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

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FITTING A HIGH TOTAL IMPULSE ELECTRIC PROPULSION SYSTEM IN A STUDENT CUBESAT TO COMPENSATE THE ATMOSPHERIC DRAG IN LOW-EARTH ORBIT

Abstract

In this era where the interest in nanosatellites is growing rapidly, the next big step for them is to integrate a propulsion subsystem in order to accomplish more complex missions. With electric propulsion in particular, nanosatellites will be able to perform new maneuvers and new missions, such as missions in LEO by compensating the drag with a thruster. However, designing such a mission and the satellite for it was not easily feasible for a student project. Here we present a preliminary design for a 6U CubeSat capable of maintaining an altitude of about 350 km for more than several months. This project is a fully student project, and it is supported by the CNES, the École polytechnique, in Paris. It is planned to be ready for launch in the early 2020s. The phase B planning of this project allowed us to design a nanosat capable of withstanding the high demand for power and capable of performing all maneuvers necessary to reach the target altitude and maintain it. All the technical choices allowing these performances are explained: high-capacity batteries capable of providing energy for one whole thrust (50Wh), large, deployable but not steerable solar panels to recharge them and a balanced ADCS strategy allowing both a high energy intake and regular thrust phases to keep a stable altitude. It is shown that a three-axis reaction wheels stabilization is necessary for such a mission, even while rotating the satellite only around a fixed thrust axis. Finally, the trajectography algorithm, for now based on periapsis raising based on GPS data, under constraints of battery charge and eccentricity, is described, as well as the structure of the on-board computer and the technical choices around them. This preliminary design shows how a satellite can handle atmospheric drag at around 350 km for several months with the constraints of a student-designed CubeSat.