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

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RESEARCH ISSUES AND CHALLENGES IN AUTONOMOUS ACTIVE SPACE DEBRIS REMOVAL

Abstract

With the beginning of space flight, the thread of space debris has become a problem. Simulations show, that an adequate solution to stabilize the space environment in low Earth orbit can be achieved by a combination of two activities: limiting the time in orbit of spacecraft to 25 years after their end of life (post mission disposal – PMD) and removing objects in orbit that no longer serve any useful purpose and have no self-deorbiting capability (active space debris removal – ADR). The presented research concentrates on the latter issues. Existing problems are addressed and first approaches to the topic are presented.

Mission scenarios for ADR involve docking and grabbing as well as formation flying operations with non-cooperative targets. Prospectively, ADR will require a higher level of autonomy than implemented in today's spacecraft, especially during close approach maneuvers, when real-time data transfer becomes critical due to missing ground station contacts. The collision risk during such maneuvers is quite high, autonomy and its potential for situation based reactions can alleviate this challenge. The system needs to meet requirements like e.g. high fault tolerance, noise immunity, and an algorithm to decide independently and situation based on-board the spacecraft. Already existing autonomy concepts are presented, differences are elaborated and discussed. The most suitable concept is selected.

For a simulation of the chosen autonomy concept within an accurate environment, a reference scenario has to be selected. Based on the following criteria, the scenario is discussed: The most important requirement is to meet the reduction of the collision probability of objects in space and thus, to prevent smaller, eventually no longer traceable particles to be created. Another relevant aspect is the reusability of the ADR-system. On one hand, it is unfavorable to send one spacecraft up, remove solely one non-functional object and leave mission related debris up there. On the other hand, it is handy to remove geometrically similar objects. Thus, the reference scenario addresses rocket bodies in close-by orbits.

Within this study, the feasibility of the autonomy concepts to be implemented in future missions will be proven by analyses and simulations within the selected reference scenario. The design and configuration of the chaser satellite will be developed at a later stage of the project.