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INFLATESAIL DE-ORBIT FLIGHT DEMONSTRATION RESULTS AND FOLLOW-ON DRAG-SAIL
APPLICATIONS

Abstract

The InflateSail (QB50-UK06) CubeSat, designed and built at the Surrey Space Centre (SSC) for the Von Karman Institute (VKI), Belgium – was one of the technology demonstrators for the European Commission's QB50 programme. The 3.2 kilogram 3U CubeSat was equipped with a 1 metre long inflatable mast and a 10m2 deployable drag sail. InflateSail's primary mission was to demonstrate the effectiveness of using a drag sail in Low Earth Orbit (LEO) to dramatically increase the rate at which satellites lose altitude and re-enter the Earth's atmosphere and it was one of 31 satellites that were launched simultaneously on the PSLV (polar satellite launch vehicle) C-38 from Sriharikota, India on 23rd June 2017 into a 505km, 97.44o Sun-synchronous orbit. Shortly after safe deployment in orbit, InflateSail automatically activated its payload. Firstly, it inflated its metre-long metal-polymer laminate tubular mast, and then activated a stepper motor to extend four lightweight bi-stable rigid composite

(BRC) booms from the end of the mast, so as to draw out the 3.1m x 3.1m square, 12 micron thick polyethylene naphthalate (PEN) drag-sail. As intended, the satellite immediately began to lose altitude, causing it to re-enter the atmosphere just 72 days later – thus successfully demonstrating for the first time the de-orbiting of a spacecraft using European inflatable and drag-sail technologies. The InflateSail project was funded by two European Commission Framework Program Seven (FP7) projects: DEPLOYTECH and QB50. DEPLOYTECH had eight European partners including DLR, Airbus France, RolaTube, Cambridge University, and was assisted by NASA Marshall Space Flight Center. DEPLOYTECH's objectives were to advance the technological capabilities of three different space deployable technologies by qualifying their concepts for space use. QB50 was a programme, led by VKI, for launching a network of 50 CubeSats built mainly by university teams all over the world to perform first-class science in the largely unexplored lower thermosphere. The boom/drag-sail technology developed by SSC will next be used on a third FP7 Project: RemoveDebris, due for launch in 2018, which will demonstrate the capturing and de-orbiting of artificial space debris targets using a net and harpoon system. This paper describes the results of the InflateSail mission, including its body and orbital dynamics, and the observed effects of atmospheric density and solar activity on its trajectory. It also describes the application of the technology to RemoveDebris and its potential for routine application as a de-orbiting add-on package for future space missions.