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DEVELOPMENT AND ANALYSIS OF NOVEL MISSION SCENARIOS BASED ON ATMOSPHERE-BREATHING ELECTRIC PROPULSION (ABEP)

Abstract

Electric propulsion is advantageous over chemical propulsion due to a significant weight reduction in its required on-board propellant. However, the need for carrying any amount of on-board propellant would be theoretically eliminated by introduction of Atmosphere-Breathing Electric Propulsion (ABEP) which collects the atmospheric residual gases and supplies them as a propellant to an electric thruster.

ABEP can find a variety of application not just on Earth-based satellites but also to any celestial body with atmosphere by introduction of ISRU to electric propulsion. For Earth-referenced missions, the system would open the unexploited resource of Very low Earth Orbits (VLEO)to venture in applications beyond Earth Observation such as Telecommunication, providing cheaper test-bed for scientific experiments. The ABEP system could also prove to be a worthy candidate for Interplanetary missions like a space-tug between Earth and Moon. Within the DISCOVERER framework, a Horizon 2020 project, IRS is developing its own concept of intake and contact-less RF Thruster 'IPT' suitable for the above mentioned concepts.

This paper presents development and investigation of various mission scenarios using ABEP to analyse their scope of application. The successful operation of an ABEP thruster depends on several critical system parameters like intake efficiency, available power, thruster efficiency, system lifetime, etc., and vary depending on the environment of operation and purpose of the mission. The purpose of the paper is to identify these parameters and gauges their variation by placing ABEP in varying environmental conditions and mission types to provide a basic reference for the system design. The work starts by considering a scenario with ABEP application on Earth-referenced satellites providing full drag compensation and then extends to more complex scenarios. The analysis is primarily done using MATLAB and the results are verified using commercially available ASTOS simulation software.

Keywords: ABEP , RAM-EP, VLEO,VLMO, ISRU, Simulation