Paper ID: 33504
oral
student

SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

Author: Mr. Josué Zabeau
Ecole Polytechnique de Montreal, Canada

Mr. Alexis Noël
Ecole Polytechnique de Montreal, Canada
Prof. Giovanni Beltrame
Ecole Polytechnique de Montreal, Canada

MANUFACTURING COMPACT ELECTROSPRAY THRUSTERS TO DEORBIT A NANOSATELLITE

Abstract

Cheaper technologies and standardized production processes have greatly improved our access to space. CubeSats and nanosatellites are now obiquitous in start-ups and education. However, the greater the number of orbiting objects, the greater the risk of exponential cascade of orbital debris, as explained by the Kessler effect. These are the reasons why a student team from Polytechnique Montreal decided to design an electrospray ion thruster small enough to fit on a CubeSat frame. Named IonDrop, this compact propulsion system is meant to de-orbit the most recent prototype of a 3U CubeSat developed by Polytechnique Montreal's PolyOrbite. The project is conducted in the context of the 2014-16 iteration of the Canadian Satellite Design Challenge, an inter-university competition. Nevertheless, IonDrop is more than a simple deorbiting system. It can provide attitude and orbit corrections at a very small cost and it is compatible with any nano-satellite that complies with the CubeSat standard. With an expected specific impulse higher than 3000s and a total weight of less than 350gr., the IonDrop thrusters may also be implemented as a full propulsion system. The small size of the thruster and the desire to avoid the traditional pitfall of including delicate moving parts pushed us to design components replacing traditional pumps and valves to improve the reliability. The principle under which IonDrop operates is relatively simple: a non-pressurized fuel tank brings an ionic liquid to a porous emitter array by capillarity; from here, the particles are accelerated through an electric field. Microfabrication, precision tools and unconventional processes such as micro chemical etching and laser ablation are being used to fabricate the critical parts of IonDrop and the article focuses on their designs and manufacturing processes.