

Accurate Attitude Estimation Based on Adaptive UKF and RBF ANN Network Using Fusion Methodology for Low Cost Micro IMU Applied to Rotating Environment

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Abstract

An Adaptive Unscented Kalman Filter (AUKF) method combining sensor fusion algorithm with Artificial Neural Network (ANN) is designed for high precision attitude tracking of low cost, small size Micro-Electro-Mechanical System (MEMS) Inertial Measurement Unit (IMU) in high dynamic environment. The different control strategies fusing multi MEMS inertial sensors are adopted under various dynamic situations. The AUKF attitude estimation approach utilizing the MEMS sensor and Global Positioning System (GPS) could provide reliable estimation in high dynamic environmental variations. The adaptive scale factor is used to adaptively weaken or enhance the effects on new measurement data through the adjustment of the estimation according to the predicted residual vector. To solve the problem that new measurement data could not be updated in case of GPS failure situation, an attitude algorithm based on RBF-ANN feedback correction is proposed to apply in AUKF. The estimated deviation of predicted non-augmented system state would be provided based on Radial Basis Function (RBF)-ANN. The corrected the predicted non-augmented system state would be used for estimation process in AUKF. The experiment platform simulating the rotation of spinning projectile the was setup. The comparative experimental results show better control performance of the proposed method under various dynamic conditions.

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