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An Improved Robust Algorithm Based on Cubature Kalman Filter for Single-Frequency Global Navigation Satellite System/Inertial Navigation Tightly Coupled System

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Abstract : The Global Navigation Satellite System (GNSS) signal received by the dynamic vehicle in the harsh environment will be frequently interfered with and blocked, which generates gross error affecting the positioning accuracy of the GNSS/Inertial Navigation System (INS) integrated navigation. Therefore, this paper put forward an improved robust Cubature Kalman filter (CKF) algorithm for single-frequency GNSS/INS tightly coupled system ambiguity resolution. Firstly, the dynamic model and measurement model of a single-frequency GNSS/INS tightly coupled system was established, and the method for GNSS integer ambiguity resolution with INS aided is studied. Then, we analyzed the influence of pseudo-range observation with gross error on GNSS/INS integrated positioning accuracy. To reduce the influence of outliers, this paper improved the CKF algorithm and realized an intelligent selection of robust strategies by judging the ill-conditioned matrix. Finally, a field navigation test was performed to demonstrate the effectiveness of the proposed algorithm based on the double-differenced solution mode. The experiment has proved the improved robust algorithm can greatly weaken the influence of separate, continuous, and hybrid observation anomalies for enhancing the reliability and accuracy of GNSS/INS tightly coupled navigation solutions.

Keywords : GNSS/INS integrated navigation, ambiguity resolution, Cubature Kalman filter, Robust algorithm
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