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DESIGN OF A FLEXIBLE PROPULSION TESTBED FOR CUBESATS

Abstract

CubeSats and nanosatellites represent an emerging opportunity to pursue a broad set of mission goals, including science, technology demonstration, communications, and Earth observation, at low cost and fast delivery. To fully exploit the potential of this class of spacecraft, there is a need for improvement of technology to enhance nanosatellites performance and to increase mission success. Propulsion is one of the key technology areas that shall be developed to enable this paradigm shift. In fact, functions associated with advanced nanosatellite missions require the capability of controlling position and velocity of spacecraft, i.e. to enable constellation build up and maintenance, close proximity operations, spacecraft deorbit, and orbit transfer for a wide range of applications. Applied to nanosatellites, propulsion poses new challenges at system level that influence heavily the spacecraft design and its verification. At subsystem level, many concepts have been recently proposed and/or are under development, which need to be tested and qualified for space. ESA intends to support the evaluation and selection of suitable propulsion systems for future generations of cubesats and therefore, the present research, carried out with the Politecnico di Torino, identifies needs and requirements associated with cubesats propulsion, and defines an effective test platform to support propulsion systems development and verification. Standardisation and reproducibility of test methodologies have been considered essential in this work, in order to provide a reliable tool for new mission designers. Final objective of the present research, rather than evaluating specific propulsion system performance, is to assess the impact of propulsion technology choices on the major subsystems of the spacecraft (e.g. power, structure, thermal), and on its operations (e.g. plume impingement and disturbance torques). Hence, a 6U CubeSat simulation bench to support testing of propulsion systems has been developed, which will be tested in the propulsion laboratory of ESA/ESTEC. The platform is designed to host different propulsion systems occupying up to two units of the spacecraft. The design of the testbed features modularity to allow the assessment of several propulsion systems. The ultimate scope of the overall research is not restricted to any specific class of propulsion systems. On the other hand, the start of the activity has been dedicated to Electric Propulsion, in order to explore high performance propulsion systems while dealing with the challenge of more complex subsystem architectures than other propulsion technologies.