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MULTI RATE SENSOR DATA FUSION FOR SPACECRAFT STATE ESTIMATION

Abstract

India's first Moon Mission, Chandrayaan-1 spacecraft requires high attitude pointing control, stability and fast maneuvers for the various scientific payloads. To achieve the same, the Attitude and Orbit Control System (AOCS) employs highly accurate inertial measurement system (Gyro) and star sensors. The star sensors and Gyro data are available at different sampling rates. A unified estimator has been developed that estimates spacecraft angular rate, spacecraft attitude, environmental disturbance torque and gyro biases using fusion of star sensor and gyro data, that are available at different sampling rates, as measurements and control torque as the input. The conventional design incorporates these measurements in two filters that estimates rate and disturbance torque and attitude and gyro drift by decoupling the dynamics and kinematics in the filter formulation. Combining the measurements available in a single filter gives considerable improvement in performance. Further, under Gyro failure condition the same estimator structure can be used in backup option for estimation of spacecraft angular rates, attitude and environmental disturbance torques using only star sensor data as the measurement and wheel control torque as the input by proper gain selection. This unique feature greatly enhances the operational flexibility and simplicity. This unified estimator is implemented in Chandrayaan-1 and it met all the mission requirements in terms of performance and operational flexibility.