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TRACKING ENVISAT: THE STRUCTURAL DEVELOPMENT OF E.INSPECTOR

Abstract

Based on the European Space Agency (ESA) policy for space waste mitigation, the decommissioning of the currently inoperable satellite Envisat - one of the largest pieces of space debris in Low Earth Orbit (LEO) -, has been investigated since its breakdown in 2012. In order to remove Envisat from orbit, ESA's Clean Space introduced the e.Deorbit, the first-ever active debris removal mission projected to launch in 2023. The mission would target the Envisat and capture it towards a controlled reentry in the atmosphere, which otherwise would only occur by orbital decay after 150 years. Two capturing prototypes were proposed to the misssion: one using a net and another using a robotic arm to couple with the satellite. However, the Envisat is currently tumbling through space with an unknown rotational rate and imaging techniques are not able to provide accurate answers. Therefore, a short-duration mission was proposed to carry out the task; in a piggy-back launch, a CubeSat would rendezvous with the satellite, acquire and transmit data, and spend the rest of its lifetime studying the Earth. The aformentioned short-duration mission, e.Inspector, was developed in the framework of ESA Academy Concurrent Engineering Workshop 2016. Guided by experts, a group of twenty-two selected students from ESA member states were divided into ten subsystems, and they accomplished for four days the initial design phase of such mission using the ESA Open Concurrent Design Tool. In the case of the structures subsystem, this requires to provide a mounting platform for all onboard equipment, and it needs to be compatible with the selected launcher as well as support the load path from the payload to the launch vehicle. An Analytic Hierarchy Process (AHP) is used to determine the primary structure, and a trade-off analysis highlights the benefits of off-the-shelf solutions over in-house development. A twelve-unit CubeSat structure was developed, fulfilling the low out-gassing criterion, weighting around 20 % of the satellite total mass, and achieving a Technology Readiness Level (TRL) of 6.

Keywords: Space Debris, Active Debris Removal, Concurrent Engineering, CubeSat Structure Development.