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TEST OF TETHERED DEORBITING OF SPACE DEBRIS

Abstract

Current investigations on space tethers include their application to space debris deorbiting, specifically on the set of manoeuvres performed by a chaser tug to change the orbital parameters of a target body. Targets can be cooperative spacecraft at the end of their life or uncontrolled objects such as defunct satellites without clearly available capturing interfaces. In this latter case, a link joining tug and target may be misaligned with the target body inertia axes, influencing the attitude of both bodies; in case of rigid links, torques transmitted during tugging operations may overcome the tug attitude control system. This issue is clearly less significant in case of non-rigid connections, such as tethers; furthermore, with such connections the chaser can remain at a safe distance from the target during the whole deorbiting operation.
On the other side, the initial phase of tethered space debris removal manoeuvres can be influenced by transient events, such as sudden tether tension spikes, that may cause longitudinal and lateral oscillations and, in case of resonance with the target attitude dynamics, could represent a serious issue for tug safety. In this paper it is proposed to provide the tug with a tether deployer mechanism capable to perform reel-in and reel-out, smoothing loads transmission to the target and damping oscillations. This concept is validated through a representative test campaign performed with the SPAcecRraft Testbed for Autonomous proximity operatioNs experimentS (SPARTAN) on a low friction table. A prototype of the deployer is manufactured and the deployment and rewind of a thin aluminium tape tether is proved. Test results include the determination of the tether visco-elastic characteristics, the direct measurement of spikes and oscillations and the estimation of the proposed system damping capabilities.