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Performance of BDS Triple-Frequency Positioning Based on the Modified TCAR Method

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Nowadays, various GNSS systems have already transmitted or will transmit triple or even quad frequency signals. It is, thus significant to explore the advantages of the increasing number of frequencies and search for the optimal triple-frequency TCAR method to achieve high precision positioning, especially over the medium long baseline. Usually, compared with the extra-wide-lane (EWL) and the wide-lane (WL), the narrow-lane (NL) ambiguity resolution is the major challenge over medium-long baseline in the classical TCAR method. Therefore, this paper presents a modified TCAR method to improve the NL ambiguity resolution over medium long baseline. Firstly, four sets of real BDS data are collected to evaluate the ambiguity resolution and positioning performance of the classical TCAR method in comparison with the LAMBDA method. It is concluded that the residual double-differencing (DD) ionospheric delay is the major limiting factor that influences the NL ambiguity resolution, thus affecting the positioning accuracy. And then, the modified TCAR method is proposed, in which the estimated DD ionospheric delay derived from the floating solution estimation is adopted to modify the floating NL ambiguities. The results reveal that this algorithm is very effective for the NL ambiguity resolution, especially for the 11km baseline. In order to further improve the performance of the NL ambiguity solution in the case of 72km, the smoothing algorithm is adopted to refine the estimated DD ionospheric delay. Compared with the reference value derived from the LAMBDA method, the refined DD ionospheric can achieve high precision, thereby improving the NL ambiguity resolution significantly. In addition, in order to achieve high precision positioning, partial fixing ambiguity strategy is introduced according to the successively increasing elevation and the observation residuals. At last, the paper compares the performance of positioning and time cost of the modified TCAR with LAMBDA method. The results show that the positioning performance of the modified TCAR method is comparable to the LAMBDA method, and in the case of 72km baseline the results are even better, in which centimeter positioning accuracy can be enabled. It is worth noting that affected by exceeding parameters and complicated integer search process, time cost of the LAMBDA method is obviously higher than that of the TCAR method over medium-long baseline. For the medium long baseline, the TCAR method is about 6 times as fast as the LAMBDA method, which reflects the significance of research on the TCAR method.