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SITAEL LOW POWER HALL EFFECT PROPULSION SYSTEMS FOR SMALL SATELLITES

Abstract

Low power electric propulsion is an enabling technology for a many future missions, especially the ones involving mini- and micro- satellites. For such missions the adoption of an efficient propulsion system is crucial in order to save propellant and maximize the payload mass. From Earth Observation platforms to large constellations intended to provide worldwide internet coverage, the possibility of using an electric thruster as main propulsion system turns out to offer a terrific improvement in terms of propellant mass reduction. Missions that require a total DV larger than 100 m/s already experience remarkable benefits thanks to the high specific impulse of electric thrusters. More ambitious missions, requiring a total DV of 200 m/s or more, can be accomplished only by means of EP, as it would be otherwise impossible to store the necessary propellant onboard. Typical EP tasks are drag-compensation for satellites operating in VLEO, orbit insertion, orbit raising, transfers from parking orbit to active orbit (for spare satellites of a constellation), de-orbiting. To effectively respond to these market needs, SITAEL is developing a compact, low-cost propulsion subsystem based on HT100, the smallest and lowest-power Hall Effect thruster ever developed in Europe. SITAEL's HT100 has a peculiar architecture based on permanent magnets which brings a significant reduction in thruster weight, complexity and size. Such propulsion system operates in a power range between 150 and 300W, covering thrust levels from 5 to 15 mN and providing a total impulse in excess of 75 kNs. The HT100-based propulsion system is a perfect match for small satellites with a mass below 250 kg. For heavier satellites, in the range of 250-500 kg, a more powerful thruster is under development (HT400, with a nominal operating power of 400W) which is capable of a higher thrust and a considerably larger total impulse. Design pays special attention to overall cost, as this is one of the most relevant driving factors for small satellite applications. The power processing and control unit is largely based on COTS, with possible upgrades of the class of the electronic components for those missions that require a higher level of radiation-hardening because of their orbit or their duration. The present work describes the architecture of the two low power electric propulsion systems (one based on HT100, one on HT400), illustrating their performance and discussing possible target missions, highlighting the advantages of adopting such electric thrusters to accomplish them.