20th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Small/Micro Platforms (6A)

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MICRO ELECTRIC PROPULSION TECHNOLOGY FOR SMALL SATELLITES: DESIGN, TESTING, MISSIONS AND IN-ORBIT OPERATIONS

Abstract

Electric propulsion (EP) systems can provide an increased specific impulse over typical chemical systems and resistojets. This allows for a higher total delta V for a mission or significant mass savings. The use of EP systems for small satellites has so far been prohibited by the high cost of the systems and the high power needs to run them within the physical constraints of small satellites. The Surrey Space Centre of the University of Surrey, together with its industrial partners is working on the development of low cost, highly innovative micro-EP systems for small satellites which can currently support and enhance current space missions as well as to enable new mission concepts for the near term. The paper details a number of micro-EP technologies currently in preparation for flight as well as the initial test results of new micro-EP thrusters such as: (i) The micro-PPT experiment on the STRaND-1 Cubesat satellite scheduled for launch on the 25th February 2013 (ii) A novel micro Hollow Cathode Thruster (HCT) which has been designed as a bolt on system to work with SSTL's Xenon resistojet propulsion system intended to generate 1 mN of thrust with an Isp of 65-80s. (iii) The Quad Confinement Thruster (QCT) which is a family of low cost hall effect thrusters with a unique electromagnetic topology which allows thrust vector control. Various QCT models are presented in the paper such as the 40W/1mN, 200W/3mN, 1500W/50mN thrusters (iv) The Helicon Double Layer Thruster (HDLT), a collaborative research project between the University of Surrey, Astrium and the Australian National University is presented based on the experimental test results of this radio frequency plasma thruster which promises long duration spaceflight with micro-EP. Low cost/low power micro EP can give small satellites unprecedented capabilities and as a disruptive technology provide unique capabilities for small satellites. The paper presented a few mission concept studies which can be enabled by micro EP (i) low flying optical/radar missions (ii) small satellite GEO communication missions.