Using SAC-C as a Testbed for Precise Onboard Orbit Determination

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ABSTRACT

Satelite de Aplicaciones Cientificas-C (SAC-C) is a cooperative mission between NASA and the Argentine National Commission on Space Activities (CONAE). The JPL-provided Blackjack receiver on SAC-C is a multi-antenna, dual-frequency GPS receiver that can be re-configured in orbit. Position information from the zenith-pointing antenna is currently post-processed to decimeter levels. Real-time kinematic position accuracies are on the order of several meters. SAC-C will participate in coordinated flying as an element of the "AM constellation," comprising SAC-C, Landsat 7, EO-1, and Terra. In order to demonstrate the capabilities of performing precise autonomous orbit determination and maintenance, JPL's Real-Time GIPSY (RTG) software has been uploaded to the Blackjack receiver and run in real-time.

The RTG orbit determination module is a compact and portable software package optimized for real-time processing and designed for use on embedded systems. RTG makes use of an extended Kalman filter as well as precise dynamic models for orbiting receivers. RTG simulations using actual GPS data from the CHAMP spacecraft (also carrying a BlackJack GPS receiver) together with JPL's global differential GPS (GDGPS) corrections demonstrate 30 cm 3D RMS real-time orbit determination capabilities. However, because it is not possible to receive GDGPS corrections onboard SAC-C, uncorrected broadcast GPS ephemeris are used for the onboard orbit determination, resulting in meter-level orbit determination accuracies. For comparison, truth orbits are generated by post-processing the GPS data using the GIPSY/OASIS II software. We will present the SAC-C autonomous OD performance analysis, as well as the high fidelity simulations of the capabilities of RTG when GDGPS corrections are available. We will also discuss the technology path toward the integration of GDGPS capabilities on future missions.