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ASSESSMENT AND DESIGN OF THE ACTIVE AIR INTAKE FOR VLEO OPERATION

Abstract

This paper describes an assessment and design of an Active Air Intake, which serves to trap the atmospheric particles in VLEO orbits (150 - 300 km) and compress it to density, preferable for plasma generation. Application of this device can ensure the long-term presence in VLEO, boosting the performance of the existing satellite's systems: high-resolution imaging, low-latency communication satellites, precise measurements of the gravity field, atmospheric decomposition, and so on. Furthermore, the ability to compress and store the atmospheric particles can enable new types of highly efficient missions: on-orbit propellant mining and distribution, iterative space debris removal, satellite de-orbiting service, and on-orbit servicing.

While the implementation of the active intake can substantially improve the existing satellite systems, a question of applicability in space arises. To compress and collect particles effectively, the rotational speed of the rotor has to be in a range of 50'000-80'000 rpm, which imply complexity to a system. This study reveals a list of the technological solutions, that can provide high reliability of the Active Intake, solve issues with thermal dissipation, structure, adaptation to launch requirements and design of compression stages. The test strategy of Active Intake was proposed. According to the results of numerical simulation, the potential configuration of a satellite which can ensure long term operation at 220 km using Active Intake and Ion Engine was proposed.