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DESIGN OVERVIEW OF AN ELECTRODYNAMIC TETHER PAYLOAD FOR THE DESCENT MISSION.

Abstract

This paper details the design and test of the primary mission payload of the upcoming DESCENT mission, slated for launch in early 2019 via a NanoRacks LLC orbit insertion from the International Space Station (ISS). DESCENT is a 2U tethered CubeSat mission, currently being developed at York University in collaboration with Ryerson University and supported by Honeywell International Incorporated and the Canadian Space Agency. The primary objective of the mission is to provide proof-of-concept for an end-of-life Electro-Dynamic Tether (EDT) spacecraft deorbit mechanism. The primary payload consists of a 4mm wide,100m long, and 35μm thick, aluminum tape tether mounted between two 1U CubeSats, along with a tether deployment mechanism (separation, release and braking mechanism and tether stowage) and a Spindt array, and associated tension, length, voltage and current measurements to assess payload performance.

Prior to separation, the tether will be folded and stored within the daughter satellite. A novel magnetic separation system is used to deploy the tether in orbit, which will employ two electromagnets, one mounted on each CubeSat, to generate a repulsive magnetic force that will impart the required relative separation velocity. The satellites will also be tied together prior to separation, and once the separation mechanism is activated, the physical connection between the two CubeSats will be severed using NiChrome wire. The stowage unit for the tether will include a passive braking mechanism which will reduce the relative separation velocity of the two CubeSats and prevent recoil at the end of the deployment process. Once deployed, as the tether moves across the ambient plasma in Low Earth Orbit, an estimated +10 V bias will be induced across it, with the higher-altitude mother satellite having a higher potential than the lower daughter satellite. Finally, the Spindt array in the lower cubesat will discharge the electron charge accumulated on the tether, completing the current loop to generate the required deorbiting Lorentz force.

The novel aspects of the tether design have been validated using an inclinable rotating air-bearing table at York University. The table has simulated the tether deployment and braking mechanisms verifying that the design meets mission and payload requirements. The paper presents the design and experimental results of the tether deployment, braking and sensor measurements, as well as the design and initial test results of the Spindt array.