Paper ID: 16644
oral
student

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

Author: Mr. Niels van der Pas
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), The Netherlands, niels.vanderpas@gmail.com

Mr. Joao Lousada
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, jmclousada@gmail.com
Mrs. Claudia Terhes
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, claudia.terhes@dlr.de
Mr. Marc Bernabeu
Deutsches Zentrum fur Luft- und Raumfahrt e.V. (DLR), Germany, marc.bernabeu@dlr.de
Mr. Waldemar Bauer
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, waldemar.bauer@dlr.de

ANALYSIS OF MISSION DESIGN AND TARGET SELECTION FOR SPACE DEBRIS REMOVAL BY DLR'S ADVANCED STUDY GROUP

Abstract

Space debris is a growing problem. Models show that the Kessler syndrome, the exponential growth of debris due to collisions, has become unavoidable unless an active debris removal program is initiated. The debris population in LEO with inclination between 60 and 95 degrees is considered as the most critical zone. In order to stabilize the debris population in orbit, especially in LEO, 5 to 10 objects will need to be removed every year. A large number of solutions for the capture and deorbiting of space debris objects have been proposed in previous research. These are however not the only challenges faced by an active debris removal mission.

The unique circumstances of such a mission require that several objects are removed with a single launch, more launches increase costs and every launch has the potential to cause new debris objects. This will require a mission to rendezvous with a multitude of objects orbiting on different altitudes, inclinations and planes. Removal models have assumed that the top priority targets will be removed first. However this will lead to a suboptimal mission design and increase the ΔV-budget. Since there is a multitude of targets to choose from, the targets can be selected for an optimal mission design. In order to select a group of targets for a removal mission the orbital parameters and political constraints should be taken into account.

Within this paper an analysis of the orbital properties of the space debris objects with the highest mass and collision probabilities is given. Due to the mass of these objects, it is assumed that all objects will need a targeted reentry. Afterwards the target selection criteria are presented. The possible mission targets and their order of retrieval is dependent on the mission architecture. A comparison between several global mission architectures will be given. Under consideration are 3 missions. The first mission launches multiple separate deorbit kits. The second launches a mothercraft with deorbit kits. The third launches an orbital tug which pulls the debris in a lower orbit, after which a deorbit kit performs the final deorbit burn. A RoM budget comparison is presented.

The research described in this paper has been conducted as part of an active debris removal study by the Advanced Study Group (ASG). The ASG is an interdisciplinary student group working at the DLR, analyzing existing technologies and developing new ideas into preliminary concepts.