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Post Mission Disposal and Space Debris Removal (1) (5)

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THE ADEO PASSIVE DE-ORBIT SUBSYSTEM: REFERENCE MISSION SELECTION AND PRELIMINARY DESIGN OF PROTO FLIGHT MODEL

Abstract

The ADEO subsystem is a scalable drag augmentation device that uses the residual Earth atmosphere present in Low Earth Orbit applicable for passive de-orbit of satellites between 1 kg to 1000kg. For initiation of the de-orbit maneuver a large surface is deployed which multiplies the drag effective surface of the satellite. Thereby the drag force is increased as well causing accelerated decay in orbit altitude. Advantageous about a drag augmentation device is that it does not require any active steering and can be designed for passive attitude stabilization thereby making it applicable for non-operational, tumbling spacecraft as well. The ADEO subsystem consists of four deployable CFRP booms that span four sail segments in a truncated pyramid shape configuration. While the sails are made of an aluminum coated polyimide foil, its coating thickness was chosen such that it provides sufficient protection from the space environment. To prove the survivability of the sail material in the space environment over 25 years de-orbiting time, multiple environmental tests were performed at material and sample level, including mechanical strength and stiffness tests, thermal cycling, atomic oxygen exposure tests, UV exposure tests, and high velocity impact tests, as well as crack propagation tests at room and reduced temperature. A fully functional full scale 25 m2 sail demonstrator with one sail and two booms has been subjected to environmental testing including, vibration, rapid decompression, deployment testing in thermal-vacuum environment and ambient conditions showing great performance during the ADEO-1 activity concluded in spring 2017. Furthermore, a dynamical de-orbit analysis has been carried out as part of an ESA De-Risk activity confirming the functionality of the subsystem to de-orbit passively. The next step is now the development of a proto-flight model of the ADEO subsystem under a follow up ESA GSTP program. The activity will commence in May 2018 and will finish at the beginning of 2020 with the full qualification test of the de-orbiting subsystem PFM. The presentation at hand will give a summary on the ADEO demonstrator activity and the outcomes of the ADEO De-Risk Dynamical Analysis. Furthermore, by the time of the SmallSat conference, the reference mission selection for the PFM will be in full swing giving the participants of the SmallSat conference the chance to influence the PFM reference mission selection for the de-orbiting subsystem ADEO.