DESIGN AND DEVELOPMENT OF A HYPERTHERMAL ATOMIC OXYGEN WIND TUNNEL FACILITY

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ABSTRACT

DISCOVERER is a €5.7M, 4½ year Horizon 2020 funded project which aims to revolutionise Earth observation (EO) by operating satellites at much lower altitudes than usual. EO data and service market is estimated to reach $8.5 billion by 2026 and is comprised of different strategic sectors, like maritime surveillance, intelligent and security, food security and land management, among others. Orbiting closer to the Earth allows satellites to be smaller, lighter and less expensive without compromising data throughput or image resolution. However, at reduced orbital altitudes drag forces are more significant, thus affecting considerably the satellite orbital life. One of DISCOVERER’s main objectives is to identify and characterise materials which are less susceptible to drag. The work presented here will discuss the design and development of the experimental facility for on-ground orbital aerodynamics tests of materials. ROAR (Rarefied Orbital Aerodynamics Research) Facility is a unique experiment composed of a hyperthermal oxygen atom generator (HOAG) along with two ion-neutral mass spectrometers (INMS) to characterise the flow onto and reemitted from material samples. It will be dedicated to identifying materials suitable for satellite applications in very-low Earth orbits (VLEO), and specifically those with interesting aerodynamic properties (promoting specular or quasi-specular reflections). It will do this by determining the gas-surface interaction from the measured flow field whilst varying relevant experimental parameters like atomic oxygen flux, angle of incidence, and exposure time. In this context, the system’s capabilities will be presented and discussed. It is currently in its design stages and is expected to be commissioned by early 2019.

Key words: Atomic oxygen, ground testing, very-low Earth orbit, aerodynamics properties, low drag materials, ultra-high vacuum, gas-surface interaction.