MEMS-based multi-sensor integrated attitude estimation technology for MAV applications

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Abstract: In this paper we proposed an integrated attitude estimation Kalman filtering technology based on the MEMS sensors for the guidance and navigation of MAV. In the designing of algorithm, the outputs of accelerometer were compensated by airspeed meter, then the gravitational and geomagnetic field vectors were used to correct the attitude solved from gyroscopes through a fifteen-state Extended Kalman Filter. The measurement values of Kalman filter were calculated from the attitude errors obtained through introducing the magnetic yaw and horizontal attitude. Furthermore, the stochastic errors of the gyroscope and accelerometer were set into state vector, which could correct the outputs of the inertial sensors and improve the measurement accuracy. The foremost advantage with presented approach was that the state equations and measurement equations were linear which making it easily to implement. The simulation of dynamic flight tests demonstrated that the estimated error of yaw, pitch and roll less than 1.0° , 1.2° and 0.5° respectively. It also proved the presented Kalman filter could improve the accuracy of attitude estimation effectively.

Author Keywords: Attitude estimation; Extended kalman filter; MAV; MEMS sensors; State vector; Stochastic errors

Year: 2009

Source title: 4th IEEE International Conference on Nano/Micro Engineered and Molecular Systems, NEMS 2009

Art. No.: 5068749

Page : 1031-1035

Link: Scorpus Link

Document Type: Conference Paper

Source: Scopus

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