Development of 3-axis control system for 3U CubeSat

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Overview

CubeSats are increasingly being used for Scientific missions. Many Scientific missions require pointing. By combining reaction control wheels and magnetic torque rods (Mag Torquers) it is possible to create a system that is able to point quickly and accurately without the problems of momentum saturation.

Simulations

Simulations were developed to analyze and predict the performance of both mag torquers and reaction control wheels. Two simulations were developed, one representing only one axis of rotation, and the other demonstrating all 3 axes of rotation. These simulations are designed to take in the mass, size, and spin rate then calculate the moments of inertia, the optimal mass of the reaction wheel then output graphs showing the detumble time, satellite rotation rates and angular momentum.

Key Findings

A combination of mag torquers and reaction control wheels creates a control system that:

- Detumbles CubeSats in significantly less time than just mag torquers
- Has more efficient use of mag torquers
- Allows for quicker deployment of solar panels and antennas, if applicable
- Does not run the risk of momentum saturation

Conclusions

This research was done to improve the attitude control systems for Space Hardware’s current CubeSat program. With this system, the CubeSat will have a significantly reduced detumble time, increased dynamic pointing performance, and more accurate pointing capabilities without the possibility of permanent reaction control wheel momentum saturation.

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