Real-time attitude-independent sun-sensor/magnetometer calibration algorithm for micro-satellite

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Abstract: Sun-sensor/Magnetometer has become the usual instruments combination for micro-satellite attitude determination with the low-weight/high-reliability character. Although these instruments have already been calibration strictly in ground testing, error items may appear during the launch and on-orbit running period. The magnetometer is affected not only by mechanical deformation but also by the disturbance of residual magnetic field of the satellite body. The sun-sensor is only affected by the mechanical deformation. A real-time on-orbit attitude-independent calibration method for sun-sensor/magnetometer is proposed. In the existing real-time attitude-independent magnetometer calibration algorithm, only the norm of the geomagnetic field is used as the measurement. In this paper the angel between the magnetic vector and the sun vector is introduced as another measurement, so that the system observability is reinforced, and it also enables the real-time calibration of the sun-sensor. The system state equation and measurement equation are constructed, and two kinds of filter are used to design the system sequently, Kalman filter and unscented Kalman filter(UKF). Although Kalman filter is widely used in many ways, its linearization process introduces some errors into the system. UKF is a non-linear filter which needn't the linearization process. Calibration algorithm using KF and UKF are researched in this paper, and the simulations are done on the basis of satellite simulation software Satellite Tool Kit(STK). The results show, the constructed recursive filtering algorithm in this paper realizes the real-time calibration of magnetometer/sun-sensor well, and UKF performs generally better than Kalman filter.

Author Keywords: Attitude; Calibration; Kalman filter; Micro-satellite; Unscented Kalman filter

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