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STRATHSAT-R: DEPLOYING INFLATABLE CUBESAT STRUCTURES IN MICRO GRAVITY

Abstract

This paper presents the design, manufacturing and testing of a student-led sounding rocket experiment to test novel inflatable structures in space conditions. This experiment is the first step in what will be the first Scottish university satellite program. In December 2011, the StrathSat-R team of the University of Strathclyde was selected to launch their experiment into micro-gravity onboard the REXUS 13/14 sounding rocket by March 2013. A multidisciplinary team of over 25 undergraduate and graduate students was formed to design, build and test the experiment between June 2011 and the experiment delivery to the REXUS (DLR/SNSB/ESA's Rocket Experiments for University Students) programme in December 2012. The student team is part of StrathSEDS, a subdivision of UKSEDS (UK Students for the Exploration and Development of Space) and led by a core team of six students. The experiment aims to test novel inflatable space technology in micro-gravity and micro-pressure conditions. It consists of three distinct sections, the ejection housing on the rocket and two ejectable modules that are based on a CubeSat architecture measuring 10x11x13 cm3. Shortly before reaching apogee, the two satellites are ejected from the rocket and will deploy their individual inflating structure during free flight. After landing, the ejectable modules will be recovered by using a GPS beacon with Globalstar transmission and a RF beacon. The two modules carry two different structures resulting in distinct mission objectives: The aim of FRODO (Foldable Reflective system for Omnialtitude De-Orbiting) is to deploy a large, conical reflective sail from a small volume (4x10x10 cm3). This is the first step in the technology development of a passive de-orbiting system for high altitude spacecraft which will in the future utilise solar radiation pressure, the J2 effect

and aerodynamic drag. The objective in the REXUS experiment is to test the inflation space conditions, to validate the shuttlecock attitude dynamics and to assess the structural behaviour of the device during re-entry. The aim of SAM (Self-inflating Adaptive Membrane) is to serve as a technology demonstrator for the residual air deployment method with a bio-inspired cell design approach. The unique architecture of the membrane sub-structure opens the possibility of changing the shape of the membrane to be adapted to various space mission stages or environmental conditions. Proving this concept in micro-gravity conditions will open the door for future space structures serving multiple purposes.