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Title: FLEXIBLE, REAL-TIME ON-ORBIT NAVIGATION AND AUTONOMOUS EXPERIMENT MANAGEMENT USING GPS

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This paper describes the flight navigation software for the TurboRogue GPS receiver. This software uses a low order gravity model with a Runge-Kutta integrator to project and smooth its trajectory solution over time and to protect onboard operations from anomalous data. It also provides for autonomous experiment control.

The TurboRogue receiver was developed by JPL for NASA to meet high-accuracy tracking requirements and a ruggedized version will be flown on two upcoming low-Earth orbit spacecraft. The receiver produces dual frequency pseudorange and carrier phase observables. An onboard RISC processor (AMD29050) performs digital tracking, navigation, data handling, and system management. In order to ready the TurboRogue for on-orbit use, the cold-start Doppler search window was widened to include the range of Dopplers seen from low earth orbit. To improve warm-start acquisition and to autonomously schedule GPS-based science and other payload experiments an orbit integrator has been implemented. Navigation and integrator precision are being improved to provide 10 meter-level real-time positioning by incorporating better dynamic models from precise orbit determination post-processing algorithms such as those used in JPL’s GIPSY OASIS 1.1. The integrator is also used to screen incoming data for obvious constellation or tracking anomalies, a form of Receiver Autonomous Integrity Monitoring (RAIM).

Support for a very-low-average-power GPS receiver which only operates for brief intervals, periodically throughout the orbit is provided by another adaptation: fitting the discrete data samples to a trajectory. Tests with actual flight data from TOPEX and GPS-METI demonstrate the feasibility and accuracies of this technique will be discussed.

This paper will report on test and operations I results for procedures designed to autonomously determine the spacecraft orbit and administer the flight experiments and will review work in progress on TurboRogue flight software as applied to specific missions.