NDIA
MDA SBIR Industry Day

7 August 2008

Space Technology

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Agenda

- Disclaimer
- Research Area Objectives
- List of SBIR Topics
- SBIR Topic Overview
- List of STTR Topics
- STTR Topic Overview
- Questions

Disclaimer

- The published SBIR Solicitation takes precedence over anything written, stated, or implied in this briefing.
- Anything in this briefing which conflicts with the published solicitation is an error and should be ignored.

Follow the directions and respond to what is in the published solicitation!

Space Technology Research Area

Objectives

- Solve Technical Issues/Problems/Limiters of BMDS System Concepts/Designs to Enable Space-Basing
  - Can Enable New System Concepts or Significantly Improve Existing Concept Performance/Cost/Producibility/Life
- Provide Subsystem or Component Suppliers to Our System Prime and Payload Contractors

Scope of Research Area

- All Technologies Developed Must Be Capable of Long Term Operation in Space >>>>> **Radiation!**

Relevance to the BMDS

- Space-Basing Provides Enhanced, Persistent, Pervasive Coverage while Minimizing the Geopolitical and Security Issues of Basing on Foreign Soil/Ports

Transition Is Critical!

SBIR Topics

- Improved Cryogenic Cooling Technology
- Space Component Miniaturization
- Advanced Space Power Management & Energy Storage Technologies
- Advanced Space Sensor Components and Concepts
- Radiation-Hardened Memory
- Real Time Monitoring of Natural and Enhanced Space Environments
- Spacecraft Assembly, Integration and Test Enhancement
- Silicon Carbide (SiC) Cryogenic Optics Technology Advancement

Improved Cryogenic Cooling Technology

Objective

- Improve performance of components of the cryo-cooling system for electro-optical (EO) space payloads
  - Includes load flexibility and cross-gimbal transfer of cooling

Areas of Interest

- Application of improved heat conduction materials
- Pumped or wicked cryogenic cooling transfer across a two axis gimbal or flexible join, or to route cooling to multiple locations on a spacecraft
- Thermal control devices for high density microcircuits
- Control electronics associated with any active cooling devices

Key Performance

- Cooling to temperatures as low as 35K
- Operational life 10 years
- Ability to vary loads (temperature and power) during operation
- Improved mass, input power, efficiency, reliability &/or integration capability

Phase I Goals

- Analytical **&** experimental demonstration of proof-of-principle of the proposed technologies/concepts

Space Component Miniaturization

Objective

- Develop innovative components which enhance system performance & increase payload margins for BMDS missions

Technology Areas of Interest

- Space qualifiable, broad bandwidth, near reactionless, fast steering mirror (FSM)
- Lightweight, agile, high efficiency solar array drive assembly (SADA)
- Other technologies that meet overall objective will also be considered
  - Strongly suggest talking to authors before proposing

Key Performance

- Proposed solutions must demonstrate they meet government near-term goals
- Must demonstrate path to space qualification
- Operational life $\geq$ 10 years
- Reduce mass, volume, & cost, &/or increase precision (compared to current state of the art)

Phase I Goals

- Develop preliminary design of concept
- Proof of concept hardware development and testing to prove concept feasibility highly desirable

Topic Overview

Advanced Space Power Management & Energy Storage Technologies

Objective

- Develop advanced energy storage and Power Management and Distribution (PMAD) technologies that improve overall EPS system efficiency, environmental survivability, and manufacturability for BMDS satellites

Technology Areas of Interest (A proposal must address only 1 technology.)

- Li Ion Battery: cell precursor materials, low temperature survivability, improved mechanical integrity
- PMAD: Higher efficiency, Higher Voltage operation desired

Key Performance

- Radiation Hardness $\geq$ 300Krad (both protons & ionizing radiation)
- Reduce mass, improve reliability, enable higher voltage operation (75-100V vs. 28V)

Phase I Goals

- Produce an experiment article to demonstrate proof of concept
- Identify feasible, executable path from experimental article to prototype to be developed in Phase II

Advanced Space Sensor Components & Concepts

Objective

- Develop innovative sensor material solutions to improve strategic space sensors

Technology Areas of Interest*

- Visible - very long wavelength infrared wavelengths of greatest interest
  - Detectors & detector materials and processing
  - Focal plane arrays (FPAs) including Read Out Integrated Circuits (ROIC)
  - Design, processing, hybridization techniques and packaging
- Innovative concepts exploiting Radio-Frequency (RF) emissions

Key Performance

- Concepts must meet performance goals post $\geq$ 300Krad (both protons & ionizing radiation) exposure
- Performance > current sensor approaches & sufficient for BMDS strategic sensors

Phase I Goal

- Availability of proof-of-concept/principle demonstration articles for radiation testing by the government

* May propose on more than one but suggest focusing a given proposal on only one area

Radiation-Hardened Memory

Objective

- Develop high performance, radiation hardened monolithic, volatile or non-volatile memory components to support the diverse needs of the BMDS

Memories of Interest (Suggest each proposal address only one!)

- SRAM
- Non-Volatile Memory (NVM)
- Proposals that focus on employing advanced packaging to provide multiple memory chips within a single package will not be considered

Key Performance

- Radiation hardness $\geq$ 300Krad (both protons & ionizing radiation)
- Highly resistant to single event effects
- SRAM > 64Mb, Access time < 10ns
- NVM: >16Mb, Target read access time < 100 ns; write cycle time < 500 ns

Phase I Goal

- Analytical model demonstration of performance of the proposed concept

Real Time Monitoring of Natural and Enhanced Space Environments

Objective

- Develop innovative sensors &/or sensor algorithms to detect, characterize, report, & mitigate mission critical space environmental events or effects occurring from natural &/or manmade origins that could potentially inhibit performance of the Ballistic Missile Defense System

Capabilities Desired

- Real time sensing of, and accommodation for, manmade anomalies or natural perturbations in the space environment to assure operation of the Ballistic Missile Defense System across the full threat spectrum

Key Performance

- Must be capable of 10 years operation in a space environment
  - $\geq$ 300Krad total dose of radiation (ionizing and proton)
- Design goals: Volume < 30 cubic in., Weight < 2.5 lb., and Power < 20 W

Phase I Goals

- Conceptual designs of the hardware based on preliminary analysis with sufficient hardware development and testing to demonstrate concept feasibility

Spacecraft Assembly, Integration and Test Enhancement

Objective

- Develop innovative hardware and methodology concepts for Assembly, Integration and Test of Electro-Optic sensors to reduce the cost and time associated with these payloads

Capabilities Desired

- Optical calibration sources for ground and space
- High-fidelity target simulators and methods for far field line of sight accuracy and stability measurement during ground test and verification
- Advanced hardware in the loop simulation methods and tools

Key Performance

- Optical calibration sources/targets must have well characterized optical cross sections (OCS) and irradiance (intensity and frequency)
  - OCS ~ 1 m^2 in the visible and near IR spectrums
- Line of sight determination to microradian accuracy
- Real-time simulation and operation of BMDS components to decrease const/risk of integration

Phase I Goals

- Conceptual designs of the hardware based on preliminary analysis with sufficient hardware development and testing to verify requirements can be met

Silicon Carbide (SiC) Cryogenic Optics Technology Advancement

Objective

- Develop and demonstrate technologies for silicon-carbide (SiC) optical systems to be operated in a cryogenic space environment

Technology Areas of Interest (A proposal must address only one!)

- Figuring and Finishing
- Coatings
- Integration/Mirror System

Key Performance

- Figuring and Finishing
  - Applicable to off-axis parabolic mirrors with low F numbers
  - Minimum damage (defects and stresses) introduced
- Coatings
  - Maximize reflectivity in spectral bands of interest (visible through LWIR)
  - Stress free, highly adherent over temperature range of interest (~100 – 400K)
- Integration/Mirror System
  - Prototype mirror system experiment

Phase I Goals

- Coatings, Figuring and Finishing: coupon-level demonstration of proposed technique
- Integration: Preliminary design of an experimental prototype SiC optical system and analytical prediction of it's performance

STTR Topics

- Revolutionary Inertial Angular Sensing
- Payload Thermal Management Modeling
- Reconfigurable Course-Grain Analog Arrays
- Lithium-Ion Cell and Battery Life Modeling to Encompass Wider Life Parameters

Revolutionary Inertial Angular Sensing

Objective

- Develop and demonstrate innovative, revolutionary approaches to improving space qualifiable inertial angular rate or displacement sensing

Key Performance

- Extremely high precision and low drift
- Minimize size, weight, power and volume
- $\geq$ 10 years $\geq$ 300Krad (Si) for both protons and ionizing dose
- Must identify a path to space qualification of the concept

Phase I Goals

- Develop the underlying physical principles and develop a preliminary design to capable of meeting performance goals
- Demonstrate concept feasibility, though modeling & simulation as a minimum
- Proof of concept hardware development and testing to prove concept feasibility highly desirable

Topic Overview

Payload Thermal Management Modeling

Objective

- Develop an open architecture, physics-based model for payload performance with respect to thermal and dynamic stability and general requirements

Areas of Interest

- First order joint thermal-lumped capacitance and component level dynamic vibration models
- Finite element or difference models of payload/component performance

Key Performance

- Model predictions should closely match actual payload experiment data

Phase I Goals

- Develop basic models and refine payload general requirements

Reconfigurable Course-Grain Analog Arrays

Objective

- Develop (design, fabricate, test) monolithic, reconfigurable, radiation-hardened course-grain analog components

Capabilities of Interest

- Field Programmable Analog Array (FPAA)

Key Performance

- Total Dose radiation hardness ≥ 300Krad (both protons & ionizing radiation)
  - Hardness to ≥5x108 rad(Si)/s ionizing dose rate is desired
- Support bandwidths of at least 250 MHz with signal to noise ratio of 68.5 db

Phase I Goal

- Develop a candidate design for a radiation-hardened, large-scale, course-grain, reconfigurable Field Programmable Analog Array
- Analytical model demonstration of performance of the proposed concept

Lithium-Ion Cell and Battery Life Modeling to Encompass Wider Life Parameters

Objective

- Develop physics-based models of lithium-ion chemistry battery and cell life modeling for the full range of earth orbits

Capabilities Desired

- Account for calendar life as well as orbit cycle
- Encompass LEO, MEO, HEO and GEO cycles
- Account for pulse power requirements and varying depths-of-discharge
- Include operating temperatures from ambient to below -20C

Key Performance

- Model predictions of battery performance should closely match actual on-orbit battery performance data

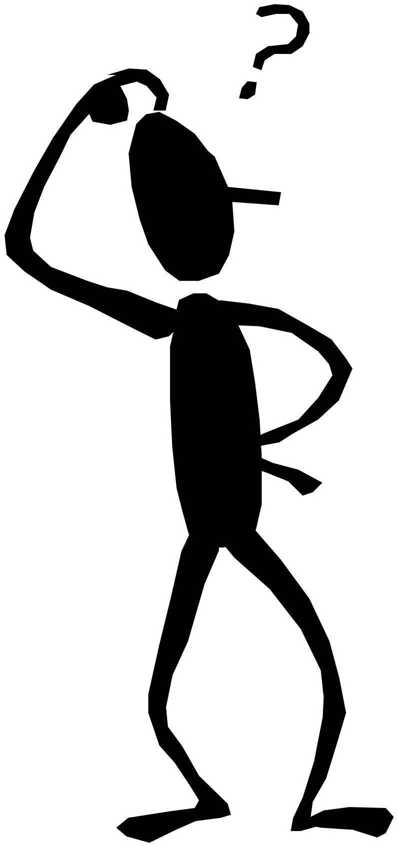
Phase I Goal

- Design and develop a representative proof of concept model for a cell and simple battery chemistry which incorporates calendar life into current LEO life modeling to accommodate MEO and GEO cycles

Helpful Hints

- Respond to solicitation!
  - Address all evaluation criteria!
- Transition is as important as innovation!
  - Do your homework on the BMDS problem/system you are proposing against
  - To solve a BMDS problem, you have to get your product into a BMDS system
- Watch out for ITAR problems!
  - Do your homework on ITAR!
  - Foreign persons will, in almost all cases, be prohibited from working on critical BMDS space technologies
    - When in doubt, don't use foreign nationals
    - Establish citizenship status of key personnel in proposal
- Where a topic is broader/multiple concepts/technologies are of interest, focus a proposal on one concept
  - > 1 award/contractor in A topic RARE
- Target your audience (the evaluators)!
  - Proposal is not a scientific paper or journal article

Questions?



Backups