

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)  
Mobile Communications and Satellite Navigation Technology (2)

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## FALSE ALARM REDUCTION METHOD FOR FORMATION FLYING SPACECRAFT FDI

**Abstract**

In recent years, there has been increased interest in the design of a fault detection and isolation algorithm for new and advanced autonomous unmanned space vehicles. One of the common methods for performing fault detection and isolation is a threshold method. When one of the spacecraft sensors has in trouble, the sensor output will be exceeded normal sensor output area. Thus, we can detect and isolate the fault sensor using a threshold method. However, the threshold method has a defect. When one of the space vehicle sensors output exceeds threshold limit only once, the space vehicle decides whether the sensor is out of order. Therefore, we need to apply filtering method for preventing false alarm. The formation flying of micro-satellites is the next generation space-born platform which will replace many monolithic larger satellites. It is important that the vehicles in formation must keep relative position and velocity with respect to a reference satellite. One special feature of formation flying is redundancy and reconfigurability. Thus, relative navigation information and fault tolerance requirement for navigation system are more important than absolute navigation information in multiple satellites formation flying scenario. Instead of discretizing nonlinear relative dynamics equation of two satellites, we have used continuous time system model directly and discrete time RADAR measurements and discrete time position measurements from CDGPS sensors to get more accurate relative position and velocity estimates. In this paper, we construct a federate UKF(unscented kalman filter) for estimate navigation information and use threshold method for spacecraft fault detection and isolation. Also, we apply an extended scalar adaptive filter for prevent false alarm as a pre-filtering method. The extended scalar adaptive filter is a very useful filtering method for eliminate abnormal jumping signal. This filter continuously estimates the measurement noise covariance using an innovation method, the velocity error covariance and the acceleration error covariance using a least square method. This filter is located before each sensor measurements transfers the local filter in federate UKF. Thus, when the sensor output exceeds threshold limit due to sudden noise, we can eliminate abnormal jumping signal. In conclusion, we can provide stable sensor measurement to each local filter using the extended scalar adaptive filter as a pre-filter before performing local filter algorithm. Therefore, we can prevent a false alarm and can provide accurate navigation estimation information.