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SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Concepts (6)

Author: Mr. Marc Scheper
OHB System AG-Bremen, Germany

Dr. Rolf Janovsky
OHB System AG-Bremen, Germany
Mr. Johannes Gelhaus
Technische Universität Braunschweig, Germany

SPACE DEBRIS REMOVAL FROM LEO - CONTROLLED RE-ENTRY USING AN OTV / SPACE-TUG VS. DE-ORBIT PACKS

Abstract

Space-debris around Earth is becoming a more and more significant threat to the proper functioning of our satellites in orbit. To cope with this increasing problem, different strategies to enhance mission protection are being established by a European consortium composed in a multi-disciplinary manner, involving research organizations and academia on the one side and industrial companies and SME on the other. The work is being performed within the EC's 7th Framework Programme as a collaborative project in the activity "Strengthening of space foundations" called P2ROTECT (Prediction, Protection Reduction of Orbital Exposure Collision Threats). As for debris with certain characteristics like size, mass or the presence of poisonous or hazardous materials an uncontrolled re-entry into Earth's atmosphere is not acceptable, the controlled re-entry by active de-orbiting means is mandatory at least for objects in the LEO. Within the proposed paper and presentation, based on the current understanding of methods to remove debris actively from space, the current work will be presented in the following fields:

- Active de-orbiting of one or more objects by an Orbit-Transfer-Vehicle (OTV) / Space-Tug
- Active de-orbiting of multiple objects by De-Orbit Packs
- Mission design for both concepts
- Comparison of total mass and mission cost for both concepts

The active de-orbiting of debris from LEO will be feasible in an acceptable cost frame only if multiple objects can be removed per mission. The Orbit-Transfer-Vehicle (OTV) approaches and connects to the individual debris, starts together with it the de-orbit maneuver and detaches before re-entry to rise its orbit back to the next debris object to be approached. One main draw-back of this concept is the huge amount of propellant to be carried during the first maneuvers for the following maneuvers. Thus, as an alternative to this solution the utilization of De-Orbit Packs was studied as well. The De-Orbit Packs to be attached to different debris objects have to provide many of the capabilities of an autonomous spacecraft like propulsion, AOCS, power, thermal control and communications subsystems. Therefore the cost increases due to the fact that multiple complex De-Orbit Packs have to be provided per mission. A common challenge for all concepts is the approach to attach the vehicle (OTV or De-Orbit Pack) to non-cooperative debris like rocket upper stages or satellites out of service. The paper will compare the overall missions by their technical feasibility and related cost.