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SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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SYSTEM ANALYSIS AND TEST-BED FOR AN ATMOSPHERE-BREATHING ELECTRIC PROPULSION SYSTEM USING AN INDUCTIVE PLASMA THRUSTER

Abstract

Challenging space mission scenarios include those in low altitude orbits, where the atmosphere creates significant drag to the S/C and forces their orbit to an early decay. For drag compensation, propulsion systems are needed, requiring propellant to be carried on-board. An atmosphere-breathing electric propulsion system (ABEP) ingests the residual atmosphere's particles through an intake and uses them as propellant for an electric thruster. Theoretically applicable to any planet with atmosphere, the system might allow to orbit for unlimited time without carrying propellant. A new range of altitudes for continuous operation would become accessible, enabling new scientific missions while reducing costs. Preliminary studies have shown that the collectible propellant flow for an ion thruster (in LEO) might not be enough, and that electrode erosion due to aggressive gases, such as atomic oxygen, will limit the thruster's lifetime. In this paper we introduce the use of an inductive plasma thruster (IPT) as thruster for the ABEP system. IPT is based on a small scale inductively heated plasma generator IPG6-S. These devices have the advantage of being electrodeless, and have already shown high electric-to-thermal coupling efficiencies using O2 and CO2 as propellant. A water cooled nozzle has been developed and applied to IPG6-S. The system analysis is integrated with IPG6-S equipped with the nozzle for testing to assess mean mass-specific energies of the plasma plume and estimate exhaust velocities.