SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Issues (5)

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DEVELOPMENT OF A GRAPPLING SYSTEM FOR CAPTURING HEAVY SPACE DEBRIS

Abstract

The active removal of heavy space debris (typically >1000kg) has been identified as a key development to control the growth in the debris population and to limit the risk to active satellites. These objects can be divided into two classes : spent rocket bodies and inactive satellites. Rocket bodies generally consist of large aluminium structures which might still be partially pressurized. For satellites there is wider variation in mass and size, they may contain pressurized elements such as propulsion tanks, and they might also have large appendages (such as solar arrays). Both classes of object may be spinning with different dynamic properties. Therefore an important aspect of active debris removal is the development of a capture system which is applicable to a wide range of objects under different dynamic conditions. An example of which could be a grappling device which is fired from another spacecraft which subsequently de-orbits the target itself, or releases a de-orbiting device.

The grappling system has several advantages over other capture concepts. It is relatively insensitive to the spin state of the target since the capture process is fast. It is also applicable to a wide range of objects by varying the firing parameters and can be fully tested on the ground due to the simple flight dynamics. Lastly it is lightweight and simple so that redundancy can be built-in, leading to lower risk and simpler operations.

To understand how a grappling system could be applicable to active debris removal an on-ground breadboard has been developed for testing on realistic satellite structural elements. This paper describes the design of the grappling concept, the breadboard concept and the testing results which have been obtained. The results are compared with modelling predictions and the applicability to known debris objects is demonstrated.