ASTRODYNAMICS SYMPOSIUM (C1)
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SDS-4 ATTITUDE CONTROL SYSTEM: FIRST FLIGHT RESULTS OF ATTITUDE CONTROL RESPONSE

Abstract

The Small Demonstration Satellite (SDS) program is a JAXA technology-demonstration program aimed at the in-orbit demonstration of advanced technology and components by using small satellites weighing approximately 50 – 100kg. The SDS-4 spacecraft will be launched on May 2012 and continues in-flight demonstration of SPace-based Automatic Identification System Experiment(SPAISE), Quartz Crystal Microbalance(QCM) for monitoring contamination environment around the spacecraft, Flat-plate heat pipe eXperiment(FOX), and In-flight experiment of Space materials using THERME which is developed by the JAXA-CNES joint research program.

The SDS-4 attitude control subsystem provides 3-axis zero-momentum stabilized control by using reaction wheel. Three magnetic torquers are positioned within the satellite to deliver magnetic dipole moment control for detumbling of body angular rates after launch and momentum dumping of the reaction wheels.

This paper describes the initial flight results of the attitude control response in the first three months of operation. After separation from the launch vehicle, the satellite will be tumbling at an unknown rate. A simple B-dot rate damping controller is used. In B-dot mode, the interaction with the magnetic field is used to reduce spacecraft angular rates. This is the main rate reduction mode to remove the excess angular rate imparted to the spacecraft at separation. It also serves as the fallback safe mode in cases of anomalies. After the satellite has been detumbled, the satellite will be controlled with respect to the sun vector obtained by a digital sun sensor. In this sun acquisition mode, the yaw and pitch angles are controlled using a closed loop PD-type wheel controller. In the nominal operation mode, the attitude is controlled with respect to the Sun frame. An extended Kalman filter using the star sensor and gyro measurements are used for attitude/rate estimation. In this mode, the roll, yaw and pitch angles are controlled using a closed loop PID-type wheel controller. The specific attitude control results during these modes are briefly explained.