Analysis of inner-consistency of BDS broadcast ephemeris parameters and their performance improvement

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The space segment of the Beidou regional navigation satellite system (BDS) consists of 5 GEO/5 IGSO/4 MEO satellites. Orbit information of the broadcast ephemeris is obtained by the Orbit Determination and Time Synchronization (ODTS) technique based on the observations of regional tracking network, while clock information is obtained by the satellite-station Two Way Time Transfer (TWTT) technique realizing the time synchronization among satellites and monitoring stations. ODTS and TWTT are two independent techniques. TWTT makes the difference of uplink and downlink range observations to estimate satellite clock offset with respect to the BDS system time. Thus, satellite clock estimation is less affected by the satellite orbits error. However, owing to the situation that only regional tracking network is used for the ODTS process, satellite clock parameters estimated are highly correlated with the orbit parameters and thus partly absorb the radial orbital parameters. In this presentation, the estimated satellite clock differences between the ODTS and TWTT techniques are analyzed in detail. It is shown that the differences can be divided into two parts: firstly, the systematic offset caused by the hardware bias of the equipment; secondly, periodical terms caused by the correlation of satellite clock and orbits in TWTT. On this basis, a refined strategy to improve the self-consistency of satellite clock and orbit in the BDS broadcast ephemeris is developed. Experimental results show that the SISRE of the refined broadcast ephemeris is reduced by more than 60 %, and pseudo-range based single-point position accuracy using the refined BDS broadcast ephemeris is improved by 29 %, 32 % and 19 % in the North, East and Height components, respectively.