

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

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## CAPTURE AND REMOVAL OF LARGE, SPINNING OBJECTS BY SMALL CAPTURE SYSTEMS

**Abstract**

One reason for the progression of space debris is the collision of large objects in populated orbits. Potential target objects are rocket upper stages at masses around 2 tons and spinning rates up to 40 degree per second. However, most debris removal concepts follow the approach of capturing slowly tumbling objects directly by a chaser spacecraft, e.g. by employing a robotic manipulator. This paper discusses the feasibility and requirements for the capture of large, spinning objects by a cable tethered, 6 degree of freedom, small capture system. The capture system is linked to a chaser spacecraft by a cable which can be used for power supply and as data link. While the chaser performs orbit, closing and rendezvous maneuver, proximity operations and capture are performed by the free flying capture system. This concept provides the advantage of multiple use, reduced constraints and capture operations at safe distance w.r.t. the chaser spacecraft. The study presents design drivers, architecture trade-offs and budgets for the capture system. Appropriate sensor and actuation systems are identified and evaluated. By a simulation of tethered multibody dynamics during capture and target rate damping, the effects of a cable on the GNC subsystems, support forces and cable stress are identified. The resulting mission envelope is formulated and compared with other approaches.