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DEMONSTRATION OF AERODYNAMIC CONTROL MANOEUVRES IN VERY LOW EARTH ORBIT USING SOAR (SATELLITE FOR ORBITAL AERODYNAMICS RESEARCH)

Abstract

Aerodynamic forces have often been proposed as a possible means to perform a variety of different attitude and orbit control manoeuvres in very low Earth orbits including pointing control, constellation and formation management, and re-entry interface targeting. However, despite interest and numerous studies conducted in this area there has been lack of on-orbit demonstration of these manoeuvres beyond simple proof of aerostability and some operational use of differential drag for constellation maintenance. SOAR (Satellite for Aerodynamics Research) is a CubeSat mission and part of DISCOVERER, a Horizon 2020 funded project to develop technologies to enable sustained operation of Earth observation satellites in very Low Earth Orbits. SOAR is due to be launched in 2020 with the primary aim to investigate the interaction between different materials and the atmospheric flow regime in very low Earth orbits. This satellite, with its set of rotating aerodynamic fins, also offers the unique opportunity to demonstrate and test novel aerodynamic control methods in the Very Low Earth Orbit (VLEO) environment. This paper presents the approach to demonstrate novel aerodynamic control methods in-orbit which will be

used on the experimental SOAR Cubesat. The aerodynamic manoeuvres and associated control methods selected for demonstration are first described. Simulations of the aerodynamic control manoeuvres and expected satellite dynamic behaviour are also presented, demonstrating potential advantages for spacecraft operations which can be achieved by utilising the natural aerodynamic forces present at these lower orbital altitudes.