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SYSTEM DESIGN ASPECTS FOR VLEO PLATFORMS WITH ATMOSPHERE-BREATHING ELECTRIC PROPULSION

Abstract

Very low Earth orbits (VLEOs) with altitudes in the range between 150 and 250km promise significant benefits particularly for Earth observation and telecommunication applications. However, the low orbital regime also poses challenges to spacecraft design, particularly the need to minimize and compensate the drag caused by the residual atmosphere. Moreover, the particular implications on communication, thermal household, and attitude control need to be taken into account.

Within the ESA-funded RAM-CLEP project, a design study of a spacecraft powered by an atmosphere-breathing electric propulsion (ABEP) system based on an electrode-less RF Helicon-based Plasma Thruster (IPT) is currently being carried out. The study prominently includes configuration analysis, a multi-disciplinary optimization approach, as well as detailed analyses of orbit evolution also of non-circular orbits.

In this contribution, the impact of the VLEO environment particularly on the thermal household, communication system, and attitude control system are discussed using the example of an Earth observation-driven satellite platform. The analysis of satellite aerodynamics, including the ABEP system, using a combination of analytical and DSMC-based methods, is presented. Moreover, open research questions are described and plans to address them within the DFG-funded long-term basic research project (Collaborative Research Center) "ATLAS" to be established in April 2024 are outlined.