Many robotics applications require reliable, high precision navigation (error less than meter level) while using low-cost consumer-grade inertial and global navigation satellite systems (GNSS). The application environment causes numerous GNSS measurement outliers. Common implementations use a single epoch Extended Kalman Filter (EKF) combined with the Receiver Autonomous Integrity Monitoring (RAIM) for GNSS outlier detection. However, if the linearization point of the EKF is incorrect or if the number of residuals is too low, the outlier detection decisions may be incorrect. False alarms result in good information not being incorporated into the state and covariance estimates. Missed detections result in incorrect information being incorporated into the state and covariance estimates. Either case can cause subsequent incorrect decisions, possibly causing divergence, due to the state and covariance now being incorrect. This dissertation formulates a sliding-window estimator containing multiple GNSS epochs, and solves the full-nonlinear Maximum A Posteriori estimate in real-time. By leveraging the resulting window of residuals, an improved fault detection and removal strategy is implemented. Experimental sensor data is used to demonstrate the interval RAIM (iRAIM) performance improvement.

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