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DEVELOPMENT ROADMAP OF A DEORBIT KIT BASED ON ELECTRODYNAMIC TETHER TECHNOLOGY

Abstract

Low Earth Orbit (LEO) is an environment rich of natural resources. Earth magnetic field is used to control spacecraft attitude, Earth gravity harmonics are used to control the satellite's orbit evolution and Solar radiation is used to generate power. Nevertheless, today's spacecraft are not designed to use another very valuable natural LEO resource: the ionospheric plasma. Among the different devices that could take advantage of it, ElectroDynamic Tether (EDT) is the most promising due to its passive and propellant-less character. EDT consists of a long metallic tape connected with a spacecraft. It naturally captures electrons from the plasma and an active electron emitter or a coating with a low work-function emits the electrons back to the plasma to achieve a steady electrical current. The action of the ambient

magnetic field on the tether current gives a Lorentz force without using propellant. The EDT physics has been already demonstrated in orbit in the 1990s, but it is not until today that the technology has found a primary application in the satellite de-orbiting. Thanks to the use of the environment, EDT technology can be more efficient than conventional chemical and electrical propulsion resulting in the best choice for passive de-orbit systems. The promising character of this green de-orbiting system has been recently acknowledged by the European Commission that granted the FET-OPEN project entitled *Electrodynamic Tether technology for PAssive Consumable-less deorbit Kit* (E.T.PACK). Funded with 3Meuro and started in March 2019, E.T.PACK will develop a DK based on EDT technology with Technology Readiness Level equal to 4 and aligned with the needs of a future In Orbit Demonstration (IOD). The DK will be a fully autonomous system designed to de-orbit satellite from 200 to 1000kg in orbit up to 1200km. DK will be bolted on customer satellite before launch. Upon activation from ground the DK will remove spacecraft residual angular velocity, acquire a stable attitude and deploy a maximum of 3km long tape. The DK mass is expected to be less than 5% of the customer satellite mass and de-orbit a 700kg satellite from 800km altitude polar orbit in less than 1.5 years. The work presents the design of the de-orbit kit, simulations of the system performances and the development roadmap. Specific goals of the IOD are to test the deployment mechanism in orbit, to evaluate the performances of the de-orbit system and assess the maneuverability of the tether for collision avoidance.