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TETHER DEPLOYMENT USING HIGH SPIN RATE CONTROL FOR INTERPLANETARY NANOSATELLITE MISSIONS

Abstract

This paper presents a high spin rate control algorithm based on a Linear Quadratic Regulator (LQR) used for tether deployment on the ESTCube-2 3U nanosatellite. The 300m long tether, consisting of 4 parallel 25 μm diameter wires, will be deployed using centrifugal force generated by spinning up the satellite. The deployed tether will be used for a deorbiting experiment employing the plasma break technology. The attitude control system of ESTCube-2 will use electromagnetic coils, reaction wheels and cold gas thrusters as actuators. The LQR will be designed based on linearized satellite dynamics. The aim of the controller is to spin up the satellite to 360 deg/s about the X-axis (short axis) while simultaneously aligning the spin axis with the Earth's polar axis. The paper will also describe the design of an LQR optimal controller with controllability and stability analysis to meet the strict pointing requirements of the ESTCube-2 Earth observation camera and the high speed communication antenna. The simulation results will be presented and analysed to improve controller performance. The attitude control algorithms will be flight tested on ESTCube-2 as a stepping stone for ESTCube-3 which is planned to be launched to lunar orbit.