 inches. Contractor shall have an independent test and evaluation conducted on the switching power supply. Contractor shall provide the independent test and evaluation report to the

Government. Contractor shall deliver 2 switching power supply evaluation boards with prototype switching power supply integrated circuit to the Government. Contractor shall provide a final report, and a preliminary data sheet, for the switching power supply.

PHASE III: Contractor shall develop a production version of the Phase II switching power supply.
This SBIR topic addresses the need for low power components to increase system runtimes and reduce battery quantities and weight on the battlefield: Army Regulation AR 70-1; Research, Development and Acquisition; Army Acquisition Policy, 31 December 2003.
Battery operated and portable medical devices will benefit from higher efficient switching power supplies.
Modern consumer battery powered electronics, cell phones, handheld video games, pagers, smart phones, etc. all need more energy efficient power conversion to maximize battery life.

REFERENCES:
1. C. Basso: "Switch-Mode Power Supplies," McGraw-Hill Companies, February 2008, ISBN-13: 9780071508582.

2. J. Bennett: "Practical Computer Analysis of Switch Mode Power Supplies," CRC Press, July 2005, ISBN-13: 9780824753870.

3. F. Shearer: "Power Management in Mobile Devices," December 2007, ISBN-13: 9780750679589.

4. L. Ka and D. Alfano: "Design and implementation of a practical digital PWM controller," IEEE Applied Power Electronics Conference and Exposition, 9-23 March 2006.

5. A. Lotfi and M. Wilkowski: "Issues and advances in high-frequency magnetics for switching power supplies," Proceedings of the IEEE Vol. 89, Issue 6, pp. 833 – 845, June 2001.

6. R. Vazquez, et al.: "Theoretical study and implementation of a high dynamic performance, high efficiency and low voltage hybrid power supply," IEEE 32nd Annual Power Electronics Specialists Conference, vol. 3, pp. 1517 – 1522, 17-21 June 2001.

7. I. Lindroth, P. Melchert, and T. Sahlstrom: "Methods of improving efficiency in wide input range boost converters at low input voltages," IEEE Twenty-second International Telecommunications Energy Conference, pp. 424 – 431, 10-14 Sept. 2000.

8. C. Severt: "Design of dual use, high efficiency, 4H-SiC Schottky and MPS diodes," 35th Intersociety Energy Conversion Engineering Conference and Exhibit, Vol. 1, pp. 180 – 184, 24-28 July 2000.

9. Y. Nakayashiki: "High-efficiency switching power supply unit with synchronous rectifier," Twentieth International Telecommunications Energy Conference, pp. 398 – 403, 4-8 Oct. 1998.

10. J. Garate: "Ultra Low Input Current Consumption Power Supplies under No-Load Condition for Discontinuous Transmission Systems," pp. 1542 – 1547, 4-7 June 2007.

11. Y. Ramadass, and A. Chandrakasan: "Voltage Scalable Switched Capacitor DC-DC Converter for Ultra-Low-Power On-Chip Applications," IEEE Power Electronics Specialists Conference, pp. 2353 – 2359, 17-21 June 2007.

12. F. Khairy, et al.: "An Asymmetrical Switched Capacitor and Lossless Inductor Quasi-Resonant Snubber-Assisted ZCS-PWM DC-DC Converter with High frequency Link," CES/IEEE 5th International Power Electronics and Motion Control Conference, Vol. 2, pp. 1-5, 14-16 Aug. 2006.

KEYWORDS: Low power, high efficiency, switching power supply, battery operation

A09-002 TITLE: Anti-tamper for JTAG boundary scan ports

TECHNOLOGY AREAS: Materials/Processes, Electronics

ACQUISITION PROGRAM: PEO Missiles and Space

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: Contractor shall develop methods for controlling access to, preventing tampering through Joint Test Action Group (JTAG) boundary scan ports for microprocessors, field programmable gate arrays (FPGA), or other integrated circuits.

DESCRIPTION: JTAG boundary scan techniques, and other types of test access ports (TAP), have become critical in the design, test, and maintenance of modern digital designs. At the most fundamental level, these TAPs allow for the verification of hardware interconnections via boundary scan. However, many systems use them to upload software and data, access debugger capabilities, verify memory and register contents, and generally provide full and open access to the internals of a device under test. While these capabilities are critical to the development process and to system maintenance, they provide a major vulnerability to the security of a system once it is fielded. We are interested in software and/or hardware techniques to protect and control access to JTAG boundary scan ports on commercial integrated circuits, including but not limited to microprocessors, FPGAs, and ASICs. We are interested in techniques to detect a boundary scan in process and/or prevent unauthorized boundary scans. These techniques should not impede the developer's access to the normal JTAG function; but, once invoked, these techniques should detect and/or disallow all unauthorized accesses to the JTAG port in a way that is irreversible both at the software and hardware level. Once invoked, these techniques should determine access authority in a way that is difficult to spoof. The techniques should be effective even in the face of off-nominal operation (outside the performance specifications for the integrated circuit). The basic idea is to deny even a very capable and determined adversary access to this port.

We are interested in techniques for protecting JTAG ports on common commercial integrated circuits commonly used in embedded computer systems (PowerPC, FPGA, ASICs, microcontrollers, etc.) The contractor may focus on protecting a specific microprocessor, FPGA, etc. or the contractor may choose to focus on applying protection techniques to a wider range of devices.

PHASE I: Contractor shall research and determine the feasibility of developing a method(s) to protect JTAG ports, detect JTAG boundary scans, etc. Contractor shall provide a report on the proposed hardware/software method to control access, and/or detect boundary scans, etc.

PHASE II: Contractor shall developed proposed method from Phase I into a functional prototype. Contractor shall demonstrate the effectiveness of the anti-tamper for JTAG boundary scans. Contractor shall have an independent test and evaluation conducted to test the effectiveness of the prototype.
Contractor shall provide a final report, an independent test and evaluation report, and deliver a prototype to the government point of contract. Contractor shall provide a 1 day demonstration and training at the government's facility.

PHASE III: Department of Defense Directive (DOD) 5000.2R provides instructions on identifying critical technologies and on defining methods to protect them. Commercialization opportunities exist throughout the Defense Department. Commercialization potential exists with other agencies like the Department of Homeland Security. Contractor will evaluate the potential of creating a commercial version of the JTAG protection technology for civilian markets of electronic funds transfer, banking industries, electronic automatic teller machines (ATM), and Federal Information Processing Standards Publication (FIPS) 140-2 [12] applications.

REFERENCES:
1. R. Oshana: "Introduction to JTAG", Embedded Systems Design, October 29, 2002. www.embedded.com.

2. TI: "TMS320C6000 DSP Designing for JTAG Emulation Reference Guide," Dallas, TX, 2003, http://focus.ti.com/lit/ug/spru641/spru641.pdf

3. K. Parker: “Boundary-Scan Handbook,” Springer-Verlag, New York, 2003, ISBN-13: 9781402074967.

4. Wikipedia: “JTAG,” June 2008, http://en.wikipedia.org/wiki/Jtag.
J. Andrews: “An embedded JTAG, system test architecture,” IEEE Electro/94 International Conference Proceedings, pp. 691-695, 10-12 May 1994.

5. C. Ravikumar, and S. Chopra: “Testing interconnects in a system chip,” Thirteenth International Conference on VLSI Design, pp. 388-391, 3-7 Jan. 2000.

6. S. Pizzica: “Open systems architecture solutions for military avionics testing,” Proceedings of Digital Avionics Systems Conferences, Vol. 1, pp. 4D1/1 - 4D1/8, 7-13 Oct. 2000.

7. R. Barr, et al.: “End-to-end testing for boards and systems using boundary scan,” Proceedings of International Test Conference, pp. 585-592, 3-5 Oct. 2000.

8. S. Gyoochan: “Test ready core design for a DSP core,” Twelfth Annual IEEE International Conference ASIC/SOC, pp. 243-248, 15-18 Sept. 1999.

9. C. Cousineau, et al.: “Design of a JTAG based run time reconfigurable system,” Annual IEEE Symposium on Field-Programmable Custom Computing Machines, pp. 268-269, 21-23 April 1999.

10. T. Huan-Chih, et al.: “On improving test quality of scan-based BIST,” EEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, Vol. 19, Issue 8, pp. 928-938, Aug. 2000.

11. A. Jas, et al.: “Virtual scan chains: a means for reducing scan length in cores,” 18th IEEE VLSI Test Symposium, pp. 73-78, 30 April-4 May 2000.

12. NIST: “Security Requirements for Cryptographic Modules,” Federal Information Processing Standards Publication 140-2, December 2002. (http://csrc.nist.gov/publications/fips/fips140-2/fips1402.pdf)

KEYWORDS: JTAG, boundary scan, anti-tamper, FPGA, field programmable gate array, system-on-a-chip, SOC, microprocessor, ASIC

A09-003 TITLE: <u>High-Speed Surface Measurement Device</u>

TECHNOLOGY AREAS: Materials/Processes, Weapons

ACQUISITION PROGRAM: PEO Missiles and Space

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: The objective of this topic is to develop a high-speed measurement technique and the requisite hardware to support on-going research into weather impact damage assessments for both current and advanced infrared (IR) domes and radome materials. The measurement parameter of interest is a 3D surface map of non-flat surfaces with an accuracy of one thousands of an inch. The surface to be measured will have a velocity in the range of 1000 to 5000 feet per second. Dynamic holography is one emerging technology of interest that has the potential to produce this needed capability, but other non-invasive approaches will be considered in this topic.

DESCRIPTION: IR transparencies and radomes while traveling through the atmosphere encounter particulates (rain, ice, sand) which can be very damaging and can ultimately cause catastrophic failure of the IR transparency, transmission loss increases, an increase of radome boresight error, and numerous other detrimental changes . In addition, the mechanical erosion of thermal protection system materials can enhance heating leading to potential system failures, and will typically decrease system delivery accuracy.

Currently, the assessment of such materials for military systems has included single drop testing (water or water simulant), and sled testing. While single drop testing is needed to understand the detailed fracture mechanics of a brittle ceramics, there is a question about possible incubation responses that require multiple impacts before any damage is manifested. Indications of this have been seen for a variety of materials. Sled testing will remain the final system validation test, but it cannot reproduce the damage that would ultimately occur at altitude, and its cost does not make it amenable to material development efforts. Due to these limitations, there has been a need established by the Tri-Service Weather Encounter Working Group lead by AMRDCE for a testing method that can fill in all of gaps between these two established methods.

The basic concept is to utilize gun ranges with controlled dripper systems installed to induce flight-like environments. The projectiles, with material samples installed, would fly through a well controlled weather environment, and would be "imaged" as it exited the field. This would allow for a detailed mapping of the surface for subsequent analysis. The projectile would then enter another weather environment and be imaged again. This process would occur multiple times and the detailed physics of the impact damage as a function of altitude, drop shape, drop size, and velocity, would be captured with a fully coupled aerodynamic environment. This novel testing approach combined with a high-speed surface measurement device has the potential of advancing the weather resistance of all future seeker domes, radomes, and thermal protection system materials.

PHASE I: The focus of the Phase I effort is to develop and demonstrate a lab-scale prototype system of the basic approach. In this prototype the surface area to be covered should be on the order of a six inch projected square. Performance parameters would be surface roughness and deformations that range from a tenth of an inch to one mil. The surface does not have to be moving at a high rate of speed, but the final Phase II approach must be able to capture an image in microseconds. Test set-up, planning, and execution can be coordinated through the topic monitors and the small business is not required to have the expertise in weather encounter physics needed to perform the final system testing.

The Phase I program should also highlight the probable performance, cost, set-up, calibration time, and usage requirements of the expected Phase II system. Several systems might be needed for the full implementation of this approach so cost will be a key parameter. In addition, the Phase I program should be able to logically transition into the Phase II effort that will begin to extend the measurement rate to those required for the test methodology.

PHASE II: The Phase II program will develop and demonstrate a full-scale measurement device/approach that can be used in multiple facilities to record high-speed visualization of surface roughness and contours. The system must be capable of coordinating at least three separate measurement stations, and quickly post-process the data in a format suitable for post-test data review. At the end of the Phase II program, developed hardware should be considered as off-the-shelf for various test facilities to purchase.

The Phase II effort will also extend the Phase I slow rate measurement capability to rates high enough to accurately image surfaces traveling up to five times the speed of sound. The Phase II product must provide a user friendly interface to automatically calculate the surface contours. The surface required to be imaged in this effort would be on the order of a projected six-inch square or greater and the surfaces will likely be hemispherical, conical, or an ogive, but should not be limited to such shapes.

PHASE III: The Tri-Service Department of Defense Weather Encounter Working Group being which is coordinating the research into all areas of high-speed weather encounters has identified the need for such a measurement device as one of their key technology areas of interest to vastly increase our knowledge of material performance in real-world weather environments.

The Phase III use for this topic exists in enabling Government, major aviation/missile system integrators, and subsystem component developers to produce superior aviation and flight systems with sufficient design margin to make advanced systems "all-weather" capable. Such a measurement device is needed at government sled track facilities, both government and commercial sand and dust facilities, and whirling arm test facilities.

In addition to these uses, such a device would be highly desirable for use in a multitude of industries that require manufacturing inspections of parts. Such a high speed device would enable large part inspections at unbelievable rates. This would decrease quality control costs dramatically, and also greatly increase the inspection rates. When manufacturers can both quickly and accurately map all of the flaws and surface deformations on their parts, they can compare these results to the minimum standards and immediately know if a part is acceptable or must be rejected.

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KEYWORDS: Dynamic holography, Non-intrusive measurements, High-speed measurements, Surface profilimetry, Analog holography, Digital holography

A09-004 TITLE: Solid State Infrared Flare

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PEO Missiles and Space

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 replacement for the M278 Infrared Flare using solid state lighting technology.

DESCRIPTION: The Army and other services use the M278 Infrared flare rocket to provide illumination compatible with night vision gear. The current flare uses an illuminant candle which is subject to variations in burn times and provides some output in the visible region. Recent advances in solid state lighting offer the potential to replace the burning candle with a Light Emitting Diode (LED) or other solid state source. Use of the LED would allow consistent output both in power and in duration. The spectral content of the light can also be tailored to optimize the output in the wavelengths of interest to the user while minimizing or eliminating output in undesirable regions. Current solid state lighting applications have focused on replacing traditional incandescent lighting. Further effort is needed to tailor solid state lighting for the flare application.

PHASE I: Conduct a feasibility study on approaches to providing a solid state replacement for the candle in the flare rocket. The study should include an analysis of several approaches for the light source, electronics, optics, and power. Operating alternatives, such as high speed pulsing, should also be investigated. Current solid state lighting applications have required long operating lifetimes. The flare application is required to operate for only 180 seconds. Limited destructive bench tests of LEDs or other sources to drive them into the extreme high output regimes while measuring photometric and lifetime data should be performed. The desired spectral output in the 0.7-1.1 micron region is a minimum of 250 watts/steradian. The output of Phase I should be a proposed design for a solid state replacement for the infrared candle meeting the specifications above. The final report should also include results from the destructive testing.

PHASE II: The goal of Phase II is a benchtop demonstration of a form factor solid state infrared flare. Measurement of the optical, electrical, and lifetime characteristics of the prototype shall be conducted. Experiments to show that the prototype design would survive the shock environments of the M278 rocket should also be performed.

PHASE III: Finalize the design for production of the solid state flare replacement. Life fire demonstrations will be conducted. Commercial applications include high intensity blinking rescue beacons and broadcast tower beacons.

REFERENCES:
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KEYWORDS: flare, solid state lighting, light emitting diodes, LED

A09-005 TITLE: <u>Polarimetric Sensor for Air-to-Surface Missile Systems</u>

TECHNOLOGY AREAS: Electronics, Weapons

ACQUISITION PROGRAM: PEO Missiles and Space

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OBJECTIVE: Develop and integrate a dual-band (mid and long wave) electro-optic Polarimetric sensor for air-to-ground missile systems.

DESCRIPTION: The Army has identified the need to enhance existing tactical, precision guided missile systems by utilizing emerging sensor technologies. Recent advances in situational awareness and ISR imagery have resulted in improved capabilities for locating and identifying potential threats. The need still exists to transition these enhancements to missile systems to more fully utilize their effectiveness for increasing the missile's autonomy. Previous development has provided polarimetric imaging hardware that is too large to implement in missile constraints. Polarimeters to date have been used in either fixed environments (no motion) or relatively slowly moving environments. Therefore, micro polarimetric sensor packages need to be researched and developed to address the size issues along with resolution and sensitivity problems that arise with smaller packaging. Polarimetric imagery is one promising enhancement to aide targeting and guidance for automatic target recognition and tracking systems. Electro-Optical Polarimetric imagery can provide improved contrast and help defeat countermeasures in situations where visible or infrared sensors have difficulty. Specifically, when targets and backgrounds exhibit minimal visible or thermal differences, polarization contrast can still be significant. This topic seeks innovative concepts for incorporating polarimetric imaging into seekers for missiles. Size, weight and power (SWAP) is limited to existing missile resources.

PHASE I: Determine the most appropriate polarimetic sensor design with requirements and appropriate architecture for use on an air-to-ground missile system and analyze the feasibility of implementation. Develop sensor design requirements and conduct a trade study for key sensor components. Candidate sensor designs should minimize impact to existing field-of-view and image resolution capabilities. Direct fire and fly over shoot down geometries are required. Complete a sensor design concept and demonstrate through modeling or analysis that it meets the requirements. Real-time polarimetric image processing requirements should also be addressed.

PHASE II: Use the design requirements and concept developed in Phase I to build a prototype of the polarimetric sensor. Develop polarimetric imagery specific target tracking algorithms. Conduct a detailed analysis of the sensor performance in a laboratory environment. Provide engineering data that shows the sensor meets SWAP required for use in missile platforms.

PHASE III: Develop a polarimetric sensor design package for integration into a tactical, air-to-ground missile system such as the JAGM. Conduct captive carry and hardware-in- the-loop test of the sensor and missile system to show the sensor meets all performance requirements. Additionally, conduct a live test including actual deployment from an airborne platform. Other multi-mode seeker missile programs could benefit from this technology such as the Air Force's Small Diameter Bomb II program. This polarization technology could be used in search and rescue operations.

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KEYWORDS: Polarimeter, missile, sensor, targeting.

A09-006 TITLE: Missile Interceptor Base Flow Simulation

TECHNOLOGY AREAS: Air Platform, Weapons

ACQUISITION PROGRAM: PEO Missiles and Space

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OBJECTIVE: To develop an advanced detailed physics-based model for the flow field in the base of a missile interceptor capable of capturing the flow physics of a hypersonic, low altitude, solid propellant missile in flight.

DESCRIPTION: Missile base flow is an area that has eluded a satisfactory solution since the 1950"s. This flow region contains most of the complications of aero thermo chemical problems including flow separation, two phase gas/particle non equilibrium, chemical kinetics, turbulent flow, and complex geometry. Even the state of the art hybrid Reynolds averaged Navier Stokes/ Large eddy simulation (RANS/LES) computational fluid dynamic (CFD) formulations have proven largely inadequate to use as a predictive tool.

Innovative solutions techniques are sought which can advance the state of the art for the prediction of the flow field in the base region of a hypersonic missile flying at low altitude (turbulent flow) while accounting for the effects of incoming boundary layer, asymmetric body flows, arbitrary particle size/number densities at the combustor exit, and three dimensional arbitrary geometry. The model shall be able to predict the flow separation environment, base heating, particle distribution field, and aerodynamic loading in the base region as well as base drag.

PHASE I: Innovative technical approaches will be formulated in Phase-I to address the key problem areas of hypersonic base flow modeling; namely, the coupled effects of incoming boundary layer flows, asymmetric body flows, arbitrary particle size/number densities at the combustor exit, and three dimensional arbitrary geometry along with possible flow separation, and base heating/burning. These formulated approaches shall be coded into an existing computational fluid dynamic model for non equilibrium, chemically reacting multiphase flows.

One meaningful demonstration shall then be executed and a flow field solution produced with this advanced computational model during Phase I. This demonstration shall model the simple case of a Mach 2.5 air flow over an axisymmetric cylindrical body-base as given in References 4-6 since this methodology would feed directly into the Phase II model development. Although not a hypersonic test case, this high quality open literature data set has proven to be a challenge for state-of-the-art hybrid RANS/LES CFD models without adding the complexities of an engine exhaust or hypersonic effects. The outcome of this Mach 2.5 test case will serve as a gauge to assess the potential for Phase II success.

PHASE II: The physical model formulated in Phase I will be developed and refined using computational fluid dynamics to evaluate engine performance and flight characteristics over a range of flight scenarios of interest. Additionally, this advanced computational fluid dynamics model will be run blind for a hypersonic test case for which detailed flowfield data will be made available to allow the contractor to demonstrate the advanced capabilities for analyzing and modeling base flow regions.

PHASE III: If successful, the end result of this Phase I/Phase II research effort will be a validated predictive model for the analysis of hypersonic, low altitude, solid propellant missile base flows.

The transition of this product(a validated research tool) to an operational capability will require additional upgrades of the software tool set for a user friendly environment along with the concurrent development of application specific data bases to include the required input parameters such as missile geometries, solid rocket motor properties, and performance parameters.
For military applications, this technology is directly applicable to all rocket propulsion missile systems. The most likely customer and source of Government funding for Phase III will be those service project offices responsible for the development of advanced missile interceptors such as the KEI, THAAD, PAC-3, and NMD programs.

For commercial applications, this technology is directly applicable to all commercial launch systems such as the NASA Aries, and the Delta and Atlas families.

REFERENCES:
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KEYWORDS: Base flow, computational fluid dynamics, two phase, gas particle flow, finite rate chemistry, combustion, propulsion, aerodynamics, hypersonics.

A09-007 TITLE: Equation of State for High Pressure Air

TECHNOLOGY AREAS: Materials/Processes, Weapons

ACQUISITION PROGRAM: PEO Missiles and Space

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OBJECTIVE: To formulate and validate a thermodynamic equation of state for high pressure air.

DESCRIPTION: The development of a thermodynamic equation of state covering the full operational range of hypersonic flight is necessary in the development of missile interceptors. Such equations have been offered but lack validation data for air at high pressures and temperatures.

The National Institute of Standards and Technology (NIST) has previously developed a data base for a variety of fluids encompassing a wide range of thermodynamic conditions. This data base is, in fact, currently being used to advance hypersonic missile technology. In this data base, data for N2 are available for pressures to 2000 MPa and temperatures from 300 K to 1000 K but reliable data for air extend only to pressures of 100 MPa. NIST used a combination of this high accuracy N2 data, theoretical thermodynamics, and a scaling of N2 and air data to develop an equation of state for air covering the entire range up to 2000 MPa. However, since data was not available at pressures greater than 100 MPa, the quality of the data at higher pressures is unknown. Hence, an experimental data base for air at elevated pressures and temperatures is required to validate the NIST semi empirical data base, and to advance the state of the art in hypersonics.through formulation and validation of an equation of state for high pressure air.

PHASE I: The contractor shall develop the technology to produce a thermodynamics equation of state for air valid up to 2000 MPa. Phase I proposals shall demonstrate the contractor’s analytical capability to pose an equation of state by formulating the theoretical thermodynamics equations to include the interaction physics between the molecules. For example, the physics of dense gases is much different than lower pressure gases since molecular interactions occur at a distance. Phase I proposals shall also demonstrate the contractor's experimental capabilities to measure the required thermodynamic properties at the relevant conditions. The contractor must demonstrate both the capability to produce the thermodynamic conditions of interest and previous experience in the measurement of thermodynamic properties at relevant conditions. Specifically, the contractor shall propose the facility to be used for the measurements, an instrumentation plan which describes the specific instrumentation that will be used in the experimental program, and a program plan detailing the data acquisition, data reduction, data smoothing, data matrix, and data presentation. In addition, the contractor shall demonstrate the feasibility and quality of the plan by acquiring sample data in the range where no data currently exist.

PHASE II: The contractor shall produce an experimentally validated equation of state over the entire range from 100 MPa to 2000 MPa. To accomplish this, the plan formulated in Phase-I shall be implemented to cover the entire void in the high pressure air data base from 100 MPa to 2000 MPa at selected temperatures in the 300 K to 1000 K range. It is unlikely that the entire temperature range can be covered in Phase-II and further, that the temperature range to be covered will need to be developed as the Phase-II program matures to assure validity of the proposed equation of state for high pressure air.

PHASE III: If successful, the end result of this Phase-I/Phase-II research effort will be a validated equation of state for high pressure air from 100 MPa to 2000 MPa at temperatures within the range from 300 K to 1000 K.

The transition of this product, a fully validated equation of state for high pressure air, will require additional testing to adequately cover the temperature range from 300 K to 1000 K.

For military applications, this technology is directly applicable to all high speed air-breathing missile systems. The most likely customer and source of Government funding for Phase-III will be those service project offices responsible for the development of advanced hypersonic missile systems such as the Navy/DARPA HyFly, Air Force X-51, and DARPA Facet programs.
For commercial applications, this technology is directly applicable to industrial processes using very high pressure gases such as currently employed in the decaffeinated of coffee and nicotine modification in tobacco.

REFERENCES:
1. NIST Standard Reference Database 23, http://www.nist.gov/srd/nist23.htm.

2. Jacobsen, R.T., Clarke, W.P., Penoncello, S.G., and McCarty, R.D., "A thermodynamic property formulation for air. I. Single-phase equation of state from 60 to 873 K at pressures to 70 MPa," International Journal of Thermophysics, Vol 11, No. 1, January 1990.

KEYWORDS: High pressure air, equation of state, experimental verification.

A09-008 TITLE: <u>Metallic Grid Application for Green Ceramic Domes</u>

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PEO Missiles and Space

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: The goal of this topic is to develop methods for applying/printing a metallic/conductive grid to the surface of a green ceramic hemispherical dome.

DESCRIPTION: A multilayered tri-mode seeker dome has recently been demonstrated but the design is not easily manufactured and is prohibitively expensive. An alternate approach being considered has potential to ease manufacturing and reduce costs. One of the key technical areas to overcome is the ability to deposit/print a metallic grid on a green ceramic dome. The important technical aspects are to be able to apply sufficiently narrow, continuous lines of conductive material on green ceramic surfaces. The conductive material must be able to survive the high temperatures encountered during the firing process and still maintain sufficiently low electrical resistance. The approach must be affordable and compatible with high rate production.

PHASE I: Demonstrate a process for applying/printing a conductive grid to the surface of a green ceramic ALON or spinel 4 inch domelet with approximately 3.5 inch radius. The grid can be applied to either the concave or convex surface. The grid must have line widths less than 1 mil and grid spacing between 10 and 20 mil. The conductive material has to have sufficiently low electrical resistance after firing, less than 4 ohms/square for an approximately 90% open area square grid. The conductive lines will/may be opaque, but cannot degrade the transparency of the surrounding fired ceramic.

PHASE II: Demonstrate the application of a conductive grid to either an ALON or spinel green ceramic 7-in hemispherical dome. The process from Phase I must be expanded to demonstrate depositing/printing on both the concave and convex surfaces. The process should demonstrate a production capability that supports 250 domes per month.

PHASE III: Demonstrate a full production capability for applying/printing conductive grids on hemispherical green ceramic domes using the application technique(s) developed and refined in Phases I and II. It must be shown that all aspects of manufacturing can be put in place to support large scale production at rates to be determined by the Army.

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KEYWORDS: conductive grid, deposition, ink printing, metallic ink, green ceramic, ALON, spinel

A09-009 TITLE: <u>Low-Cost Method for Metal Nano-Coating of Anisotropic Carbon Fibers</u>

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: To develop a low-cost method of coating individual carbon fibers with a 50-nanometer or less highly conductive metal layer.

DESCRIPTION: Currently carbon fibers are produced regularly with diameters ranging from tens of nanometers to microns. Carbon fiber has many military and industrial applications because of its strength, heat resistance, and, in nano-size, its optical properties. Coating carbon fibers will enhance their electrical and optical properties, thus opening the doors for new military applications and improving current applications. Because metal coated carbon fibers have enhanced optical properties; they are excellent attenuators in the microwave region of the electromagnetic spectrum. The Joint Program Manager (JPM) Reconnaissance and Platform Integration will start an obscurant microwave munitions acquisition program in fiscal year 2014. These metal coated carbon fibers can be used as the payload for the JPM microwave obscuration program. The increase of microwave attenuation by metal coating of carbon fibers has been proven in theory (Waterman, et al.).

PHASE I: Obtain or produce carbon fibers with diameters less than 2 microns which are NOT agglomerated (As an alternative, a non-conductive fiber with a diameter of less than 5 microns will work). Develop a procedure to coat the fibers with different metals of various coating thicknesses up to 50 nanometers. Produce 50 to 100 gram quantities of the metal-coated (conductivity of iron or better) carbon fibers - in dry form, preferably. Agglomeration must not exceed 50% of sample to facilitate aerosolization of fibers. Demonstrate by scanning electron microscopy (SEM) that the thickness of the metal coating is less than 50 nanometers and that the coating is continuous. Demonstrate by 2-pt or 4-pt conductivity test that coated fiber has a DC conductivity within a factor of 10 of the pure metal used for coating. Perform aerosol optical tests to determine microwave screening performance. Carbon fibers with a diameter of 8 microns and a length of 3 millimeters or 6 millimeters have an extinction coefficient of about 3 m2/gm at 35 GHz. To be useful, a metal-coated carbon fiber should have an extinction coefficient of at least twice this value. Government facilities at ECBC will be used to measure the performance.

PHASE II: Scale-up metal coating process for capability to produce 10-kilogram runs and perform product quality tests. Aerosol chamber tests will be conducted to measure the microwave attenuation performance and to characterize the fibers. In Phase II, a design of a manufacturing process to commercialize the production of low-cost metal nano-coated carbon fibers should be developed. A total of 5 kilograms of material will be produced and delivered to the government.

PHASE III: This product is a material that can be integrated into current military applications: Electromagnetic Interference (EMI) shielding, vehicle parts and combat uniforms. New military application would be microwave threat sensor countermeasures. Industrial applications for the metal-coated carbon fibers include electronics, fuel cells/ batteries, furnaces and others.

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3. Bohren, C.F.; Huffman, D.R. Absorption and Scattering of Light by Small Particles; Wiley-Interscience: New York, 1983.

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KEYWORDS: Metal coating, carbon fiber, nano-size, nanoparticle, microwave, manufacturing process, manufacturing coatings

A09-010 TITLE: Tactical Biofuel Production System for Forward Fixed Sites

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

OBJECTIVE: Develop an onsite, portable and scalable biofuel production facility that can support ongoing tactical mobility and energy requirements at forward deployed locations.

DESCRIPTION: Currently, the ability to operate tactical vehicles in forward-deployed locations over extended timescales requires the ability to establish long, logistically cumbersome supply lines for diesel fuel, resulting in additional high costs and risk to the personnel who drive and escort fuel convoys. In addition, the climbing costs for petroleum make the development of alternative fuel sources for military vehicles an increasingly pressing need. The most hopeful solution to these urgent military needs are found within the broad purview of biofuels. To date, biofuels research has focused primarily on large-scale ethanol production from corn grain (starch) and sugar cane (sucrose) that, while reducing the environmental impact and the dependence on foreign fuel sources, still suffer from dependence on long supply lines, dependence on food crops, low liter per hectare yield, and high energy requirements, (Chisti 2007; Chisti 2008; Hill et al. 2006; Patzek 2004; Williams 2007). However, ongoing research into non-food feedstocks for ethanol production (e.g. switch grass, bagasse, corn stover, wood, grasses), other photosynthetic biomass sources such as alga, combined with rapid progress in genetics and biotechnology, and advances in small-scale processing technology should make tactical in-theater production of biofuel possible (Gray et al. 2006; Hahn-Hagerdal et al. 2006; Chandra et al 2007; Chisti 2007;Chisti 2008). Specifically, high-yield ethanol or oil-producing systems (Spolaore et al. 2006) combined with efficient small–scale, solar-powered biofuels harvesting and production is desired. The proposed system must be capable of producing tactically relevant quantities of biofuels at long-term, forward "off-grid" operating sites. Ideally such a system will be operated by enlisted-level personnel and will be able to produce operationally relevant quantities of biofuel with minimal ongoing maintenance.

PHASE I: The Phase I study will demonstrate the performance and efficiency of the proposed ethanol, oil, or bio-diesel fuel production system at a reasonable lab–scale, and be able to point to how the system will be scalable for movement to and operation in forward operating sites. System must not rely on food crops, or long lead times to grow fuel –specific biomass.

PHASE II: The Phase II effort will fabricate and test a forward-deployable bio-fuel generation system that meets military requirements for quality, deployability, volume, and operation.

PHASE III: Current ethanol biofuels require similarly long logistical supply chains since they cannot be transported in pipelines due to their hygroscopic nature. Likewise, the requirement to transport conventional petroleum fuels to agricultural areas introduces significant inefficiencies into our current food supply system that might be overcome with point-of-use biofuels production capabilities. Therefore, the ability to produce "tactical" quantities of biofuels using minimal land area is also critical to the development of a petroleum-independent fuel supply and to supply fuel for other geographically remote and "off-grid" locations.

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KEYWORDS: biofuel, biodiesel, bio-oil, solar, lignocellulose, ethanol, algae, tactical, transportation

A09-011 TITLE: Bimodal Biometric Collection Device to Identify and Verify Subjects

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PEO Enterprise Information Systems

OBJECTIVE: Design, build and demonstrate the capability of a bimodal collection device to identify and verify subjects at a distance.

DESCRIPTION: The US Army has a requirement for a full function, bimodal collection device that uses iris and facial recognition biometrics signature for identifying known enemy combatant. This device will be operated similar to a surveillance camera monitoring up to a minimum 100 meter away, with a 90 degree field of view. It must provide simultaneous biometric signature up to a minimum of 10 subjects per every 30 sec (Objective), 60 sec (Threshold) data stream. The scope of this project is to develop an integrated biometric collection device incorporating the two biometric signatures and detecting multiple subjects simultaneously. Currently this capability is not available in the market place. This capability will allow us the ability to identify known combatants who are surveying or executing attacks on US positions. All Biometric and Biographical Data formats shall be Electronic Biometric Transmission Specification (EBTS) /Electronic Fingerprint Transmission Specification (EFTS) compliant. The system design shall be an open architecture, Industry standard compliant and maximized COTS component usage to ensure seamlessly integration with existing Department of Defense (DoD) and commercial biometrics collection and identification systems.

PHASE I: Perform a feasibility study to determine if iris and facial recognition signatures can be captured at distances up to 100 meter. The study shall include specific performance parameters, anticipated system limitations, and an assessment of technical risk. Prepare a preliminary design including interface requirements.

PHASE II: Develop, test and demonstrate prototype(s) under representative operational environments.

PHASE III: The initial path for transition will be thru PM Biometric, which will integrate it into its Enterprise Biometrics Architecture to provide identity superiority across the Department of Defense. The techniques, processes and technology developed may be applied to other federal sector in support of the Global War On Terror. And commercial businesses that have similar need, like banks to identify known suspect before they reach the teller.

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KEYWORDS: Biometric Identification & Detection Equipment

A09-012 TITLE: Tactical Ballistic Missile (TBM) Composite Tracking and Discrimination Capability for Army System of Systems (ASoS) Integrated Air and Missile Defense (IAMD)

TECHNOLOGY AREAS: Weapons

ACQUISITION PROGRAM: PEO Missiles and Space

OBJECTIVE: Develop innovative advanced techniques, algorithms and software for composite tracking, classification and discrimination of tactical ballistic missiles that meet requirements for, and can be integrated into, the Joint Track Manager (JTM) function of the Single Integrated Air Picture (SIAP).

DESCRIPTION: The US Army Air and Missile Defense requires the evolution of current systems and those under development to become an integrated Army System of Systems (ASoS) architecture to enable increased operational flexibility to meet the needs of the current and future battlefield. This ASoS architecture is designed to depart from the system-centric architectures of the past and evolve into a network-centric architecture, where component sensor and weapon elements can serve the needs of the netted architecture, instead of their own individual command and control element. The ASoS architecture will integrate sensors, weapons, and a common battle command element across a single Integrated Fire Control (IFC) network. The Common Battle Command element is called the Integrated Air and Missile Defense Battle Command System (IBCS).

Potential sensors to be included in this ASoS architecture include JLENS, Patriot radar, Sentinel radar and the Missile Defense Agency's (MDA) ANTPY-2 class radars (e.g., THAAD, Forward Based). The ASoS has the requirement to perform composite tracking on tactical ballistic missiles and support contribution of composite tracks into the joint Single Integrated Air Picture (SIAP). This composite tracking capability will be performed in a distributed fashion across the above referenced systems for both TBMs and Air Breathing Threats (ABTs) simultaneously. This composite tracking capability differs from civilian air traffic control systems in that the composite tracker will be processing and correlating both aircraft and high velocity missile tracks from multiple military sensors resulting in a single composite track that will be used for threat engagements. The distributed process is preferred to utilize measured data, but other alternatives will be considered and are encouraged that utilize tracklets or tracks. The solution must address the TBM correlation/association process at the sensors to generate associated measurement/tracklet/track reports. In addition, the solution must support separating objects and rules associated with which objects to report. The intent of the composite tracking is to fuse the measurement, tracklet or track data from multiple sensors into a single integrated composite track of the object. By using multiple sensors to observe targets at different geometries, there is the potential for an integrated air picture that is much improved over the air picture of any single sensor (it may be more complete, more accurate, etc.). However, in order to realize the potential advantages, there are a number of challenges that must be overcome. In order to eliminate redundant tracks, it is important that data registration be addressed. Data registration is the process of correcting for navigation, alignment, and timing errors across all platforms. Redundant tracks reduce the clarity of the air picture and may result in wastage of engagement resources. Data association is also a critical component of the composite tracking process, especially in the presence of maneuvering targets or closely-spaced objects. Proper data association is key in establishing the correct number of tracks for the correct number of truth objects, when the individual objects are resolvable by the sensors. In addition, data association is important in ensuring that the correct identification data (for air breathing targets) or correct discrimination data (for ballistic missiles) gets paired with the correct track. Incorrect association of this data could result in leakage, fratricide, or wastage. Because classification, discrimination, and identification (CDI) decisions are an important component of the air picture, it is important that CDI is also worked in an integrated fashion, and not just track kinematics. To take advantage of some of the benefits of composite tracking it may be desirable that sensor resource allocation be conducted with the knowledge that the other sensors are present. This may be difficult or not possible with existing sensor suites where the ability to modify sensors may be limited.

The performance of the IBCS composite tracking function will be required to adhere to the following SIAP attributes: Completeness, Clarity, Continuity, Kinematic Accuracy, ID completeness, ID Correctness, ID Clarity and Commonality. Some of the technical issues to be considered for a composite track capability include: a) a process for handling situations in which track classification is ambiguous, b) a process for handling situations in which track classification decisions are wrong and need to be corrected, c) the need for distributed track data fusion, d) interaction of track-related data with battle management functionality, e) host system displays, f) allocation of functions between IABM (Integrated Air and Missile Defense System Behavior Model) and ASoS sensor components, and g) identification of interfaces between system and distributed system components.

Another major issue related to the composite track problem is classification and discrimination of air breathing targets, TBMs and associated objects that support the IBCS fire control timelines. The component sensors within the ASoS IAMD network vary in terms of operating band, detection range and bandwidth. A major issue in TBM engagements is the identification of the lethal object, or potential lethal objects, among the associated inbound objects. To be worked in conjunction with the composite track are techniques for performing composite discrimination to establish the likely lethal object(s) based on features from multiple sensors and during multiple phases of the TBM flight. The solutions should be implementable within a distributed system similar to the composite tracking solution. The sensor data from the ASoS sensors should be combined with the data from the MDA sensors as well to refine the discrimination solution. Potential applications include the IAMD SoS IBCS, SIAP, Counter Rockets, Artillery and Mortar System, Homeland Defense Border Surveillance, and Drug Enforcement Air Interdiction.

The key technical risks in developing a composite tracking capability are data association between multiple sensor sources (e.g., correcting pairing of track data with an object) and data registration for correction of navigation, alignment, and timing errors across multiple sensor platforms. In terms of programmatic risks, the most significant programmatic risk is being able to successfully integrate the composite tracking algorithms into the SIAP Joint Track Manager.

PHASE I: Perform an engineering study to investigate and evaluate alternative composite tracking and discrimination techniques and architectures for 1) building a composite track file from multiple individual sensor track sources and 2) performing a discrimination function based on the composite track file.

PHASE II: Develop composite tracking and discrimination software for integration into the Joint Track Manager (JTM) within the ASoS IBCS. Conduct performance assessment of the composite tracking and discrimination software. Perform verification and validation of composite tracking and discrimination software relative to meeting SIAP JTM performance requirements.

PHASE III: Integrate composite tracking and discrimination software into SIAP JTM and assess performance.

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KEYWORDS: Composite Track, Joint Track Manager, Tactical Ballistic Missile Discrimination, data association, data registration, risk.