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SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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ELECTRIC PROPULSION TUG FOR MULTI-TARGET ACTIVE SPACE DEBRIS REMOVAL MISSIONS

Abstract

The relevant increase in the number of uncontrolled space debris is considered nowadays one of the main threats for future sustainability of space activities and space access. It is now clear that in the near future the access to space might be seriously endangered by the large amount of space debris populating the orbital regions in the vicinity of the Earth. Currently, about 1000 satellites out of 6000 launched after the Sputnik-1 are still operational and roughly 85A number of different Active Debris Removal (ADR) concepts has been already proposed and analyzed such as electromagnetic methods (i.e. electrodynamic tethers and magnetic sails), momentum exchange methods (i.e. solar sails, drag augmentation devices and foam-based methods), remote methods (i.e. lasers) and capture methods (i.e. nets). Each method may represent a valuable solution for space debris belonging to specific classes or types, or orbiting in particular space regions and the European Space Agency (ESA) in the framework of the Clean Space initiative has recently focused its interest in the development of technologies for space debris rendezvous, capture and re-entry. Nonetheless, regardless of the method identified as the most suitable, a generic ADR mission scenario can be thought as composed of different phases in which a deorbiting platform is in charge of approaching a target debris, bringing it to a lower altitude orbit and then, in case of a multi target mission, chasing another one and then deorbit itself. Considering the high total impulse typical of this kind of missions, electric propulsion plays a key role in reducing the propellant mass consumption required for each manoeuvre, thus increasing the mass available to deorbit a relevant number of debris per mission. This kind of multi-target, multi-transfer mission is a clear example of a mission definitely enabled by an electric propulsion system. The ADR mission proposed in this study is aimed at targeting several different non-functional and uncooperative objects. The mission is intended to be performed by means of a small chaser platform equipped with a low mass and low cost electric propulsion system. This is driven with some hundreds Watt and operates with high specific impulse so that the orbital maneuvers required would not result in a high propellant burden. The ADR mission scenario is detailed in the paper together with preliminary performance estimation and the platform design and sizing.