IAF SPACE SYSTEMS SYMPOSIUM (D1)
Interactive Presentations - IAF SPACE SYSTEMS SYMPOSIUM (IP)

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A LOW-COST ATTITUDE CONTROL SYSTEM USING HARD DISK DRIVE BASED REACTION WHEELS FOR CUBESATS

Abstract

Attitude Control Systems (ACSs) have come a long way since the CubeSat concept was proposed in 1999. They had significant improvements from using permanent magnets as passive attitude control to using magnetorquers (MTs), reaction wheels (RWs), micro pulsed plasma thrusters, and control moment gyros as active attitude control. Magnetorquers and permanent magnets are the most frequent actuators in CubeSats. These actuators can only deliver limited results in terms of accuracy and agility. Adding one or more reaction wheels to a satellite can increase its performance and permit new mission possibilities. However, space-qualified reaction wheels are expensive due to their technology and the various tests conducted to ensure their survivability in harsh space environments. This research paper has evaluated and tested the feasibility of using a personal computer Hard Disk Drive (HDD) based reaction wheel for attitude control in CubeSats. The main components required from the HDD are the spindle motor and the disks. The HDD-based reaction wheel has been integrated with 1U CubeSat structure to test its functionality in single-axis attitude control. A comparison was made with a space-grade reaction wheel in terms of maximum angular momentum storage, maximum torque, power consumption, mechanical dimensions, pointing accuracy, and time required to accomplish CubeSat pointing. Preliminary results suggest that employing an HDD-based RW in CubeSats is feasible and it significantly reduces the cost.