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Small Space Science Missions (2)

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INVESTIGATION OF NOVEL DRAG-REDUCING AND ATOMIC OXYGEN RESISTANT MATERIALS IN VERY LOW EARTH ORBIT USING SOAR (SATELLITE FOR ORBITAL AERODYNAMICS RESEARCH)

Abstract

Interest in operating spacecraft in very low Earth orbits (VLEO), those below approximately 450km, is growing due to the numerous benefits offered by reducing altitude. For remote sensing and Earth observation applications, improvements in resolution can be achieved or smaller instruments used with associated benefits in cost or mission value. Similarly, for communications applications, link-budgets and data latency can be improved by reducing the operational altitude.

However, a key challenge to sustained operations in lower altitude orbits is to minimise and compensate for the aerodynamic drag that is produced by the interaction with the residual atmosphere.

A principal aim of the DISCOVERER project is to identify, develop, and characterise materials that can promote specular reflections of the residual atmosphere in VLEO whilst also remaining resistant to the erosive atomic oxygen that is predominant at these altitudes. In combination with geometric design, such materials would be able to reduce the aerodynamic drag experienced by satellites in orbit and would also be able to generate usable aerodynamic lift enabling novel aerodynamic attitude and orbit control.

SOAR (Satellite for Orbital Aerodynamics Research) is a 3U CubeSat that has been designed to investigate the aerodynamic performance of different materials in the VLEO environment and provide validation data for further ground-based study in a UHV atomic oxygen exposure facility. The spacecraft will employ a combination of two payloads to perform these experiments: a set of steerable fins that can expose different materials to the oncoming atmospheric flow at varying incidence; and a forward-facing ion and neutral mass spectrometer (INMS) that provides in-situ measurements of the atmospheric density and flow composition.

SOAR is scheduled for launch to the ISS in October 2020. This paper will present the design of the spacecraft, the experimental method that will be used to investigate the aerodynamic properties of materials in orbit, and will provide an update on the status of the spacecraft as it prepares for launch and deployment.

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