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AUTONOMOUS NAVIGATION FOR HEO SATELLITES BASED ON SINS/GNSS TIGHT INTEGRATION METHOD

Abstract

Geostationary and High Earth Orbit (HEO) satellites, which are located above the Global Navigation Satellite System (GNSS) constellation, receive very weak signals due to the high path loss of those signals. What's more, the number of visible satellites is very small, and each satellite is available for only a short period of time. This makes it difficult for the implementation of autonomous navigation. In this paper, for the navigation of HEO satellites, a kind of multi-mode GNSS receiver with high precision and high dynamic performance was developed, and a kind of autonomous navigation scheme was introduced based on tight integration of Inertial Navigation System (SINS) and GNSS. For SINS, the inertial sensors can be calibrated, while with the assistance of SINS it also can help to improve the trace ability for GNSS receiver and increase its dynamic and anti-jamming performance. The tight integration method uses the ephemeris given by the GNSS receiver, and the position and velocity given by SINS, to calculate the pseudo range and the pseudo range rate related to the position and velocity given by SINS, then they are compared with the pseudo range and the pseudo range rate give by GNSS receiver to get the error. Subsequently, a Kalman filter is used to estimate the error, and then open-loop or feedback correction can be used for the following solution. The observability of the measure equation of tight integration method (using pseudo range and pseudo range rate) is much better than that of the loose integration method (using position and speed). The simulation results show that the position and velocity estimation precision of SINS/GNSS tight integration method is better than that of the loose integration method, and the proposed scheme can satisfy the navigation demand for HEO satellites.