

A Modular Low-Power Cube Satellite Attitude Control System Using Magnetorquers

Clayton B. Jaksha, *United States Military Academy*

Abstract—In this work, we create a modular control system with magnetorquers that provides single-axis attitude and stability and control for a variety of common CubeSat configurations. We achieve this by analyzing the advantages and limitations of magnetorquers for attitude control, simplifying the controller design challenge, determining a low-power control algorithm, and testing the control solution through simulation. In a system that relies solely on magnetorquers for stability and control, the Earth's magnetic field provides the only stable frame of reference, therefore we are able to take a multi-dimensional control problem that would normally involve greater processing power and reduce it to a simple, one-dimensional control system. Taking also into account a limited power budget, we are able to design a rate-based combinational logic controller that provides attitude control on limited power and static stability with extremely little power. We validate the system with tests for standard attitude commands under different satellite inertial configurations, impulse disturbance torques, constant disturbance torques, and tumble recovery.

Index Terms—cube satellites, digital control systems, magnetorquers, attitude control, combinational logic control.