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TETHERED ACTIVE DEBRIS REMOVAL EXPERIMENTAL EVALUATION OF TETHER MODELLING APPROACHES

Abstract

Conducted studies in the field of space debris and especially the long-term evolution of the space debris environment carried out the necessity to intervene the current growth. Therefore, consequent mitigation for future space missions is an important aspect. Indeed a stabilization of the space debris environment growth can be only reached by active debris (ADR) missions.

To remove such large objects docking or capture mechanisms are under development. One solution is to capture the target object with a net or harpoon. Since 2002 an ADR - net capture system is under development at Airbus. Several performed experiments and studies prove the concept. So the ejection, capture, and closure of the net could be successfully demonstrated. Another essential part of the net capture system development is the control of the connecting tether. So for example, the target might rotate or tumble. For a safe mission, these unwanted effects need to be eliminated. All control and stabilization maneuvers will be performed by the capture and the tether transmits the maneuver via the tether to the linked target. So the tether is an essential part of the net capture systems to ensure a safe and controlled de-orbiting. To be able to perform studies and analysis in terms of stability of the captured target the the institute of space systems develops in cooperation with Airbus a software tool Tether Dynamics Toolbox. This Toolbox provides the capability to analyze an ADR mission (with flexible link) starting from the initial capture until the de-orbiting of the ADR system.

To validate the simulation in 2017 the SPHERES Tether Demo experimental-study has been carried out. More than 16 different test scenarios had been pre-defined to gain experimental data for the validation of the tether dynamics simulation. The concept and experiment conduction, as well as some preliminary results, have been shown during the last year conference. Now an update on the experiment evaluation and the especially the validation process shall be given. Therefore it will be carried out how the findings of the experiments lead to the tether model development. Furthermore, aspects of experiment scaling and the initial tether condition (slack/taught) are considered.

In this paper, the overall idea and concept for tether model validation via the gained experimental data from the ISS as a test bed for an application to demonstrate the towing of a passive object in space under microgravity will be summarized.