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UNISAT-8: A STABLE SATELLITE FORMATION USING ELECTRIC PROPULSION

Abstract

Autonomous small satellite formations operating in LEO have been attracting a growing interest and recent studies indicate that their performance for several commercial and strategic applications is now comparable to those of larger satellites, while guaranteeing lower cost.

A critical challenge in the design of a LEO satellite formation is represented by the effect of gravitational perturbations, which cause a drift of the prescribed formation configuration. The UNISAT-8 mission is designed to propose and validate in orbit a solution to deploy a satellite formation invariant with respect to perturbations. The use of an electric propulsion system (EPS) allows for correction of the relative velocity between the satellites, establishing a specific equilibrium which compensates for the secular drift associated to the perturbations.

The UNISAT-8 mission is a joint mission between the Italian company GAUSS Srl and the German company Berlin Space Consortium GmbH (BSC), with the support of Airbus SE. GAUSS is the first company to have deployed nanosatellites from a larger satellite, the UNISAT platform. For the UNISAT-8 mission, the 50-kg microsatellite UNISAT-8A, is equipped with a Hall-effect EPS which allows deploying the two nanosatellites UNISAT-8B/C providing the above-mentioned velocity corrections, resulting in an invariant 8-shaped relative trajectory of the UNISAT-8B/C with respect to UNISAT-8A. In this configuration, the UNISAT-8A/C will perform in-orbit validation of on-board subsystems pivotal to implement Inter-Satellite-Link (ISL) with the support of Airbus SE.

The use of a 5-mN Hall-effect thruster (HET-5) designed and space qualified by BSC is of crucial importance for the mission. In fact, the HET-5 provides the required thrust level to implement the necessary very high accuracy of the velocity correction. Moreover, the high specific impulse of the HET-5 guarantees compliance with the mass budget of the microsatellite platform. The HET-5 uses an innovative cathode type with immediate starting characteristics that allows for highly precise orbital maneuvers of the UNISAT-8A during the deployment phase of the two nanosatellites.

The proposed HET-5 uses Xenon as propellant in the baseline design, but could also be operated with Krypton as alternative solution. The general EPS architecture is based on the objectives to minimize the system mass and power consumption. At the same time, it presents a modular design to ensure optimal accommodation of the EPS subsystems inside the UNISAT 8 platform configuration.