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EVALUATION OF DRAG AUGMENTATION SYSTEM DESIGN REQUIREMENTS FOR A WIDE RANGE OF SMALL LEO SATELLITE PLATFORMS

Abstract

The development of passive drag augmentation systems shows potential considering the evolution of the space debris mitigation (SDM) policies and taking into account the growing of small classes of satellites in the coming years.
Cranfield Space Research Centre has existing expertise in aerobrake-type drag augmentation systems (DAS) with two specific design concepts developed. One is that used for the UK's TechDemoSat-1 and Carbonite-1 spacecraft (now in orbit). This consists of a thin frame, fitted around one of the external panels of the spacecraft, in which the lightweight sails and booms are stowed and restrained by a tough band. Deployment is achieved by cutting the band, which allows the stored energy in spring hinges to unfold the booms and sails. Advantages of this concept are that the entire deployed surface is directly useful for drag augmentation and it can be used on panels with protruding elements, such as antennas. The second concept is a compact DAS module supplied in a small cuboid outline. The module can be attached wherever appropriate on the host spacecraft and a technological demonstrator is due to fly on the upcoming ESA ESEO mission.
These modules show high TRL, however they are more research payloads than full commercial devices. A core task to bridge this gap is then identifying the design requirements and design solutions to provide a match with a wider range of satellite platforms, and, in this way, allow many more spacecraft to comply with the SDM requirements.
To achieve this, firstly, the general "debris" requirements are evaluated in each mission phase, in accordance with the SDM design and operation guidelines on ISO/TR 18146. Then the product design requirements are derived and refined from the previous projects. This leads to specific design improvements to be applied to the current baseline and design recommendations made for the spacecraft platform, maintaining at the same time a minimal impact on the spacecraft system-level architecture. In addition other configurations can be derived from the two baseline concepts, such as compact corner-mounted units and frames which fit along only one side of a panel.
This work will provide useful input within the framework of the ESA CleanSat programme to mature specifications for building blocks to support future LEO platform evolutions.