29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations - 29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

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EXPERIMENTAL RESULTS FROM THE SATELLITE FOR ORBITAL AERODYNAMICS RESEARCH (SOAR) MISSION

Abstract

The Satellite for Orbital Aerodynamics Research (SOAR) is a 3U CubeSat that has been designed to investigate the aerodynamic performance of different materials and perform demonstrations of aerodynamic attitude control manoeuvres in very low Earth orbit (VLEO). SOAR was deployed from the ISS on 14th June 2021 into a naturally decaying orbit and will deorbit in mid-2022 following 9-12 months of operations. This paper will provide an overview of the operations performed during the mission and present the first experimental results obtained from this spacecraft.

SOAR was designed and launched within the frame of DISCOVERER, a Horizon 2020 project that aimed to support the development of a new class of commercially viable spacecraft operating in VLEO, i.e., orbits below 450 km in altitude. Operating in these lower altitude orbits has several benefits to the design of spacecraft, particularly for Earth observation and communications applications. However, development of spacecraft that can operate sustainably at these altitudes requires advancement in foundational technologies, for example atmosphere-breathing electric propulsion (ABEP) and novel aerodynamic materials.

The primary aim of SOAR was to characterise the aerodynamic performance of different materials at very low altitudes and accomplished this task using a set of steerable fins that exposed different materials to the oncoming flow and an ion and neutral mass spectrometer (INMS) to provide in-situ measurements of atmospheric properties. SOAR was also designed to perform novel aerodynamic attitude control manoeuvres and measurements of thermospheric winds.

Two of the materials carried to orbit were selected for their atomic oxygen erosion resistance and potential improvement in aerodynamic performance. The identification of such materials would allow for a reduction in the drag experienced in VLEO, the design of atmospheric intakes with greater efficiency used for ABEP, and implementation of enhanced aerodynamic attitude and orbit control. Ongoing ground-based experimentation seeks to further characterise the properties of such materials and to deepen our understanding of the physical interaction mechanisms that occur in the rarefied flow environment of VLEO.