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STRATHCUBE: A CUBESAT AGAINST SPACE DEBRIS

Abstract

The responsible management of space debris is critical for the continued use of space. The STRATHcube project purposes a CubeSat which focusses on two issues of space debris - detection and removal. There is an increasing need to detect, track and catalogue debris in the Low Earth Orbit (LEO). One method to do so is by using Passive Bistatic Radar (PBR). The project purposes to launch the CubeSat into LEO as a PBR technology demonstrator, where a signal processor algorithm developed at the University of Strathclyde to detect debris will be tested. The concept involves a radar receiver and a patch antenna on-board the CubeSat from which the CubeSat will be able to detect radio signals from the operating satellites orbiting in a higher orbit. If debris were to pass between the CubeSat and the transmitting satellite, this signal would be disturbed, indicating the presence of debris. If successful, the technology demonstration will provide an alternative to conventional ground-based tracking that is cheaper and more available to the space community. Furthermore, once adopted in industry, this method can be upscaled to provide data at increased accuracy.

As a secondary payload, the STRATHcube project aims to provide data on fragmentation of solar panels upon re-entry into the atmosphere. To reduce the volume of debris in low orbits, the Design for Demise (D4D) initiative champions removal of debris via uncontrolled atmospheric re-entry in which satellites completely demise. Current D4D analysis tools under-predict the effectiveness of break up upon re-entry due to a lack of re-entry data – in particular fragmentation data. The STRATHcube project, with its secondary payload, aims to provide data on the fragmentation of solar panels during re-entry by utilising thermal imaging cameras, mechanical break switches and thermal sensors. This will allow for the gathering of data regarding the conditions experienced during re-entry into the atmosphere. With this flight data, STRATHcube aims to provide greater validation and verification of satellite re-entry modelling tools that currently exist, as well as providing the framework for future fragmentation studies.

To verify the life cycle of the CubeSat, an Integrated Systems Tool (IST) has been developed. Using MATLAB code, the IST creates a digital twin of the CubeSat which provides a high-fidelity simulation of the propagation as well as interlinking subsystems of STRATHcube (AOCS, power, thermal, mission analysis). The IST will verify the component and orbit selection prior to launch of the STRATHcube mission.