

Modeling & Simulation

SBIR 10.3 Topics



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Modeling and Simulation Research Area Scope and Objectives

- **Objectives**

- Technological Innovations in Modeling & Simulation (M&S)
- Support Development & Testing of the Ballistic Missile Defense System (BMDS)

- **BMDS Relevance**

- Enhanced signature prediction capability for active and passive EO and RF sensors used in BMD elements and systems supports test planning, test target design, sensor design/development/test, data and system analysis, operational test and evaluation, and algorithm development
- M&S of adverse environments for testing of innovative sensor packaging concepts



M&S Research Area SBIR Topics

- **SBIR**
 - Solid Rocket Motor Thrust Termination Modeling
 - Advanced Reentry Vehicle and Wake Models
 - Innovative Sensor Packaging and Testing
 - High Speed Representation of Complex Scenes



Solid Rocket Motor Thrust Termination Modeling

- **Objective:** Develop both engineering and high fidelity methods/modules to accurately model the effects of a solid rocket motor's thrust termination system

- **Capabilities Desired:** The developed thrust termination model (including burn to completion) must be able to not only predict the impact to the stage trajectory but also provide a description of the port and main nozzle properties (gas and particulate properties, size distribution, and velocity profiles of all ejecta material)

- **Phase I Goals:**
 - Select one or more pertinent phenomenological processes (e.g. propellant, slag, or an inert material) and identify first-principles requirements for the formation and size distribution of the ejecta
 - Provide an approach towards the development of a model for the formation, distribution and transport of the ejecta
 - Develop and demonstrate the capabilities of a test bed model using a simplified approach



Advanced Reentry Vehicle and Wake Models

- **Topic Objective:** Develop robust modeling and simulation tools to predict plasma effects on reentry vehicle hardbody signatures as well as wake radar cross-section and optical signatures

- **Capabilities Desired:**
 - Validated, tightly coupled suite of modeling and simulation codes/modules that will: calculate the plasma levels and non-equilibrium neutral and plasma chemistry in the flow around reentry vehicles, radar cross-sections, Doppler profiles, and other relevant radar observables as a function of range, frequency, and aspect angle and calculate EO signatures in the plasma surrounding the hard body and the near and trailing wake.
 - Handle a broad range of vehicle types and shapes

- **Phase I Goals:**
 - Select one (or more) modules for development and validation.
 - Identify innovative algorithms for including in the selected module
 - Plan the interface requirements to other parts of the suite of codes
 - Demonstrate the improved algorithm against current MDA and DoD simulation capabilities



Innovative Sensor Packaging and Testing

Objective

- **Develop and demonstrate novel IR sensor packaging, integration, and testing capabilities for the evaluation of IR sensors for various missile defense applications.**

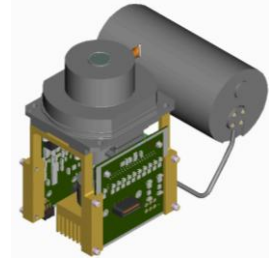
Technology Areas of Interest

▪ **Packaging**

- FPA chip assembly design and fabrication (non-destructive backfill)
- Optics/Cooler/Dewar/Electronics assembly (Compact optics and electronics, efficient coolers)
- Calibration (non-uniformity correction, dynamic temperature calibration)

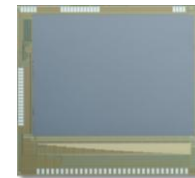
▪ **Testing**

- Modeling and simulation of adverse environments (radiation & other mission scenarios)
- Flexible testing packages compatible with 2-color 640x512 to 2048x2048 single color



Key Performance

- **Performance: Keep quantum efficiency >70%**
- **Reduce Size, weight and power of IR cameras >30%**



Phase I Goal

- **Conduct feasibility study and preliminary design, breadboard-level experiments or computer modeling . Define critical testing unit design parameters and testing scenarios for testing under mission-relevant environment.**



High Speed Representation of Complex Scenes

- **Objective:** Develop innovative approaches to representing highly detailed battlespace environments (Terrestrial/Urban/Suburban, Ocean (Deep water and Littoral)) in a manner that allows such data to be ingested by MDA scene generation tools for use in real-time and near real-time simulations.

- **Capabilities Desired:** The increasing application of higher resolution observation sensors on platforms ranging from satellites to small scale UAV's to blimps are driving requirements for improved representation of large, complex structures, such as terrain, water surfaces and cities. Full representations of such structures involve databases with sizes reaching well into the terabyte level. Static level of detail models used in current MDA tools such as FLITES cannot be expected to manipulate that level of data and achieve the required frame rates and physical accuracy required by the MDA mission.

- **Phase I Goals:**
 - Assess current approaches to representing complex scenes by existing MDA tools as well innovative representations that offer improved efficiencies in terms of computational throughput and memory utilization.
 - Provide a preliminary design of a methodology that allows efficient representation of complex scene data in way that is computationally tractable at high frame rates and supports interfacing to existing MDA scene generation tools.