SPACE PROPULSION SYMPOSIUM (C4)
Joint Session between IAA and IAF for Small Satellite Propulsion Systems (8-B4.5A)

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A LOW-COST HELICON PROPULSION SYSTEM TO BOOST SMALL SATELLITE MISSIONS.

Abstract

The market of small satellites for educational, institutional and commercial purposes is in rapid growth. In order to allow different mission scenarios, small satellite platforms down to Cubesat Units need versatile, low-cost, compact and reliable propulsion systems.

The University of Padua has worked in the promising Helicon Plasma propulsion technology for small down to multi-Unit satellite applications since January 2009, under the HPH.com FP7 Project consortium coordinated by the University of Padua and comprising 15 partners from EU nations and 2 ICPC countries1. The main features of the helicon thruster are (i) a simple architecture consisting in a discharge chamber, an antenna and a magnetic field generator, (ii) no need for neutralizer and grids, (iii) no need for the PPU to provide high voltage DC output. Thanks to these features, the overall propulsion system allows remarkable cost reductions and long lifetimes. Furthermore, the system is versatile since it allows to use different types of gases, which makes it a good candidate to satisfy current small satellite propulsion needs. T4i, the Spin-Off of the University of Padua founded by its Space Propulsion group, is currently developing a complete and compact propulsion system based on a Mini Helicon Plasma Thruster (mHPT) based on cubesat standard data and power. The mHPT propulsion system fits in a 10x10x10 cm volume, depending on the needed propellant tank volume. The thrust performance at 0.1 mg/s of Xenon is above 0.4 mN with a power of 30W.

Thanks to these features the system will allow to perform orbital variations, station-keeping maneuvers, orbit transfers, orbit raising and decommissioning. The low cost of such system is fundamental to permit also to small and low budget satellites to perform innovative or unconventional type of missions. Moreover, thanks to its characteristic long lifetimes, it will enable new mission scenarios as well as new deep space small spacecraft missions.

The first section of the present paper describes the thruster technology, the performed numerical and experimental work and the achieved performance results. In the second section, the overall propulsion system is described, with a focus on the current status and development approach up to satellite platform integration, the system requirements identification and the interfaces with the satellite platform definition.

Eventually, the paper presents and discusses the small satellites mission scenarios enabled by the mHPT propulsion system, ranging from LEO to deep space exploration missions.