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

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THE USE OF ADAPTED UPPER STAGES FOR THE REMOVAL OF SATELLITE AND ROCKET BODY DEBRIS FROM UNSTABLE ORBITAL REGIONS

Abstract

Recent studies performed by both NASA and ESA have shown that there are various indications for an uncontrolled future growth of debris objects in Low Earth Orbits, primarily driven by collision activity. This debris cascading risk manifests itself in some 'critical regions', the most severe of which is the 800-1000 km altitude band, at near polar inclinations. Although efforts have been undertaken on passive means of debris mitigation, there are strong signs that these do not suffice for those areas.

The goal of this project, performed at Omsk State Technical University (OmSTU) under supervision of the Central Scientific Research Institute for Machine Building (TnIIMASH), is the design of an effective means for active removal of large-sized debris in high-risk regions. It was found that the objects forming the greatest risk for instability of the future debris environment are the many intact satellites and rocket bodies in the 800-1000km altitude band, both having a large contribution in possible future collisions. A large number of the problematic objects can be classified among similar designs (all Kosmos-3M 2nd stages, Cosmos satellites), due to which removal systems for these objects can be developed in a very universal, efficient manner.

The current design of the active debris removal system (ADRS) focuses on the use of adapted upper stages to enable the collection and de-orbiting of these debris elements after primary payload deployment. The ADRS will be equipped with various subsystems, including a small propulsion engine for approaching the debris-object's orbit in a far-guidance maneuver and performing the final de-orbit burn, a tethered space micro-tug (SMT) for enabling rendez-vous and a docking system for establishing a physical connection with the debris object.

Along with the system's design, an analysis was done of the present worldwide developments in the debris mitigation field, based on the publications of recent seminars on the topic. Using these results, a proposal was established for a potential joint-project, in which different international partners are responsible for the various collector subsystems, according to their specializations and available means. The debris removal topic forms an ideal candidate for such cooperation, as space debris is a problem affecting many countries involved in space activity and the modularity of the collector concept enables the effective division of tasks.