SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Concepts (7)

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TRADE-OFF ON DIFFERENT CONCEPTS AND TECHNOLOGIES FOR ORBITAL CAPTURE AND FIXATION OF HEAVY DEBRIS

Abstract

This paper aims to illustrate the activities performed by Aviospacein the frame of an Astrium-internal RD study, concerning the selection of preferred in-space capture and fixation concepts (CFC) for large, heavy space debris in LEO orbits, such as, upper stages of elderly launch vehicles or decommissioned satellites, for which a non-collaborative rendez-vous and capture procedure is required. A high-level trade-off between 36 different concepts, based on several technological groups (adoption of paints and foams, inflatable structures, wires, magnetic fields, purely mechanical concepts, nets or bags, and hybrid concepts based on more technologies) was performed, trying to assess for each of them: " the impacts on masses and volumes at launch, " their level of hazardousness,intended asthe risk introduced by the CFC to produce damages or fragmentation of the debris, explosion of the debris, loss of residual amounts of propellants and other hazards " their effectiveness and stability on control of the target attitude " their robustness with respect to the effectivenessof anyde-tumbling and alignment procedure performed before the capture " their versatility towards differently-shaped debris and towards actual configuration, mass properties and dynamic behavior different than predicted from previous observation and tracking, " their overall levels complexity and affordability " the possibility to be implemented at least partially as a reusable system, and their capability to process as many targets as possible during a single mission " their intrinsic request for resources (mainly power and propellant) " the induced increase of complexity they may introduce on the architecture and design of the chaser vehicle, also in terms of the compatibility with feasible techniques for previous de-tumbling and incoming target procedures " the residual amount of tumbling that the target could still have after the capture " finally, also assessment of the innovation levels that can be achieved by each CFC, and the efforts required for the technology development have been addressed. This trade-off required a priority ranking of all this features with respect to the system requirements and the assessment, based on typical concept design methodologies, of the qualityof each concepts on each of these features. Main results of this study were the selection of a set of preferred concepts, for which more detailed design activities have been performed, in the frame of an overall orbital system able to perform target identification, approach, de-tumbling, capture and processing by de-orbiting or push to graveyard orbits.