Aimed at developing a CubeSat test-bench, a physical CubeSat model that could be used to test algorithms and to develop new systems that could be implemented in future CubeSat designs. Our present goal is to develop a light detecting system that would allow the CubeSat to point to a light source. The project has branched into a project that is being developed as an educational tool for K to 12 students.

Project Goals

1) Build a student 1U (20cm x 20cm x 20cm) 3D printed structure that can sustain the stress.
2) Develop a extendable command and data handling subsystem.
3) Develop an attitude control systems that can rotate the CubeSat automatically around the vertical axis towards a light source.
4) Serve as an educational kit for high school student and college freshmen.

Platform Development

The first CubeSat structure was 3D printed using the Makerbot Replicator 2. Although the structure was firm, some parts were warped during printing. Therefore, to print the second CubeSat structure, Mojo, which has a heated bed was utilized to improve the structural alignment. To control the CubeSat, Arduino was selected as it is low-cost, open-source and user friendly.

Structure Design

By Newton’s third law (for every action there is a reaction of equal magnitude and opposite direction), the flywheel acceleration is related to the CubeSat acceleration by

\[ \tau = I \alpha = I \frac{d\omega}{dt} \]

where \( I \) is the moment of inertia and \( \alpha \) is angular acceleration.

Circuit Design

By having a set point and a control algorithm below, the desirable angular acceleration for flywheel is obtained.

Conclusion

Currently, the CubeSat has a stable structure, a practical design, and a light sensor that stops the wheel rotation. However, it has difficulties to point directly towards a light source. In order to improve the current CubeSat and meet our initial goals, several future works are planned:

1) Completion of Proportional-Integral-Derivative (PID) controller having light source as input
2) Create a user interaction that is high school students friendly
3) Implement additional components such as a gyrometer, motor and wheel on roll and pitch axis

Reference


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