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Calculation and Analysis of Differential Corrections for BeiDou

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BeiDou Satellite Navigation System has been providing service forAsia-Pacific area. BeiDou uses observations of regional monitoring network to determine satellite orbit, which limits the satellite orbit accuracy. And the satellite clock error is produced by time synchronization system. The time synchronization delay of antenna device is general obtained through prior Calibration, and the residual calibration error is included in the satellite clock, which affects the prediction accuracy of satellite clock error. In this paper, we study the algorithms of Beidou differential corrections to improve the accuracy of satellite signals to improve the user positioning accuracy.

In this algorithm, both pseudo-range and phase observations are used to calculate differential corrections. We process pseudo-range observations to obtain equivalent satellite clock error, which include satellite clock errors and orbit radial errors, as well as the average projection of orbit tangential and normal errors in combination. And the epoch-difference of phase observations are processed to eliminate the ambiguity which simplifies algorithms and ensure the relative accuracy (corrections variety between the epochs). Observations more than 10 stations in China are processed, and the equivalent clock error calculation results are analyzed, which shows that the satellite UDRE are significantly reduced and user location accuracy improves when the equivalent clock error corrections are applied.

The residuals deducting equivalent satellite clock error contains the projection difference of satellite orbit error in all station (tangential and normal errors are main). We utilize the residuals to solve the tangential and normal orbit errors which cause the projection difference. The same observation data is processed. The results show that after calculating three-dimensional corrections, the satellite UDRE doesn't improve significantly compared to equivalent satellite clock error corrections and user positioning accuracy also has not changed significantly.

Studies of comparing broadcast ephemeris and precise ephemeris and analyzing the actual projection differences of satellite orbits in all stations are investigated. We found that: during the period of satellite arising and ascending, the projection of orbit error in each station is almost the same, and reaches to more than 10% for the comprehensive error of tangential and normal direction when satellite is on the zenith. So if the tangential and normal comprehensive error reaches meter level, the max projection difference is about decimeters. Since pseudo-range observation noise reaches decimeter level, concluded that, pseudo-range observation noise limits solution accuracy of the three-dimensional corrections.