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DESIGN OF A TEST PLATFORM FOR MINIATURIZED ELECTRIC PROPULSION SYSTEMS

Abstract

Nanosatellites represent an emerging opportunity to pursue a broad set of mission goals, including remote sensing, technology demonstration, and communications, at low cost and fast delivery. These new opportunities require a technological improvement to increase capabilities such as orbit change and transfer, formation flying and constellation build up, close proximity operations and deorbiting. In this sense, miniaturized electrical propulsion systems increase the range of missions performed with multi-unit cubesats. At subsystem level, many concepts have been recently developed but their level of readiness is limited. Moreover, the integration of propulsion poses new challenges at system level that influence heavily the spacecraft design and its verification. The present research, developed by Politecnico di Torino and supported by ESA, intends to build a flexible test platform and define effective procedures to support the evaluation of suitable propulsion systems for future nanosatellites. The main objectives are to investigate the interaction of propulsion systems with cubesat-technology from different perspectives (mechanical, electrical, magnetic, chemical) and to evaluate the performance of the integrated platform. The test platform is a 6U CubeSat able to host electric propulsion systems selected among European solutions, providing mechanical, electrical and data interfaces. A flexible and robust structure holds and protects the propulsion system and avionics, and externally interfaces the test platform with the facility of ESA/ESTEC propulsion laboratory. The onboard Electrical Power System adapts the voltage and power provided by batteries to serve loads up to 2A @ 28V. Different protocols are included in the onboard computer to exchange data and commands with a range of propulsion systems. The test platform is equipped with a wide range of sensors (e.g. temperature sensors, accelerometers, and magnetometers) to measure and acquire parameters both of the propulsion system and of onboard avionics. Data are stored onboard and sent to the ground support system via wired and/or RF links. The test platform operations are controlled through commands sent by the operator and by autonomous onboard routines in charge of managing transitions between operative modes and for detection, identification and recovery of failures. The test platform will be ready in September 2018, and it will represent the first important step for the evaluation of electrical propulsion systems integrated in small satellites. A test plan will be also proposed for execution in the near future. The paper describes into the detail the design and development of the platform and the plan for the test campaign.