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Onboard Real-time Precise Orbit Determination of LEO Satellites Using Space-borne GNSS Measurements

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With the great progress of the remote sensing based on low Earth orbit (LEO) satellites, onboard real-time precise orbit determination (RTPOD) has been rapidly developed. RTPOD using space-borne GNSS measurements is recognized as the most mainstream technology for LEO satellites, due to its global coverage, abundant observations and low-cost. Onboard RTPOD using space-borne GPS observations is rather mature and could usually achieve orbits of sub-meter or decimeter accuracy.

In this contribution, we concentrate on the onboard RTPOD based on space-borne multi-GNSS measurements. The space-borne GPS/BDS pseudo-range and carrier phase data from China's FY3C satellite are employed for the investigation of several critical aspects, such as the proper weighting strategy for GPS/BDS observations, optimal stochastic modeling of estimated ambiguities, and the impact of BDS satellites on RTPOD.

Final orbit accuracy of 0.3∼0.5m and 0.3∼0.5mm/s in terms of 3D RMS are obtained for position and velocity, respectively. Although the accuracy is only slightly superior to that using single GPS data, fusion of GPS/BDS data speeds up the convergence of Kalman filter and suppresses the local variation of orbit errors, for example when the satellite flew over Asia/Pacific region where more BDS satellites can be tracked. We also noticed that RTPOD orbit accuracy only based on BDS measurements is up to several meters because of only few tracked satellites and the obvious orbit and clock errors in the broadcast ephemeris of BDS GEO and IGSO satellites which is expected to be improved in the near future along with the development of the BDS global navigation system.