NASA SBIR 2010 Phase I Solicitation

O4.01 Metric Tracking of Launch Vehicles

Lead Center: KSC

Participating Center(s): GSFC, MSFC

Launch vehicles can exhibit high dynamics during flight and there can be external interference on the GPS frequency. The goal of this subtopic is to have a highly reliable way of tracking vehicles from launch to orbit utilizing GPS and/or inertial measurement unit.

Areas of interest:

Metric Tracking Hardware

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 highly 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.

Use of GPS and Ability to Mitigate Interference Signals

NASA seeks 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 to consider:
• GPS signal degradation can be obtained by differencing the available carrier phase and pseudo range measurements and then removing these differences from the navigation solution.

• Jamming of GPS signals are a concern during the tracking of launch vehicles.

• Technologies are sought that combine spatial processing of signals from multiple antennas with temporal processing techniques to mitigate intentional 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).

Proposals can either address a single subject as described above or a combination of subjects.

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.

Phase II Deliverables:

• Final Phase II Technical Report
• Demonstration hardware/software/field test.