

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

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ELECTRIC PROPULSION OPTIONS FOR CUBESATS

Abstract

The Cubesat platform is presently well established as a standard building block for nano-satellites and presents a large potential for application in different fields, particularly in its 3-U (or larger) version. The aim of this work is to investigate the possibilities opened by the implementation of electric propulsion (EP) on the Cubesat platform and to analyze the relative merits of several current EP technologies with respect to the specific constraints of such minimal spacecraft.

Due to the actual limitations of available size, mass and power of Cubesats, the integration of a propulsion subsystem is particularly challenging. The propulsive subsystems must be light, requiring very little electrical power, with reduced size and capable to be shaped so to exploit the clearance left by other subsystems. Thermal management issues also must be taken into account.

Several of the electric propulsion technologies currently available could, in principle, be used on a Cubesat. We focus on devices requiring limited power and with small mass and size, yet performing at relatively high specific impulse, such as Hall Effect Thrusters, Field Emission Electric Propulsion, Pulsed Plasma Thrusters and (to a lesser extent) resistojets. Performance analysis was performed first analytically, then by direct simulation of representative mission profiles on Alta's proprietary SATSLAB simulator, whereby the coupled effect of orbit, attitude and onboard energy management is accounted for. We show that performance of Cubesats is significantly enhanced, extending the operational envelope to include maneuvers such as residual drag compensation, change of orbital altitude and plane inclination, and rephasing in constellations, resulting in additional mission profile flexibility. New mission classes, enabled by the unique combination of Cubesat's tiny mass and EP maneuvering capability, are outlined and discussed.