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RESEARCH ON THE FAULT-TOLERANT INTEGRATED NAVIGATION SYSTEM FOR THE UPPER STAGE

Abstract

The Upper Stage (US) usually takes a few hours or a few days to deploy several satellites in different orbit by one launching mission. The typical US navigation system is composed of the tactical-grade duel strap-down inertial measurement units,and set up a GPS receiver and star sensors, in order to reduce the cost. During the long-time flight, the system's ability to adapt to sensors failed is guaranteed by the design of fault-tolerant integrated navigation system (FTINS). The core idea of FTINS is the design of the multi-moldel adaptive Kalman Filtering, which using of the mechanical coupling between different navigation states, such as flight attitude, position and velocity, implement the errors estimation and compensation for navigation and sensors. In addition, the design of fault detection based on Kalman Filtering also requires specialized. Because of the design of FTINS, in the case of any navigation sensor failure, the system precision can meet requirements, which are orbital semi-major axis error less than 1.5km, eccentricity error less than 0.0005, inclination error less than 0.01 degree, and attitude error less than 0.5 degree/axis. In this paper, on the background of low earth orbit multi-satellites deployment mission, the fault-tolerant autonomous navigation system was designed,and the simulation and analysis of the system's adaptability of sensor failures would be also mentioned.