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Author: Mr. Brad Cotten
Space Flight Laboratory, University of Toronto, Canada, bcotten@utias-sfl.net

Mr. Thomas Sears
Space Flight Laboratory, University of Toronto, Canada, tsears@utias-sfl.net
Mr. Jesse Hiemstra
Space Flight Laboratory, University of Toronto, Canada, jessehiemstra@gmail.com
Mr. John Chung
Space Flight Laboratory, University of Toronto, Canada, jcjchung@gmail.com
Mr. Grant Bonin
Space Flight Laboratory (SFL), Canada, gbonin@utias-sfl.net
Dr. Robert E. Zee
University of Toronto, Canada, rzee@utias-sfl.net

THE CANX-7 DEORBIT MISSION: DEMONSTRATING DEORBITING TECHNOLOGIES FOR MICRO AND NANOSATELLITES

Abstract

There is wide acceptance of the Inter-Agency Space Debris Coordination Committee's (IADC) assessment that low-Earth orbit spacecraft should be removed within 25 years of mission completion—possibly through deorbiting—in order to lessen the rate at which defunct satellites become hazardous debris. Large spacecraft with onboard propulsion systems can programmatically account for this, but single-focus small satellites are without the necessary maneuvering capabilities. Furthermore, as low-cost nano and microsatellite missions in low Earth orbit are projected to increase, they pose a serious risk to increase the debris count. Development of a compact and reliable deorbiting system, and making this technology commercially available is a necessary step towards creating a sustainable space environment for the future. One promising method for small satellites operating below 800 km is the use of a deployed sail that decreases the ballistic coefficient of the spacecraft, such that it continuously and passively slows the host spacecraft through drag forces experienced in the Earth's upper atmosphere.

This paper discusses the CanX-7 deorbit mission, which will be ready for launch in 2014, where a modular drag sail system for nano and microsatellites will be demonstrated. This paper will review deorbit technologies realizable for nano and micro spacecraft, as well as discuss the rationale for implementation of a thin-film sail over alternative technologies. It will be shown how a drag sail device is not only viable for a nanosatellite, but can be implemented with minimal impact on mass and available volume, as CanX-7 also carries an ADS-B receiver for a six month aircraft surveillance demonstration. Deorbit predictions are presented for a number of scenarios with varying altitude and spacecraft mass, and the drag sail device is shown to successfully meet the IADC's recommended deorbit time of 25 years in all cases. A discussion of the modular drag sail system is presented, including an overview of the mechanical and electrical designs.