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DATA RETRIEVED BY SCRAT EXPERIMENT DURING THE 2010 ESA BEXUS 10 FLIGHT CAMPAIGN

Abstract

This paper describes the development of the SCRAT Experiment (Spherical Compact Rechargeable Air Thruster) for the evaluation of the performance of a cold-gas thruster on board the stratospheric balloon BEXUS 10. SCRAT is a two-stage cold gas micro-actuator, which employs atmospheric air as propellant to produce thrust and does not need propellant on board, since the gas is directly collected from the external environment. The air is then energized by two micro-compressors connected in parallel that fill a two-stage tank before ejecting the propellant to deliver the thrust; the two-stage configuration allows to modulate the thrust profile and the total impulse Different environmental conditions encountered during the stratospheric flight allowed to measure the actuator thrust in function of varying external pressure and temperature from 0 to 25 km of altitude. The raw data collected were submitted to extensive signal processing, to filter out the disturbances from the environment and the measurement system: a total of 101 thrusts were sampled in the 10-4 – 10-1 N range with a total impulse between 10-3 and 10-2 Ns each duty cycle. Compared to standard cold gas thrusters, with such performances a rechargeable actuator is able to save about 0.12 kg of propellant every unit of total impulse, which is more than 1 kg in a four-hour stratospheric flight and more than 2.7 kg on lower altitude equivalent flights.