Benefits of Triple-Frequency for Cycle-Slip Detection

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SUMMARY

At the time of writing, all the Global Navigation Satellite Systems (GNSS) support or are designed to support triple- or multi- frequency, which is expected to have advantages over single- and dual-frequency. This paper will conduct research on how triple-frequency can benefit the cycle-slip detection process. Correctly detecting and repairing cycle slips can help extend the latency of the fixed ambiguities, estimate the ionospheric delay, reduce the measurement noise and finally improve the positioning precision of the carrier phase. This paper will firstly review the widely used cycle-slip detection methods, including polynomial fitting, high-order phase differencing, Doppler integration, phase combinations, and the Hatch-Melbourne-Wübbena (HMW) combination. For applying triple-frequency in cycle-slip detection, we will introduce the three-carrier ambiguity resolution (TCAR) and then modify TCAR to eliminate the effect of the ionospheric bias and reduce the measurement noise on the detection value. All the mentioned methods will be tested and compared using triple-frequency Galileo data observed in both static and kinematic conditions. The success rate and the incorrectly detected rate will be adopted as the evaluation of the detection performance. The results show that the performance of the triple-frequency method has a higher success rate and a lower incorrect detection rate than those using single- and dual- frequency methods, while the modified TCAR has many advantages in data samples with large intervals, which indicates this modification can enable this method to be used in more application scenarios.