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DEVELOPMENT AND APPLICATION OF A LOW-COST NANOSATELLITE ATTITUDE DETERMINATION AND CONTROL SYSTEM SIMULATOR

Abstract

This paper presents a low-cost testbed design testing the attitude determination and control system (ADCS) of a nanosatellite in a university environment. The University of Adelaide's first joint-satellite endeavor, the Southern University's Satellite (SUSat), is a 2-U nanosatellite being developed by faculty and students as part of the QB50 mission. The University of Adelaide designed and built its own ADCS testbed to simulate several characteristics of the space environment that the SUSat would experience in low earth orbit to test and verify the SUSat ADCS. Regarding the SUSat ADCS, the estimation of current attitude is achieved with a combination of a magnetometer, sun and nadir sensors, and a MEMS rate sensor. Magnetorquers and a single reaction wheel will be used to stabilize and control the attitude of the satellite. The magnetic components of the ADCS are tested and verified by a three-axis magnetic field generated by a Helmholtz cage which replicates the geomagnetic field in low earth orbit. In addition, a hemispherical air-bearing based platform provides a minimal-friction environment in 3 axes as if in orbit. Furthermore, manual center of mass calibration was implemented in the platform design to reduce gravitational torque. This paper describes the development and application of the ADCS testbed, provides preliminary results from the ADCS testing phase, and future extensions in progress. The work presented here has profound implications for future cube satellite programs/projects at high school and university level due to its low-cost and utilization of easily accessible materials.