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ROAR – A GROUND-BASED EXPERIMENTAL FACILITY FOR ORBITAL AERODYNAMICS RESEARCH

Abstract

DISCOVERER is a European Commission funded project aiming to revolutionise satellite applications in Very Low Earth Orbits (VLEO). The project encompasses many different aspects of the requirements for sustainable operation, including developments on geometric designs, aerodynamic attitude and orbital control, improvement of intake designs for atmosphere breathing electric propulsion, commercial viability, and development of novel materials. This paper is focused solely on the description of the experimental facility designed and constructed to perform ground testing of materials, characterising their behaviour in conditions similar to those found in VLEO. ROAR, Rarefied Orbital Aerodynamics Research facility, is an experiment designed to provide a controlled environment with free molecular flow and atomic oxygen flux comparable to the real orbital environment. ROAR is a novel experiment, with the objective of providing better and deeper understanding of the gas-surface interactions between the material and the atmosphere, rather than other atomic oxygen exposure facilities which are mainly focused on erosion studies. The system is comprised of three major parts, (i) ultrahigh vacuum setup, (ii) hyperthermal oxygen atom generator (HOAG) and (iii) ion-neutral mass spectrometers (INMS). Each individual part will be considered, their performance analysed based on experimental data acquired during the characterisation and commissioning, thus leading to a complete description of ROAR's capabilities. Among the key parameters to be discussed are operational pressure, atomic oxygen flux, beam shape and energy spread, mass resolution, signal-to-noise ratio and experimental methodology.