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SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Concepts (6)

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MISSION AND SYSTEMS DESIGN FOR THE DEBRIS REMOVAL OF MASSIVE SATELLITES

Abstract

This paper presents the results of a phase-0 feasibility study into the mission and system design of a satellite able to perform an active debris removal mission targeting the heaviest debris currently on-orbit (8000kg). Such debris will be removed from orbit via an active mechanism on the satellite (in the case studied here a thrown net connected by a tether is considered), and then directed to a destructive controlled re-entry into the Earth's atmosphere. The system design is based on an adaptation of the geostationary satellite platform (GMP-T) currently under development at SSTL, utilising a bi-propellant propulsion architecture with 2x400N liquid apogee engines providing the necessary de-orbit thrust. Flight proven avionics and attitude control hardware, is coupled with a guidance and navigation payload consisting of wide and narrow angle cameras and a lidar. For cost efficiency, the system design has also been constrained to fit within the launch envelope provided by the Vega launch vehicle. Due to the large size and mass of the debris a controlled re-entry is critical to mission success, and this places many constraints on the system architecture and design, and places important risk management constraints on the mission. Key to this is the control of the tethered debris before, during and after main engine thrusts. The high mass of the debris means that large tensions will exist in the tether and hence any mass misalignments in the system can rapidly lead to significant torques on the body of the satellite. It appears feasible to implement a controller capable of damping and controlling any torques based on a collection of reaction control thrusters, although such options may become very propellant intensive. Other options have also been studied, including a moving base plate for the tether, allowing its alignment with the system centre of mass to be optimised. Overall the mission appears broadly feasible, but there are still technology challenges, especially in the areas of the capture mechanism, and guidance navigation and control. Dedicated developments in these areas will be needed in the short term to enable such a new class of mission.