NASA SBIR 2008 Phase I Solicitation

O4.04 Timing

Lead Center: JSC

Participating Center(s): GRC, GSFC, JPL

One of the most critical components of robust relative navigation is accurate and reliable timing across the entire sensor suite. Clock errors, drift, and drift rates must be estimated and corrected. During extended duration operations small clock errors propagated from measurement to measurement can contribute to continued growth in positional errors. Improved timing estimation and reliability within a general navigation clocking system will improve navigational accuracy.

Purpose:Â This solicitation aims to develop two unique timing systems. The first timing system (TS) is for a relative navigation sensor suite to be utilized during lunar surface navigation that will utilize multiple sensors at different times. The sensor suite may include a star tracker, inertial measurement unit, vision-based feature recognition sensor, and RFID tag ranging devices. The TS will take an accurate time input from the primary base station at irregular intervals and a less accurate clock at periodic intervals from a software defined communications radio. The TS should, in an FPGA only, produce a clock signal suitable for time stamping and a clock pulse for four navigation sensors. This generated clock should be accurate to within 1ms of the base station input clock over a period of five minutes between primary clock inputs. Additionally, clock error, drift, and drift rates of the two input clocks and four output timing streams (time stamp and clock pulse) should be made available for analysis.

The second timing system is for proposals that improve timing standards. NASA seeks proposals that would improve accuracy for both ground-based tracking networks and onboard navigation systems by providing time and frequency standards that exceed the long-term performance of the GPS Block IIR Rb clocks (for ground-based applications) and current flight USO performance and also for tracking networks at ground-based locations. Timing accuracy is of the utmost importance for this TS; however, size, weight, and power consumption are still considerations. The goal of this TS is to improve the timing and frequency standards and, if possible, exceed the long-term performance of the GPS Block IIR Rb clocks in the ground-based application.

Core capabilities:Â Provide an accurate and self correcting time source suitable for use in a navigation system suite consisting of multiple sensors. The TS clock and time stamp output should be independently adjustable to the needs of the sensors.

Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward Phase 2 hardware and software demonstration, delivering a demonstration unit or software package for NASA testing at the completion of the Phase 2 contract.

Phase 1 Deliverables:

- A trade study on industry standard timing systems with a focus on overall accuracy and drift performance;

- Report on the tools and systems currently available;
- Recommendations on furthering the state-of-the-art in timing performance.

Phase 2 Deliverables:

- Demonstration of implemented timing system given the necessary inputs;
- Written report and presentation detailing the system performance including electrical and electronic characteristics;
- Delivery of the timing system and the environment used during development;
- Delivery of timing system math models for real-time simulation.