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

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NET-BASED PAYLOAD ON BOARD AVUM ENHANCED PLATFORM TO EFFICIENTLY REMOVE LARGE DEBRIS FROM LOW EARTH ORBITS

Abstract

Space debris mitigation and remediation are urgent and growing issues to be faced for future space operations and space exploitation durability, especially in Low Earth Orbits (LEO). In past decades, several launches have placed more than 6000 satellites into orbit, of which less than a thousand are still operational today. Studies show that for a future continued use of LEO, five to ten strategically chosen debris need to be removed every year. The Active Debris Removal (ADR) topic focuses on trading-off, designing and making operational mechanisms placed on board an active chaser that can rendezvous with and grapple an inert and tumbling target, to eventually change its dynamics either directly transferring it to a graveyard orbit or providing a control device to be attached to the dead element to make it controlled up to disposal. Different techniques are being proposed, starting from conventional robotic arms to grasp the target or flexible tethered-nets/tentacles to wrap it, up to action-reaction principle exploitation with no contact at all, such as gas plume impinging on the object surfaces to change its momentum. Being the target uncooperative, being its physical, inertial and dynamics features not perfectly known, techniques based on capturing debris from a safety distance, trying limiting the target chaser interaction and preserving reliability all the capture and disposal phases long appear to be well suited. The paper presents in details the design of a net-based debris capturing payload, to be embarked on an AVUM based chaser, specifically adapted for large satellites removal from LEO. The study run under ESA support, in collaboration with ELV SpA. In particular, the numerical simulator, developed at Politecnico di Milano to model the net dynamics from its launch to the target wrapping and drive the design of the flexible components in the payload, is discussed in details: models selected for flexible parts preserve the viscoelastic material features; a multi-body constrained dynamics has been implemented to represent flexible elements; tuning of the dynamics simulator already occurred with some preliminary experimental campaign, here presented. The results obtained by exploiting the mentioned simulator to make the whole net payload matching the AVUM enhanced I/F requirements are discussed to assess limitations and advantages in exploiting such a high thrust unit for ADR flexible systems. Maturity of the proposed technology and development roadmap are also presented.