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Small Space Science Missions (2)

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SOAR – A SATELLITE FOR ORBITAL AERODYNAMICS RESEARCH

Abstract

SOAR (Satellite for Orbital Aerodynamics Research) is a CubeSat mission designed to investigate the interaction between different materials and the atmospheric flow regime in very Low Earth Orbit and to demonstrate aerodynamic attitude and orbit control manoeuvres. Improving knowledge of the gas-surface interactions is important for the design of future satellites operating in lower altitude orbits and will enable the identification of materials which can minimise drag or improve aerodynamic control, a key aim of the Horizon 2020 funded DISCOVERER project. In order to achieve these objectives, SOAR features two payloads: i) a set of steerable fins which provide the ability to expose different materials or surface finishes to the oncoming flow with varying angle of incidence whilst also providing variable geometry to investigate aerostability and aerodynamic control; and ii) an Ion and Neutral Mass Spectrometer with Time-of-Flight capability which enables accurate measurement of the in-situ flow composition, density, and thermospheric wind velocity. The drag and lift experienced by the satellite in orbit can be studied and estimates of the aerodynamic coefficients calculated using precise orbit and attitude determination information and the in-situ measured atmospheric flow characteristics. This paper first presents the scientific design and operational concept of the SOAR mission, focusing on the stability and control strategy which enables the spacecraft to maintain the flow-pointing attitude required by the payloads. The methodology for recovery of the aerodynamic coefficients from the measured orbit and in-situ atmospheric data is then presented. Finally, the uncertainty of the resolved aerodynamic coefficients is estimated statistically using simulations.