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INTEGRATION OF ATTITUDE DETERMINATION SYSTEM WITH MODES OF OPERATION OF A CUBESAT

Abstract

CubeSats with Imaging payloads face unique challenges in terms of stringent pointing accuracy and stability requirements. Team Anant is a group of undergraduate students working to build a 3U Cubesat with a hyperspectral camera as its primary payload. A robust Attitude Determination System (ADS) has been developed by the team to meet the pointing requirements of the satellite. This paper discusses the integration of the ADS with the various Modes of Operation of the satellite. The Modes of Operation are states where the satellite autonomously decides and performs tasks such as detumbling, imaging and sun pointing. The paper begins with a description of the various modes of operation of the satellite and its implementation using an orbit propagator. The Orbit Propagator was indigenously developed by the team to model the dynamics of the satellite and a realistic space environment. The paper further describes the Murrell's Version Kalman Filter and the QUEST algorithms. The satellite has four sensors, including Coarse Sun Sensors (CSS), Fine Sun Sensor (FSS), a Magnetometer, and an IMU. The ADS would be fully functional in two modes, which include Pointing mode and Eclipse mode. It was observed that in each mode, the performance of the Filter considerably depends on the initial value of the error covariance matrix, which in turn depends on the accuracy of each sensor. Hence this matrix was tuned to obtain an optimum result for each mode independently. The Filter was tuned according to three cases, which include CSS only, CSS and FSS, and no sun sensor. Moreover, to reduce the error in the eclipse mode, dynamic propagation was also implemented. This paper describes the steps taken to integrate the ADS with the various modes of operation so as to satisfy the pointing requirement of the satellite. The optimal initall error covariance is determined for each mode.