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ENABLING TECHNOLOGIES VALIDATION FOR DEORBITING DEVICES USING ELECTRODYNAMIC TETHERS

Abstract

The increasing number of man-made objects in near-earth space is becoming a serious problem for future space missions around the Earth. To fully address this problem, several strategies have been proposed by scientists and international space organizations, including both capturing and removal methods of large and massive objects already in space. Removal of new spacecraft flying in LEO within 25 years from mission completion is considered to comply with the international disposal guidelines.

Among disposal strategies, and due to its passive and propellant-less character, electrodynamic tethers (EDT) appear to be a promising option for low Erath orbits (LEO) thanks to the limited storage mass and the minimum interface requirements to the host spacecraft. Recent advances on EDT technology make it feasible to deorbit large objects (i.e., 200-1000 kg) with tether lengths of a few kilometers or less from LEO altitudes in a few months, a time by far lower than 25 years.

In this context, in 2019, the European Commission awarded an H2020 Future Emerging Technologies (FET) Open project entitled "Electrodynamic Tether Technology for Passive Consumable-less Deorbit Kit" (E.T.PACK), that aims at the development of a Deorbit Kit (DK) based on EDT technology that will reach Technology Readiness Level equal to 4 by the end of 2022. The E.T.PACK consortium has recently finished the design of a Deorbit Kit Demonstrator (DKD) prototype to be flown in a future in-orbit demonstration and started the manufacturing and testing phases.

The E.T.PACK team of the University of Padova is in charge of the development and the validation of some of these technologies and, to this aim, it has developed through the years both software tools and a suitable experimental setup. Specifically, the software tools include: (a) the software "FLEXSIM" that predicts EDT performances as a function of the system configuration employed; and (b) the software "FLEX" that includes the dynamical effects of tether flexibility and provides important information on the dynamic stability of the system during the deployment and the deorbiting phases. The team has also developed mockups to: (a) determine the tether mechanical properties; (b) validate the mechanisms used to deploy the tether and stabilize its dynamics; and (c) validate the attitude control actuators used during the deployment phase.

In this paper, we will present the roadmap we are following to validate the technologies that the DKD prototype is based on, showing the relevant results of our activities.