



## **NASA SBIR 2011 Phase I Solicitation**

### **04.01 Metric Tracking of Launch Vehicles**

**Lead Center: KSC**

**Participating Center(s): GSFC, MSFC**

The goal of this subtopic is to have a highly reliable way of tracking vehicles from launch to orbit. Launch vehicles can exhibit high dynamics during flight and there can be external interference on the GPS frequency. Proposals can either address a single area as described below or a combination of multiple areas. The following technology areas are of interest:

#### **Position, Attitude, and Inertial Metrics**

Metric tracking of launch vehicles requires the development of accurate and stable integrated metric tracking and inertial measurement units. The focus is on technologies that enable and advance development of low Size, Weight, and Power (SWaP), tactical grade, integrated metric tracking units that provide accurate and stable positioning, attitude, and inertial measurements on high dynamic platforms. Factors to address include:

- Ultra-tight coupling of rate sensors, accelerometers, and attitude determining GPS receivers that will provide very high frequency integrated metric solutions.
- The ability to reliably function on spin-stabilized rockets (up to 7 rev/s), during sudden jerk and acceleration maneuvers, and in high vibration environments.
- Advancements in MEMs-based rate sensors and accelerometers, algorithm techniques and Kalman filtering, high bandwidth and low noise outputs, phased-based attitude determination, single aperture systems, quick Time to First Fix and reacquisition.
- Robust tracking during separation.

#### **Use of GPS and Ability to Mitigate Interference Signals**

Innovative technologies to increase the accuracy of the L1 C/A navigation solution by combining the pseudo ranges and phases of the L1 C/A signals, and use of the L2 and L5 carriers. Factors that degrade the GPS signals can be obtained by differencing the available carrier phase and pseudo range measurements and then removing

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these differences from the navigation solution.

Technologies are sought that combine spatial processing of signals from multiple antennas with temporal processing techniques to mitigate interference signals (jamming) received by the GPS receiver. The coordinated response of adaptive pattern control (beam and null steering) and digital excision of certain interfering signal components can minimize strong jamming signals. Adaptive nulling minimizes interfering signals by the optimal control of the GPS antenna pattern (null steering).

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I (to reach TRL 3) and show a path toward Phase II hardware and software demonstration and delivering a demonstration unit or software package for NASA testing at the completion of the Phase II contract (to reach TRL 5).

#### Phase I Deliverables:

- Midterm Technical Report.
- Final Phase I Technical Feasibility Report with a Phase II Integration Path. Proof-of-concept bench top demonstration preferred.
- Verification matrix of measurements to be performed at the end of Phase II, along with specific quantitative pass-fail ranges for each quantity listed.

#### Phase II Deliverables:

- Working model of proposed product, along with full report of development and measurements, including populated verification matrix from phase II (TRL 5).
- Final Phase II Technical Report.
- Demonstration hardware/software/field test.
- Opportunities and plans should also be identified and summarized for potential commercialization.