

The Contribution of BeiDou-3 Binary Offset Carrier Signals to Single Point Positioning

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SUMMARY

Aimed at providing first-class positioning, navigation, timing (PNT) services, the People's Republic of China successfully completed the commissioning of its modernised satellites with a BeiDou Navigation Satellite System (BDS)-3 Geostationary Earth Orbit (GEO) satellite in June 2020. As of December 2020, BDS has 49 nominal satellites in a constellation of which 44 are included in the operational orbital constellation and the remaining 5 are still in-orbit validation. Currently, BDS-3 satellites broadcast Binary Offset Carrier (BOC) signal frequencies (B1-C and B2a+b) with a completely unique modulation scheme to the other BDS-3 modernised signals (B2a and B2b) and the legacy B1I, B2I, and B3I (BDS-2) signals. With the multi-constellation and multi-frequency BDS signals, it is imperative to establish the current performance of the BDS modernised signals. Thus, in this paper, a comprehensive investigation of BDS is undertaken in terms of multipath; signal-to-noise ratio (SNR); the visible number of satellites; dilution of precision (DOP), and single point positioning (SPP). The investigation is based on 30 days datasets spanning from the day of the year (DOY) 153 to 182 in 2020 from 19 Multi-Global Navigation Satellite System (GNSS) Experiment (MGEX) tracking stations. The experimental results show that the modernised signals have more significantly reduced multipath errors than the legacy signals. For all the broadcast signals, the SNR is noticeably at least 42 dBHz. For both BDS-2 and BDS-3, at least 8 satellites are visible in each navigation system and their fusion pegs the average number of visible satellites to 15 thereby making DOP to improve from 4.8 to 2.5 by 48%. Based on the selected stations, the SPP performance of BOC signals only is more than 3 m in all three dimensions. The SPP performance is better than 0.78m, 0.51m, and 1.74m in the north, east, and vertical components, respectively. This indicates an average improvement of about 53%, 73%, and 61% in the north, east, and vertical dimensions, respectively. Upon the inclusion of the in-orbit validation BDS satellites in the operational orbital constellation, the overall SPP accuracy is likely going to improve and further extend the GNSS performance indicators.

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