SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Risk Analysis (2)

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RANKING AND CHARACTERIZATION OF HEAVY DEBRIS FOR ACTIVE REMOVAL

Abstract

Recent studies predict that if no countermeasures are actively taken, the debris population will increase in the following years, even if no more spacecraft are launched. A self-sustained cascade, where large orbital bodies such as rocket bodies or defunct satellites collide with other debris, creates even more debris. Assessments predict that the Active Debris Removal (ADR) of 5 to 10 large objects per year may reverse this effect. To preserve the valuable LEO regime Astrium proposes to develop capabilities for large object removal.

A convincing top-down approach requires the following questions to be answered: Which objects are useful as targets for ADR? What are their properties? Which objects should be approached and de-orbited in which sequence in one mission? Answering these questions is crucial for overall understanding of the ADR problem, for deriving suitable capture and de-orbit strategies and to select different mission scenarios.

This paper focuses on the selection of candidate ADR objects, their analysis and the definition of exemplary missions.

Astrium developed a ranking method via a Figure-of-Merit (FOM) that is determined for each object of a reference population, comprising in total 12883 objects. The FOM captures which objects potentially contribute most to the generation of new debris which is equal to the question which objects are most likely hit during their orbital lifetime by (large enough) debris and thus experience a "catastrophic" collision. The removal of such objects is considered as most effective.

The FOM is calculated for each object from the debris flux in the target's orbit, the geometrical cross-section area, the mass of target and its remaining orbital lifetime until it re-enters the atmosphere.

The ranking of the candidate objects is enriched with further detailed information regarding its type (R/B, satellite, debris) the country of origin, its international designator, the condition (active/passive), orbital parameters and many more. This allows a closer look on the ranked targets in order to determine possible mission profiles: What properties do the highest ranked objects possess?

The assessment shows, that objects can be well categorized (mass, R/B type, Sat type, debris, origin, orbit, etc.) and allow the definition of exemplary mission scenarios. The analysis also indicates that meaningful ADR ideally involves international cooperation. Removing the significant European objects can be a starting point.