



Novel Algorithms in Synchronized Quad-Antenna GNSS and INS Tightly-Coupled Combination

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In this contribution, several novel algorithms in synchronized quad-antenna GNSS and INS tightly-coupled combination was researched and simulated for high precision positioning and attitude determination. For the sake of improving the performance of positioning and attitude determination in urban canyon, a tightly-coupled combination of synchronized quad-antenna GNSS and INS model is established. The traditional double difference (DD) carrier phase observation model can be substituted by single difference (SD) model. As synchronized quad-antenna means four receiving antennas using a common clock, single difference carrier phase observations are no longer contain receiver clock error, and have better performance than the double difference model in view of observation noise, redundancy and parameter correlations. In the SD model, a novel carrier phase ambiguity resolution algorithm named as ambiguity Substitution Approach (ASA) is proposed. It can reduce the ambiguity search range, and enhance the integer ambiguity fixing efficiency. Due to the advantages of synchronized quad-antenna, the real-time multi-baseline adjustment algorithm for attitude determination is researched. In order to realize the high precision positioning and attitude determination using tightly-coupled combination of quad-antenna synchronized GNSS and INS, a modified adaptive Kalman filter (AKF) with fading factor algorithm is developed to merge the GNSS observables and inertial measurements, and the corresponding filter process is described simultaneously. In the end, a MATLAB simulated application is developed to carry out high precision positioning and attitude determination algorithms using quad-antenna synchronized GNSS/INS combination. The experimental results show that decimeter-level positioning and 0.1 degree per 2 meters baseline attitude determination accuracy can be achieved.

Keywords: Synchronized, Quad-antenna, GNSS, INS, Tightly-coupled, Combination, Kalman filter, Adaptive