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PRECISE POINT POSITIONING PAYLOAD FOR ENHANCED NAVIGATION MICROSATELLITE IN LOW ORBIT

Abstract

The existing high-precision positioning of LEO satellite usually uses GPS or USB System. However, with the rapid increase of LEO micro- satellites in recent years, USB, which requires ground monitoring stations, has become overwhelmed, and GPS has becomes the main means of satellite position and orbit determination. The position with GPS is usually used pseudo-range, but its accuracy is often in meters. For the general microsatellite position this accuracy is sufficient, but cannot meet sub-meter precision of the low-orbit enhanced navigation satellite position. Dual-frequency GPS receivers have also been reported for carrier phase location, but in real-time and accuracy still cannot meet the requirements. In this paper, the Precise Point Positioning algorithm (PPP) is proposed to improve the positioning accuracy by using the advantages of low-earth orbit satellites. In PPP, the precise IGS ephemeris data from the ground station is used to shorten the positioning time. In this technology, the pseudorange, L1/L2 carrier phase and the IGS precision data are used to carry out high-precision positioning solution. There are three main parts in PPP: Data Processing, Least Squares Solution to the optimal estimate and LAMBDA Method to obtain the optimal ambiguity. Firstly, the gross error and cycle slip in the carrier phase data is detected, and then be compensated. In order to eliminate first-order ionospheric effects, the different frequency observations with the same type is to form a linear combination, and then the carrier phase ambiguity is not integer and the observation noise is small.In the single-point dynamic positioning, the unknown estimated state are the satellite coordinates, the ambiguity and receiver clock error, and the best estimate of this time-varying state is solved by the least squares method using each epoch. At last, LAMBDA algorithm reduces the correlation between ambiguities based on the Lagrangian correlation principle, and then uses the search technique to obtain the optimal ambiguity vector. By LAMBDA the search space of ambiguity is smaller, and the search efficiency is improved. Compared with the RTK position in orbit, PPP need not to be equipped with base station and communication equipment. It only regularly needs the IGS precise ephemeris from the ground control station in the daily management. This greatly reduces the cost. In addition, further simulation indicates that if the LEO satellite is used as the navigation satellite and PPP is used in the ground receivers, the position convergence time is decreased from 40-50 to 10 minutes.