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REAL-TIME ON-BOARD SATELLITE NAVIGATION USING GPS AND GALELIO MEASUREMENTS

Abstract

Use of GPS for real-time on-board navigation of LEO satellites is an intriguing and cost effective technique. GPS measurement using the post processing can produce orbit estimation within centimetre level accuracy. It is well-established that using space borne GPS receiver, on-board navigation computer can estimate satellite position with accuracy of 10 metre in real-time. Inclusion of GLONASS and GALILEO measurements in the process can make the real-time navigation system of spacecraft more reliable, robust and accurate by reducing the chance of blind spots and increasing the number of measurements. In the present work, a simulation platform for real-time navigation using a multi-GNSS receiver is developed for navigational performance analysis. TANDEM-X is chosen as a test satellite with GALILEO measurements simulated for the known satellite using a Spirent simulator. The measurement simulation includes receiver clock bias, ionospheric delay and random noise. The simulated GALILEO measurements are used in an Extended Kalman Filter to estimate position and velocity of TANDEM-X in an inertial Cartesian frame. Publicly available TANDEM-X GPS receiver measurement data are used in a separate Extended Kalman Filter and the navigation solution is compared with the solution obtained from simulated GALILEO measurement for verification. For the multi-GNSS receiver experiment, Hardware in the Loop Simulation is designed which includes a UNSW Namuru GNSS receiver. GPS and GALILEO constellation signals simulated by a Spirent GNSS signal simulator are captured by the Namuru receiver and the measurements are used to estimate position and velocity of the satellite.