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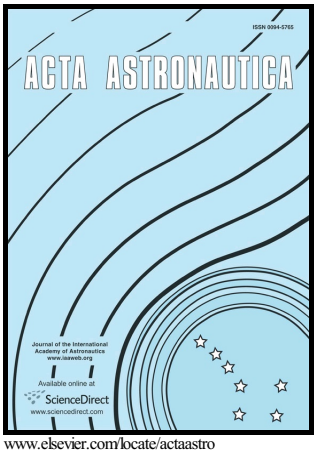

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Covariance matching based adaptive unscented Kalman filter for direct filtering in INS/GNSS integration

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Abstract

The use of the direct filtering approach for INS/GNSS integrated navigation introduces nonlinearity into the system state equation. As the unscented Kalman filter (UKF) is a promising method for nonlinear problems, an obvious solution is to incorporate the UKF concept in the direct filtering approach to address the nonlinearity involved in INS/GNSS integrated navigation. However, the performance of the standard UKF is dependent on the accurate statistical characterizations of system noise. If the noise distributions of inertial instruments and GNSS receivers are not appropriately described, the standard UKF will produce deteriorated or even divergent navigation solutions. This paper presents an adaptive UKF with noise statistic estimator to overcome the limitation of the standard UKF. According to the covariance matching technique, the innovation and residual sequences are used to determine the covariance matrices of the process and measurement noises. The proposed algorithm can estimate and adjust the system noise statistics online, and thus enhance the adaptive capability of the standard UKF. Simulation and experimental results demonstrate that the performance of the proposed algorithm is significantly superior to that of the standard UKF and adaptive-robust UKF under the condition without accurate knowledge on system noise, leading to improved navigation precision.

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